Questions are Hamblin-Issues

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1 Introduction

Operations over question acts seem to be more restricted than operations over assertions. This paper presents a novel set of data which demonstrates that issues raised by questions are more complex than the information brought by assertions. To see how this generalization is reached, let us start with the English conditional declarative in (1). In view of the suppositional semantics of conditionals (Stalnaker, 1968; Adams, 1965; Mackie, 1973; Karttunen, 1974; Heim, 1982; G ardenfors, 1986, a.o.), the antecedent serves to restrict the context of the consequent assertion. Thus, in the case of conditional declaratives like (1), the antecedent clause first temporarily updates the context with its propositional content. Second, the consequent clause updates the derived context with its propositional content.

(1) If the party is at Emma's place, it will be fun.

A conditional interrogative like (2) can be analyzed in a parallel way as done by Isaacs & Rawlins (2008). That is, just like the conditional declarative, the antecedent clause creates a temporary context by updating the current context with its content, and then the consequent interrogative updates the temporary context with the content of the consequent.

(2) If the party is at Emma's place, will it be fun?

Now, the parallel between declaratives and interrogatives breaks down when the *if*-adjunct is replaced with adjuncts of so-called *unconditionals* (Rawlins, 2008, 2013). In a nutshell, an unconditional statement creates a set of conditional statements and 'merges' them, the result of which is semantically equivalent to the conjunction of the conditional statements (see Section 4.2.1 for formal details).[1] As a result, the construction expresses a conjunction of multiple conditional assertions, e.g., 'If the party is at Emma's place, it will be fun and if the party is not at Emma's place, it will be fun'. For instance, a declarative modified by a *whether-or-not*-adjunct is grammatical and gives rise to an unconditional interpretation as in (3). That is, (3) means that the party will be fun and it does not matter whether or not it is at Emma's place.

[1] I owe this phrasing to an anonymous reviewer.

(3) Whether or not the party is at Emma's place, it will be fun.

In contrast, when the consequent is a question, the conditional *if*-adjunct cannot be rendered into an unconditional *whether-or-not*-adjunct, as in (4).

(4) *Whether or not the party is at Emma's place, will it be fun?

Assuming (4) has a parallel structure to its declarative counterpart (3), the ungrammaticality of (4) suggests that, unlike the case of assertions, merging multiple questions is not a licit act. This asymmetry between assertions and questions is the main puzzle of the paper.[2]

There is another complication in this data set. Although all the native speakers I consulted find (4) ungrammatical or infelicitous, to some speakers, it can be improved if the context is such that the speaker explicates the *independence* between the two issues, whether or not the party is at Emma's place and whether or not it will be fun as in (5). In other words, the speaker A is seeking an unconditional answer:[3,4]

(5) A: I don't think whether the party will be fun or not depends on whether it is at Emma's place or not.
?Now, whether or not the party is at Emma's house, will it be fun?
B1: Yes, whether or not it is at her house, it will be fun.
B2: No, whether or not it is at her house, it won't be fun.
B3#If it is at her place, it will be fun. If it is not at her place, it won't be fun.

Taken together, the discrepancy between unconditional assertions and questions is generalized as follows:

(6) a. 'if p, q' and 'if $\neg p$, q' can be merged as an unconditional assertion 'whether or not p, q' (Rawlins, 2008, 2013)
b. 'if p, q?' and 'if $\neg p$, q?' cannot be merged as an unconditional question 'whether or not p, q?' *unless q is independent of p.*

In this paper, I take these data to show that questions are more constrained than assertions. More specifically, as Hamblin (1958) claims, an interrogative clause must denote an exhaustive set of mutually exclusive answers:

(7) Hamblin-issue
The issue raised by a (root-level) question must be a collectively exhaustive and mutually exclusive set of possible answers.

This paper furthermore argues that some English speakers relax this con-

[2] A similar incompatibility between an interrogative and a cancellation of alternative acts is observed for the Japanese *dake-wa* 'only-TOPIC' construction. See also Section 5.2.

[3] I am grateful to the editor for bringing this contrast to my attention.

[4] Rawlins (2008, 2013) suggest a syntactic account of the unacceptability of sentences like (4) in terms of intervention effects, but such an analysis fails to account for the acceptability of (5).

straint, since the judgement for (5) varies. In other words, there are at least two groups of English speakers and each group observes a different version of the constraint (7):

(8) a. HAMBLIN-ISSUE 1
A question is an exhaustive set of mutually exclusive statements.
b. HAMBLIN-ISSUE 2
A question is an exhaustive set of possible answers.

In a nutshell, the speakers who do not accept (5) (Group 1 speakers) follow the stricter version HAMBLIN-ISSUE 1 and do not accept non-mutually-exclusive, i.e., overlapping answers, while those who accept (5) (Group 2 speakers) follow the relaxed version HAMBLIN-ISSUE 2. In either case, the current set of data supports the *Hamblin's picture* principle, the meaning of a question is understood as an exhaustive set of possible answers.

Furthermore, this paper also motivates the suppositional treatment of conditional statements and questions. Even Group 1 speakers who always reject unconditional questions due to the violation of HAMBLIN-ISSUE 1 have no problem in understanding conditional questions like (2). As we will see below, in the non-suppositional treatment of conditionals, conditional questions would also violate HAMBLIN-ISSUE 1. The suppositional treatment to conditional questions also allows us to intuitively interpret the particle answers like *yes* and *no*.

This paper is structured as follows. Section 2 characterizes the main puzzle of the paper, the asymmetry between unconditional declaratives and unconditional interrogatives in the framework of inquisitive semantics (Ciardelli et al., 2015; Ciardelli & Roelofsen, 2015; Ciardelli, 2016, a.o.). Section 3 presents the main proposal of the paper. English speakers are divided into two groups depending on which version of Hamblin's constraint is observed. In a nutshell, for both groups, unconditional questions are illicit since they violate one of the Hamblin's constraints. Furthermore, a complication arises as Group 2 speakers accept an unconditional question with the independence assumption like (5). Group 2 speakers relax the mutual exclusivity requirement and they can interpret (5) as long as they can see that the question is answerable. Then, a question arises as to: How Group 1 speakers who always require mutual exclusivity can process conditional questions? Section 4 provides an answer to this question by reviewing and modifying Isaacs & Rawlin's (2008) analysis of conditional questions which employs Kaufmann's (2000) stack-based semantics of conditionals. As we will see in Section 4.2, even with this modified stack-based system, unconditional questions would yield overlapping possibilities, which are disallowed by Group 1 speakers. Section 5 concludes the paper.

2 Puzzle

The main puzzle of the paper is the asymmetry between unconditional declaratives and unconditional interrogatives. Given Rawlins' analysis of unconditionals, (9) is a conjunction of two conditional declaratives.

(9) Whether or not the party is at Emma's place, it will be fun.

As also observed by Rawlins (2008, 2013), however, a parallel merged structure is somehow not available when the consequent is an interrogative:[5]

(10) *Whether or not the party is at Emma's place, will it be fun?

(11) a. *Whether the party is at Alfonso or Joanna's house, will it last a long time?
b. *Whoever comes to the party, will it last a long time?
c. *No matter who comes to the party, will it last a long time?
(adapted from Rawlins, 2008, p. 141)

Rawlins (2008, 2013) did not provide a full discussion but entertained a hypothesis that the ungrammaticality of (11) could be analyzed by means of an intervention effect (Beck & Kim, 2006; Shimoyama, 2006). The intervention effect describes a problematic syntactic configuration in which a focus particle such as *only* or *even* appears between the question operator and disjunction.

(12) a. ?*Did only Mary introduce Sue or Molly to Bill?
b. ?*Does even John like Mary or Sue? (Beck & Kim, 2006, p. 172)

Rawlins (2008, 2013) suggests that an unconditional adjunct acts as an intervener when it is left-adjoined to an interrogative. As presented in Sections 1, however, unconditional interrogatives can be acceptable when the "antecedent" and the "consequent" are independent. Thus, syntactic explanations like an intervention effect cannot be maintained.

Thus, unconditional questions are ungrammatical not because unconditional antecednts are incompatible with interrogative clauses or sets of propositions denoted by the clauses. Rather, as I argue below, merging multiple conditional questions without the independence assumption results in an illegitimate semantics for an interrogative clause.

In the following subsections, I first introduce the framework of inquisitive semantics (Ciardelli et al., 2015; Ciardelli & Roelofsen, 2015; Ciardelli, 2016, a.o.) since the framework allows us to treat declarative and interrogative clauses in a uniform way. Then, I formally characterize the puzzle by showing the semantics of unconditional statements and questions.

2.1 Inquisitive Semantics: technical preliminary

Let W be the set of all possible worlds. As with standard epistemic logic, an information state is identified with a set of possible worlds. Inquisitive semantics introduces another dimension which can characterize the issues that are entertained by the agents. An issue is defined as a set of information states:[6]

[5]Rawlins' (2008) original judgment was #.
[6]Adapted from Ciardelli & Roelofsen (2015, 1649)

(13) **Definition:** Issue

a. An information state s is a set of possible worlds, i.e., $s \subseteq \mathcal{W}$.
b. An *issue* $I \subseteq \wp(\mathcal{W})$ is a non-empty, downward closed set of information states.

Figure 1 illustrates four issues over the state $s = \{w_{11}, w_{10}, w_{01}, w_{00}\}$. Following Ciardelli & Roelofsen (2015), only the maximal element of each issue is represented in the diagrams. In order to settle the issue in (a), we have to pick exactly one world as the actual world. In the issue represented by (b), identifying the actual world as being in $\{w_{11}, w_{10}\}$ or in $\{w_{01}, w_{00}\}$ will settle the issue. In (c), identifying the actual world as being in $\{w_{11}, w_{01}, w_{00}\}$ or in $\{w_{10}, w_{01}, w_{00}\}$ will settle the issue. In (d), s already settles the issue; hence it is the trivial issue over s. Issues (a), (b), and (c) are *inquisitive* since they contain at least two maximal elements, while issue (d) is not (see (21) below).

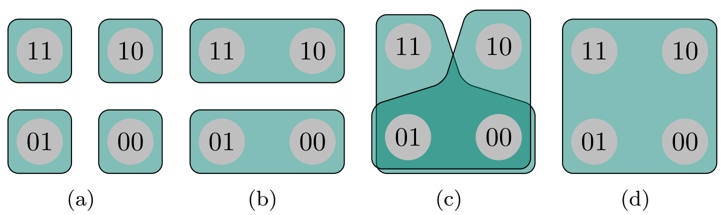


Figure 1: Issues over the state $s = \{w_{11}, w_{10}, w_{01}, w_{00}\}$ (adapted from Ciardelli & Roelofsen, 2015, 1650)

We take the following as sentences of inquisitive semantics:

(14) **Definition:** Syntax
Let P be a set of atomic sentences.

a. For any $p \in P$, $p \in \mathcal{L}$
b. If $\varphi, \psi \in \mathcal{L}$, $\varphi \wedge \psi \in \mathcal{L}$
c. If $\varphi, \psi \in \mathcal{L}$, $\varphi \vee \psi \in \mathcal{L}$
d. If $\varphi \in \mathcal{L}$, $\neg\varphi \in \mathcal{L}$
e. If $\varphi, \psi \in \mathcal{L}$, $\varphi \to \psi \in \mathcal{L}$

Note also that we treat a polar interrogative $?\varphi$ as an abbreviation of $\varphi \vee \neg\varphi$.

(15) **Definition:** A polar interrogative
$?\varphi := \varphi \vee \neg\varphi$

Let us see how sentences are interpreted in inquisitive semantics. In standard epistemic logic, sentences are evaluated against a world in a model, since the meaning of a sentence is understood as a condition on worlds that make the sentence true. Now, the meaning of an interrogative sentence is understood as a condition on information states that resolve the issue expressed by the sentence. In the current framework, then, both declaratives and interrogatives are evaluated against information states. An inquisitive model M is defined as in (16).

(16) **Definition:** Inquisitive Model
An inquisitive model M for a set P of atomic sentences: $M = \langle W, V \rangle$
   a. W is a set, whose elements are called *possible worlds*.
   b. $V : P \to \wp(W)$ is a *valuation map* that specifies for each atomic sentence in P, which set of the worlds make the sentence true.

The following definition (17) defines the conditions when a state s supports (notation: $\models$) a sentence. A state s supports an atomic declarative p when p is true in all worlds in s, i.e., "*established* or *true everywhere* in s" (Ciardelli & Roelofsen, 2015, 1653) as in (17a). Second, s supports a conjunction $\varphi \wedge \psi$ when both conjuncts are supported by s (17b). Third, s supports a disjunction $\varphi \vee \psi$ when at least one of the disjuncts is supported by s (17c), Fourth, a state s supports a negative sentence $\neg\varphi$ when no non-empty subset of s supports φ (17d). Finally, s supports a conditional $\varphi \to \psi$ if and only if all subsets of s that support φ support ψ (17e).

(17) **Definition:** Semantics
Let M be an inquisitive model, and s an information state in M.
   a. $s \models p$ iff $s \subseteq V(p)$,
   b. $s \models \varphi \wedge \psi$ iff $s \models \varphi$ and $s \models \psi$,
   c. $s \models \varphi \vee \psi$ iff $s \models \varphi$ or $s \models \psi$,
   d. $s \models \neg\varphi$ iff for all non-empty $t \subseteq s$: $t \not\models \varphi$,
   e. $s \models \varphi \to \psi$ iff for all $t \subseteq s$: $t \models \varphi$ implies $t \models \psi$.

Note that a sentence is evaluated against states in the current framework, while a sentence is evaluated against possible worlds in the classical possible world semantics. Therefore, in inquisitive semantics, the proposition expressed by a sentence φ is defined as a set of all states that support φ:

(18) **Definition:** Propositions
$[\varphi]_M := \{s \subseteq W | s \models \varphi\}$
(Ciardelli & Roelofsen, 2015, 1656)

Since $[\varphi]_M$ is a set of information states, therefore it is an issue.

Remember that we define a polar interrogative $?\varphi$ as an abbreviation of $\varphi \vee \neg\varphi$ Thus, the support condition for polar interrogatives is the same as that for disjunction:

(19) **Definition:** Support condition for polar interrogatives
$s \models ?\varphi$ iff $s \models \varphi$ or $s \models \neg\varphi$

Next, we define several notions to distinguish inquisitive sentences and statements (i.e., non-inquisitive sentences). As discussed by Ciardelli et al. (2015), a maximal state that supports a sentence φ contains all the states that support

φ. These maximal states are called the possibilities:[7]

(20) **Definition:** Possibilities for a sentence φ
The maximal states that support a sentence φ are referred to as the possibilities for φ.
possibility(φ) $:= \{s | s \models \varphi$ and there is no $t \subset s$ such that $t \models \varphi\}$.

(21) **Definition:** Inquisitiveness in terms of possibilities
a. φ is inquisitive iff there are at least two possibilities for φ,
b. φ is a statement iff there is exactly one possibility for φ.

Finally, we regard a set $\mathcal{C} \subseteq \wp(W)$ as the speaker's epistemic context. When we add an update operation to the system in Section 4.1.1, this is the context to be updated.

(22) **Definition:** Context $\mathcal{C}$
A context $\mathcal{C}$ is an issue, a downward closed set of information states.

We say that a context is inquisitive when there are at least two possibilities (maximal states) in the context.

(23) **Definition :** Inquisitiveness of contexts
a. $\mathcal{C}$ is inquisitive iff there are at least two possibilities in $\mathcal{C}$
b. $\mathcal{C}$ is non-inquisitive iff there is at most one possibility in $\mathcal{C}$

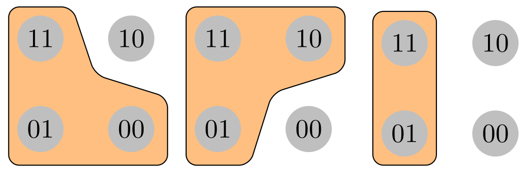
2.2 Characterization of the puzzle

Rawlins (2013) proposes that an unconditional construction '*whether or not* p, q' like (24) semantically encodes a conjunction of 'if p, q' *and* 'if not p, q'. Since the content of the main clause stays constant, the choice among possible answers does not affect the value of the main clause. As a result, the construction entails q, though Rawlins (2013) explicitly claims that the consequent entailment itself is not directly encoded in the construction but simply arises as a result of semantic composition.

(24) Whether or not the party is at Emma's place, it will be fun.

Given the framework of inquisitive semantics discussed in the previous section, the propositions $[p \to q]_M$ and $[\neg p \to q]_M$ can be depicted as in Figures 2(a) and 2(b), respectively. Since the semantics of 'whether or not p, q' is a conjunction of $p \to q$ and $\neg p \to q$, i.e., $(p \to q) \wedge (\neg p \to q)$, we can take an intersection of the two propositions $[p \to q]_M \cap [\neg p \to q]_M$, resulting in the proposition depicted in Figure 2(c).

[7]Possibilities for φ are called *alternatives* for φ in some literature of inquisitive semantics Ciardelli (see 2016).



(a) $[p \to q]_M$ (b) $[\neg p \to q]_M$ (c) $[(p \to q) \wedge \neg(p \to q)]_M$

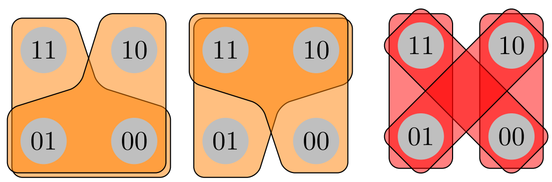
Figure 2: Two conditionals merge into an unconditional

Note that the resulting proposition is equivalent to $[q]_M$, hence we obtain the consequent entailment.

Turning to unconditional questions, an unconditional question '*whether or not* p, $?q$' like (25) should denote a conjunction of two conditional questions, i.e., 'if p, $?q$' *and* 'if not p, $?q$'.

(25) *Whether or not the party is at Emma's place, will it be fun?

As before, the propositions $[p \to ?q]_M$ and $[\neg p \to ?q]_M$ are depicted as in Figures 3(a) and 3(b), respectively. Now let us try to conjoin $p \to ?q$ and $\neg p \to ?q$, i.e., $(p \to ?q) \wedge (\neg p \to ?q)$. That is, we take the intersection of the two propositions $[p \to ?q]_M \cap [\neg p \to ?q]_M$. Then we end up in the proposition depicted in Figure 3(c).



(a) $[p \to ?q]_M$ (b) $[\neg p \to ?q]_M$ (c) $[(p \to ?q) \wedge (\neg p \to ?q)]_M$

Figure 3: Two conditional questions merge into an unconditional question

The main claim of this paper is that the proposition $[(p \to ?q) \wedge (\neg p \to ?q)]_M$ depicted in Figure 3(c) is not a legitimate question. In the framework of inquisitive semantics currently adopted, however, there is nothing wrong in the issue represented in Figure 3(c). It is not a statement since there are four possibilities (maximal states) (see (21)), but it is a proper inquisitive sentence. Nothing in inquisitive semantics rules out $[(p \to ?q) \wedge (\neg p \to ?q)]_M$ as illegitimate. Therefore, I argue that $[(p \to ?q) \wedge (\neg p \to ?q)]_M$ is ruled out by a *linguistic* constraint. More specifically, some of the possibilities do not represent possible answers to the question, which violates the Hamblin's picture.

3 Proposal: Hamblin's picture and two groups of English speakers

To solve the puzzle characterized in the last section, this paper makes two proposals regarding the interpretation of questions which are intertwined with each other. First, English speakers can be divided into two groups depending on which version of Hamblin's picture constraint they observe. Second, for one group, a linguistically-legitimate question denotes a HAMBLIN-ISSUE 1, an exhaustive set of mutually exclusive possibilities, while for the other group, it observes a HAMBLIN-ISSUE 2, an exhaustive set of possible answers.

In his seminal paper, Hamblin (1958) postulates three principles, which are jointly dubbed "Hamblin's picture" by Groenendijk & Stokhof (1997):

(26) a. An answer to a question is a statement.
b. Knowing what counts as an answer is equivalent to knowing the question.
c. The possible answers to a question are an exhaustive set of mutually exclusive possibilities. (Hamblin, 1958, 162-163)

These postulates amount to saying that the meaning of a question is an exhaustive set of mutually exclusive possible answers, which are statements. Recall from (21) that a sentence is a statement if and only if there is exactly one possibility for the sentence. In terms of the inquisitive notions introduced in Section 2.1, thus, the meaning of a question is an exhaustive set of mutually exclusive possibilities:

(27) **Definition:** Hamblin picture:
A sentence φ denotes a *Hamblin-issue* of a context $\mathcal{C}$ iff
a. $\bigcup[\varphi]_M = \mathcal{C}$. (exhaustivity)
b. If $s \in$ possibility(φ) & $t \in$ possibility(φ) & $s \neq t$, then $s \cap t = \emptyset$ (mutual exclusivity).

To illustrate, the possible answers to a polar question like 'Will the party be fun?' can be represented by a set of 'yes' and 'no' answers:[8]

(28) The possible answers to *Will the party be fun?*:
{The party will be fun, The party won't be fun}

In Hamblin semantics, this set is obtained by a polar-question operator POLQ (Hamblin's (1973, 50) adformula 'is it the case that') which takes a singleton set $\{p\}$ and returns a set that contains p itself and its negation, i.e., $\{p, \neg p\}$.[9] I

[8] The meaning of a *wh*-question is also a set of possible answers answers:

(i) The possible answers to *Who came to the party?*:
{Emma came to the party, David came to the party, Fred came to the party,...}

[9] This way of composition can be carried over to the framework of the current paper as Ciardelli et al. (2017) offer *possibility semantics*, a modification of Hamblin's alternative se-

further postulate the following constraint on polar questions.

(29) POLAR QUESTION
The basic answers to a polar question (POLQ-φ) are the yes answer φ and the no answer $\neg\varphi$.

As stated in (26c), the original Hamblin's picture dictates that the possible answers to a question are an exhaustive set of *mutually exclusive* possibilities. I claim that this mutual exclusivity is not always observed. In particular, English speakers can be divided at least into two groups, one group (Group 1) obeys the mutual exclusivity of question (HAMBLIN-ISSUE 1) and the other group (Group 2) relaxes the requirement. In other words, I propose that there are two variants of the Hamblin's picture constraint. HAMBLIN-ISSUE 1 strictly enforaces the mutual exclusivity of possibilities.

(30) HAMBLIN-ISSUE 1
A question is an exhaustive set of mutually exclusive possibilities.

In contrast, HAMBLIN-ISSUE 2 says that a question must be answerable. In case of a polar question $?\varphi$, if one possibility supports φ (i.e., *yes* answer), the other one supports $\neg\varphi$ (i.e., *no* answer).

(31) HAMBLIN-ISSUE 2
A question is an exhaustive set of possible answers.
A polar question is an exhaustive set of *yes* and *no* answers.

Let us now take a look at a conditional question 'If the party's at Emma's place, will it be fun?' (2). As can be seen in Figure 3(a), the two possibilities are overlapping with each other. This semantics is not legitimate for Group 1 speakers while it is okay for Group 2 speakers. For Group 2 speakers, a polar question is legitimate as long as it can be answered by one of the 'yes' and 'no' particles. Each possibility in Figure 3(a) indeed represents an answer, 'Yes, if it's at her place, it'll be fun.' and 'No, if it's at her place, it won't be fun.'

How about Group 1 speakers? Unlike unconditional questions, conditional questions like (2) are accepted by all the speakers. How can they interpret (2)

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mantics which is adjusted to inquisitive semantics (ses also Roelofsen & van Gool, 2010). Possibility semantics does not require a new compositional rule like Hamblin's pointwise functional application but requires adjustment of typing. Sentences, both statements and questions, are sets of possibilities, which are sets of possible worlds. Thus, sentences are of type $\langle\langle s,t\rangle,t\rangle$, which is abbreviated as T. The polar question operator POLQ is a sentential operator which takes a set of possibilities and returns another set which contains the original sentence and the negation of it.

(i) a. $[\![\textbf{The party will be fun.}]\!], [\![\textbf{Will the party be fun?}]\!] \in D_T$
b. $[\![\textbf{The party will be fun.}]\!] = \mathcal{Q}$
c. $[\![\textsc{polq}]\!] \in D_{\langle T,T\rangle}$
d. $[\![\textsc{polq}]\!] = \lambda\mathcal{P}.\mathcal{P} \cup \{\overline{\bigcup\mathcal{P}}\}$
e. $[\![\textbf{Will the party be fun?}]\!] = [\![\textsc{polq}]\!]([\![\textbf{The party will be fun.}]\!]) = [\lambda\mathcal{P}.\mathcal{P} \cup \{\overline{\bigcup\mathcal{P}}\}](\mathcal{Q}) = \mathcal{Q} \cup \{\overline{\bigcup\mathcal{Q}}\}$

if a question has to be a set of mutually exhaustive possibilities? The answer is that Group 1 speakers take the suppositional path to interpret conditionals. First, they update the context with the antecedent of the conditional questions 'If the party's at Emma's place'. Then, the hypothetical context is divided into two mutually exclusive answers, 'Yes, it is fun.' and 'No, it is not fun'. We will see how this process is implemented in Section 4.1.

In short, according to Hamblin (1958), the meaning of a question is an exhaustive set of mutually exclusive possibilities. I further argue that some speakers can relax the mutually exclusive component of the constraint. Thus, there are two linguistic constraints, Hamblin-Issue 1 which strictly enforces the mutual exclusivity and Hamblin-Issue 2 which only requires a question to mean an exhaustive set of possible answers. In either case, a question must denote a set of possible answers. In case of a polar question, its meaning is a set of 'yes' and 'no' answers.

3.1 An unconditional question cannot draw a Hamblin's picture

Given the discussion above, the puzzle in Section 2.2 is explained as a violation of Hamblin's picture but two groups of Speakers rule out unconditional questions for different reasons.

Take an infelicitous unconditional question (4) and the diagram in Figure 3(c), which depicts its proposition. Group 1 speakers reject (4) because it involves overlapping possibilities and violates Hamblin-Issue 1 as can be seen in the diagram. Group 2 speakers do not reject (4) because of the overlap, but reject the question because its meaning includes non-possible answers. The two vertical possibilities are easy to see which sentences they depict, since the left one is 'It'll be fun (q)' and the right one is 'It won't be fun ($\neg q$)'. The diagonal possibilities are harder to grasp their meanings. The maximal state that contains w_{11} and w_{00} says that the antecedent p and the consequent q have the same truth value, i.e., '(it's at her place and it'll be fun) or (it's not at her place and it won't be fun.)'. The other diagonal possibility says that they have opposite truth values, i.e., '(it's not at her place and it will be fun) or (it's at her place and it won't be fun)'. Now, the current paper adopts Rawlins (2008, 2013) for the structure of unconditional constructions. Since (4) is a conjunction of two conditional polar questions ('If it is at Emma's place, will it be fun?' and 'If it is not at Emma's place, will it be fun?'), (4) is also a polar question, which involves polq, thus it should also be answered by 'yes' or 'no'. It might be possible to assign 'yes' and 'no' to the left and right vertical possibilities, respectively, but there are no plausible ways to assign them to the diagonal possibilities. Since the meaning of an unconditional question is not comprised of an exhaustive set of possible answers, unconditional questions like (4) violate Hamblin-Issue 2, thus are not legitimate questions for Group 2 speakers.

Put another way, Group 1 speakers reject unconditional questions since they are illegitimate linguistic objects. Group 2 speakers on the other hand, reject them since the questions are not answerable.

3.2 Independence assumption

As already mentioned in Section 1, there is another complication. An unconditional question can be accepted to some speakers if the context is such that the speaker explicates the *independence* between the "antecedent" and the "consequent" as in (32). That is, the speaker A is expecting an unconditional answer from the speaker B:

(32) A: I don't think whether the party will be fun or not depends on whether it is at Emma's place or not.
?Now, whether or not the party is at Emma's house, will it be fun?
B1: Yes, whether or not it is at her house, it will be fun.
B2: No, whether or not it is at her house, it won't be fun.
B3#If it is at her place, it will be fun. If it is not at her place, it won't be fun.

Simply put, the independence assumption removes the two diagonal possibilities in Figure 3(c) because the truth values of p and q are dependent on each other in those possibilities. That is, knowing the truth value of one of the sentence determines the other. Once the diagonal possibilities are removed, the unconditional question 'whether or not p, $?q$' becomes semantically equivalent to $?q$ as in Figure 4.

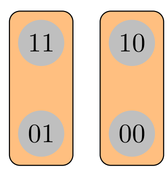


Figure 4: Unconditional question with independence assumption

To give a formal proof of the intuition just sketched, let us borrow the notion of conditional independence defined by Franke (2007, 2009).[10] We consider a context $\mathcal{C} \subseteq \wp(W)$ as the speaker's epistemic context as defined in (22). Let p, q be sentences of $\mathcal{L}$. Following Franke (2009), we introduce the following definitions.

(33) **Definition:** Entailment and Consistency
a. A context $\mathcal{C}$ entails a sentence p ($\mathcal{C} \models p$, in short) in $\mathcal{C}$ if $\mathcal{C} \cap [p]_M = \mathcal{C}$.
b. p is consistent ($\Diamond p$, in short) in $\mathcal{C}$ if $\mathcal{C} \cap [p]_M \neq \emptyset$.

Intuitively, sentences p and q are independent in $\mathcal{C}$ when learning that p or q is true or false does not decide whether the other sentence is true or false:

[10]See also Sano & Hara (2014) who provide a dynamic extension of Franke's conditional independence.

(34) **Definition:** Conditional Independence

Let $\mathcal{C} \subseteq \wp(W)$ be an epistemic state and p, q sentences. We say that p and q are *independent* in $\mathcal{C}$ if

$$\Diamond x \text{ and } \Diamond y \text{ in } \mathcal{C} \text{ imply } \Diamond([x]_M \cap [y]_M) \text{ in } \mathcal{C},$$

for all $x \in \{p, \neg p\}$ and $y \in \{q, \neg q\}$.

Sano & Hara (2014, 88) rephrase the notion of independence in terms of entailment '$\models$' as follows:

(35) **Proposition:**

Let $\mathcal{C} \subseteq \wp(W)$ be an epistemic context and p, q sentences. Then, the following are equivalent:

(i)p and q are independent in $\mathcal{C}$,

(ii)if x is consistent in $\mathcal{C}$, then

$$\mathcal{C} \cap [y]_M = \mathcal{C} \text{ is equivalent to } \mathcal{C} \cap [x]_M \cap [y]_M = \mathcal{C} \cap [x]_M,$$

for all $x \in \{p, \neg p\}$ and $y \in \{q, \neg q\}$.

Taken together we obtain the following theorem. If we already know that p and q are independent and p is consistent in the context, it follows from $\mathcal{C} \models (p \rightarrow ?q) \wedge (\neg p \rightarrow ?q)$ that the context entails $?q$.

(36) **Theorem:**

Let p and q are independent in $\mathcal{C}$ and p be consistent in $\mathcal{C}$. Then, $\mathcal{C} \models (p \rightarrow ?q) \wedge (\neg p \rightarrow ?q)$ implies $\mathcal{C} \models ?q$

(37) *Proof*

Assume that $\mathcal{C} \models (p \rightarrow ?q) \wedge (\neg p \rightarrow ?q)$. That is, $\mathcal{C} \cap [p \rightarrow ?q]_M = \mathcal{C}$ and $\mathcal{C} \cap [\neg p \rightarrow ?q]_M = \mathcal{C}$. Thus, $\mathcal{C} \subseteq \{s \in \mathcal{C} |$for any non-empty $t \subseteq s$ if $t \models p$, then $t \models ?q\}$. We show that $\mathcal{C} \cap [?q]_M = \mathcal{C}$. Given independence, it suffices to show that $\mathcal{C} \cap [p]_M \cap [?q]_M = \mathcal{C} \cap [p]_M$. Since we already know $\mathcal{C} \cap [p]_M \cap [?q]_M \subseteq \mathcal{C} \cap [p]_M$, we show $\mathcal{C} \cap [p]_M \subseteq \mathcal{C} \cap [p]_M \cap [?q]_M$. Fix any non-empty $s \in \mathcal{C} \cap [p]_M$. Then $s \models p$. We show that $s \in \mathcal{C} \cap [p]_M \cap [?q]_M$. Since $s \in \mathcal{C}$ and by assumption $s \models ?q$, we obtain $s \in \mathcal{C} \cap [p]_M \cap [?q]_M$.

To recapitulate, once there is an independence assumption between the antecedent p and the consequent q, an unconditional question 'whether or not p, $?q$' semantically entails $?q$. Thus, to some speakers, an unconditional question becomes felicitous. According to the current analysis, these speakers belong to Group 2. Group 1 speakers simply reject unconditional questions as illegitimate linguistic objects while Group 2 speakers allow overlapping possibilities as questions as long as they are answerable.

3.3 Summary

Group 1 rejects unconditional questions even with the independence assumption since its semantics involves issues that are not mutually exclusive, i.e., overlapping possibilities as in Figure 3(c). In contrast, Group 2 speakers allow overlapping possibilities, thus they do not reject unconditional questions on the basis of the mutual exclusivity requirement (26c), but on the basis of (26b) as discussed above. Without the independence assumption, the meaning of an unconditional question is not a set of possible answers. Once the independence assumption is given, the meaning becomes a set of possible answers, 'yes' and 'no'. The observation and claim are summarized as follows:

(38) a. Group 1: Observe the mutual exclusivity of questions.
  (i) disallow overlapping possibilities
  (ii) always reject unconditional questions
 b. Group 2: Relax the mutual exclusivity of questions
  (i) allow overlapping possibilities
  (ii) accept unconditional questions only if the antecedent and consequent propositions are independent.

In addition, I propose that there are two variants of the Hamblin's picture constraint, HAMBLIN-ISSUE 1 obeyed by Group 1 speakers and HAMBLIN-ISSUE 2 obeyed by Group 2 speakers.

(39) a. HAMBLIN-ISSUE 1
  A question is an exhaustive set of mutually exclusive possibilities.
 b. HAMBLIN-ISSUE 2
  A question is an exhaustive set of possible answers.

The next question pertains to: How do Group 1 speakers interpret conditional questions? As can be seen in Figure 3(a), the semantics of conditional questions also involves overlapping possibilities, yet all the native speakers of English have no problem in understanding conditional questions like 'If the party's at Emma's place, will it be fun?'. The answer is that Group 1 speakers use stack-based semantics of conditionals to observe the mutual exclusivity requirement of questions and circumvent overlapping possibilities.

The stack-based semantics of conditional questions is already motivated and implemented by Isaacs & Rawlins (2008), but as pointed out by Sano & Hara (2014), their implementation has a problem which derives wrong meanings for conditional statements and questions. Authors (2017) amend the system by employing inquisitive semantics. The current paper adopts Authors' (2017) stack-based and inquisitive system to derive the meanings of conditional questions. The rest of the paper is devoted to show how the new system successfully derives the meaning of conditional questions and how the system can be augmented to handle unconditionals. The proposed system derives the felicity of conditional questions without dealing with overlapping possibilities. I also introduce new operations to handle unconditionals and show how the augmented system derive the meanings of unconditional statements. Crucially, even with the improved and augmented system which circumvents overlapping possibilities for the processing of conditional questions, we cannot prevent unconditional questions from creating overlapping possibilities, which explains why they are always ruled out by Group 1 speakers.

4 Stack-based analysis of conditionals and unconditionals

The previous section argued that Group 1 speakers always find unconditional questions infelicitous because they strictly observe the mutual exclusivity of questions, hence they cannot process overlapping possibilities. A question that arises as to: How can they process conditional questions the semantics of which also involves overlapping possibilities? The answer is already given by Isaacs & Rawlins (2008). Isaacs & Rawlins (2008) analyze conditional sentences with interrogative consequents (conditional questions) like (40) using a suppositional semantics for conditionals and a partition semantics of questions.

(40) If the party is at Emma's place, will it be fun?

The main idea of Isaacs & Rawlins (2008) is that the antecedent clause 'If the party is at Emma's place' creates a temporary context and the consequent question 'will it be fun?' only operates over the temporary context, but not over the main context. This way, a conditional question does not create overlapping possibilities but creates an exhaustive set of mutually exclusive answers. Isaacs & Rawlins (2008) also claim that mutual exclusivity is an essential property of questions and provide a number of empirical data that support the claim (See Section 3.2 of Isaacs & Rawlins (2008) and Section 4.1.4 of this paper). In analyzing conditional questions, Isaacs & Rawlins (2008) originally combine Kaufmann's (2000) stack-based model for conditionals with Groenendijk's (1999) partition semantics for questions. However, as observed by Sano & Hara (2014), Isaacs and Rawlins' (2008) original implementation does not derive the result that they claim to derive.[11] Thus, in this paper, while I agree with Isaacs and Rawlins' (2008) claim in that mutual exclusivity is a core property of questions (especially for Group 1 speakers), I employ Inquisitive Semantics (Ciardelli et al., 2015; Ciardelli & Roelofsen, 2015; Ciardelli, 2016, among others) introduced in Section 2.1 to define the semantics of interrogative clauses.

4.1 Conditional Statements/Questions

Isaacs & Rawlins (2008) build a procedual/suppositional theory of conditionals which attempts to capture the intuition coined "the Ramsey test':

(41) 'Ramsey test" intuition
"If two people are arguing ' If p, will q? ' and are both in doubt as to p, they are adding p hypothetically to their stock of knowledge and arguing on that basis about q ..." (Ramsey, 1931, 247)

[11] See footnote 8 of Sano & Hara (2014, p. 97).

Put another way, given the suppositional view of conditionals (Stalnaker, 1968; Adams, 1965; Mackie, 1973; Karttunen, 1974; Heim, 1982; G ardenfors, 1986, a.o.), the meaning of a conditional is characterized using a three-step update procedure:

(42) a. A hypothetical context is created by updating the speech context with the antecedent.
b. The hypothetical context is updated with the consequent.
c. The original context learns the effects of the second step.

In implementing these steps, Isaacs and Rawlins employ Kaufmann's (2000) model of temporary contexts. In the current paper, I combine the stack-based model with the inquisitive semantics sketched above instead of the logic of interrogation, which was originally used by Isaacs & Rawlins (2008).

4.1.1 Updates and stacks

In standard Stalnakerian (1978) update semantics, a context is a set of possible worlds. An assertion updates the context by taking an intersection of the context and the propositional content of the assertion, which is also a set of possible worlds. In the current setting, the proposition of a sentence is a set of information states, thus a context to be updated is also a set of information states. i.e., an issue, as defined above in (13).

For simplicity, in the following illustrations we suppose $W = \{w_{11}, w_{10}, w_{01}, w_{00}\}$ and we have only two sentences p and q. The valuations of the sentences are as follows: $V(p) = \{w_{11}, w_{10}\}$ and $V(q) = \{w_{11}, w_{01}\}$. At the initial stage, the conversational agent is ignorant about the context. That is, the agent has no pre-existing commitments about information or issues. Reflecting this state of the context, there is only one maximal element, $W = \{w_{11}, w_{10}, w_{01}, w_{00}\}$. In other words, The initial ignorant context is a trivial issue $\wp(W)$ and is diagrammatically depicted in Figure 1(d) repeated here as Figure 5.

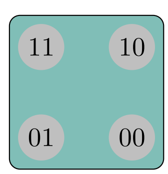


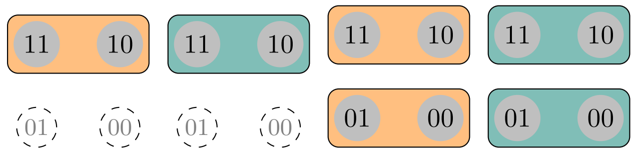
Figure 5: The initial ignorant context

Now, declarative and interrogative updates are uniformly defined as intersection of the context and the proposition:

(43) **Definition:** $\mathcal{C} \star \varphi := \mathcal{C} \cap [\varphi]_M$.

To illustrate, the update of $\mathcal{C}$ with a declarative p, $\mathcal{C} \star p$, intersects $\mathcal{C}$ with the proposition $[p]_M$ (Fig. 6(a)) resulting in the context depicted in Fig. 6(b).

Similarly, the update of $\mathcal{C}$ with an interrogative $?p$, $\mathcal{C}\star ?p$, intersects $\mathcal{C}$ with the proposition $[?p]_M$ (Fig. 6(c)) resulting in the context depicted in Fig. 6(d).



(a) $[p]_M$ (b) $\mathcal{C}\star p$ (c) $[?p]_M$ (d) $\mathcal{C}\star ?p$

Figure 6: Propositions and updated contexts

The next step is to add stacks to model conditionals. Following Kaufmann (2000) and Isaacs & Rawlins (2008), utterances are treated as operations on a *macro-context*, which is a stack or list of contexts as defined in (44) and depicted in Figure 7.

(44) **Definition:** macro-context
$\tau = \langle \mathcal{C}_0, \ldots, \mathcal{C}_n \rangle$

τ_0	$\mathcal{C}_0$
$\vdots$	$\vdots$
τ_n	$\mathcal{C}_n$

Figure 7: macro-context

We say that the topmost context $\mathcal{C}_0$ is the currently active context.

Let us first look at how a conditional statement is interpreted and turn to the meaning of a conditional question.

4.1.2 Conditional Statements

In interpreting the antecedent of the conditional in (45), a temporary context is created by making a copy of the initial context c. More precisely, a temporary context is pushed onto the stack:

(45) If the party is at Emma's place, it will be fun.

(46) **Definition:** push operator
For any macro-context τ and context $\mathcal{C}$:
$\text{push}(\mathcal{C}, \tau) := \langle \mathcal{C}, \tau \rangle$

The temporary context is updated by an update operation, i.e., intersecting the input context with the propositional content of the sentence. In a nutshell, the function of the *if*-clause is defined as the macro-context change potential

(MCCP) which creates a temporary context that is updated by the propositional content of the *if*-clause, as in (47):[12]

(47) **Definition**: MCCP of an *if*-clause
For any macro-context τ and *if*-clause 'if φ':
$\tau + (\text{if } \varphi) := \text{push}(\tau_0 \star \varphi, \tau)$
Admittance condition: 'If φ' is admissible in a macro-context τ iff $\tau_0 \star \varphi \neq \emptyset$

All the states that do not support the antecedent clause, that is, the sets that contain the worlds that make the antecedent false, i.e., w_{01} and w_{00}, are removed from the temporary context, as shown in Figure 8.

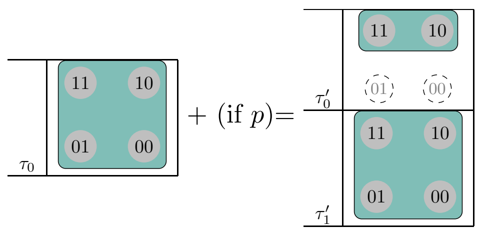


Figure 8: $\tau + (\text{if } p)$

Next, the consequent declarative clause updates the temporary context, $\tau'_0 \star q = \tau'_0 \cap [q]_M$. Since $w_{10} \notin V(q)$, the update removes all the sets that contain w_{10}.

Now, this update by the declarative clause affects not only the temporary context but also the other members in the stack. That is, the information brought by a declarative percolates down the stack. In characterizing this percolation of information, the current framework defines the notion of percolation $\vdash$ as follows:

(48) **Definition:** Percolation $\vdash$
$\mathcal{C}[\mathcal{C}' \vdash \psi] := \{s \in \mathcal{C} \mid \text{ for all } t \subseteq s,\ t \in \mathcal{C}' \text{ implies } t \in \mathcal{C}' \star \psi\ \}$

This is a reformulation of Isaacs and Rawlins' (2008) 'support' (46, p. 293) and a natural extension of Kaufmann's (2000) Conclude. $\mathcal{C}[\mathcal{C}' \vdash \psi]$' can be read as 'Discourse participants learn in a context $\mathcal{C}$ that another context $\mathcal{C}'$ supports ψ''.[13] To be more concrete, let us calculate a context $\mathcal{C}[\mathcal{C} \star p \vdash q]$.

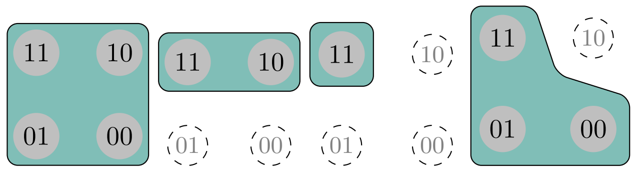
(49) $\mathcal{C}[\mathcal{C} \star p \vdash q] = \{s \in \mathcal{C} \mid \text{ for all } t \subseteq s,\ t \in \mathcal{C} \star p \text{ implies } t \in \mathcal{C} \star p \star q\ \} = \mathcal{C} \star (p \rightarrow q)$

Let our context $\mathcal{C}$ to be the trivial issue as in Figure 9(a). All and only states

[12]The admittance condition encodes the presupposition that the propositional content of the antecedent is possible, which is often assumed since Stalnaker (1968).

[13]As pointed out by Sano & Hara (2014), Isaacs and Rawlins' original definition of 'support' does not derive the semantics that they claim to derive.

that contain w_{10}, i.e., $\{w_{10}, w_{01}\}, \{w_{10}, w_{00}\}, \{w_{10}, w_{01}, w_{00}\}$, are removed, which gives us the context depicted in 9(d). Note in particular that this context $\mathcal{C}[\mathcal{C} \star p \vdash q]$ is equivalent to the context obtained by updating $\mathcal{C}$ with a non-stack version of conditional $p \to q$: $\mathcal{C}[\mathcal{C} \star p \vdash q] = \mathcal{C} \star (p \to q)$.[14]



(a) $\mathcal{C}$ (b) $\mathcal{C} \star p$ (c) $\mathcal{C} \star p \star q$ (d) $\mathcal{C}[\mathcal{C} \star p \vdash q]$

Figure 9:

With this notion of percolation $\vdash$, Isaacs and Rawlins' (2008) assertive update on macro-contexts (47, p. 293) is also carried over to the current framework as in (50). Note that unlike Isaacs & Rawlins (2008), who make a distinction between assertive and inquisitive updates on MCCP, I simply call it MCCP of UPDATE. In inquisitive semantics, updates by declarative and interrogative sentences are uniformly treated as intersection of the input context and the propositional content of the sentence (see (43) above), thus we only need a single MCCP of UPDATE. We will see how (50) works for questions in the next section.

(50) **Definition** MCCP of UPDATE
$\tau + (\text{UPDATE } \psi) := \langle \tau_i[\tau_0 \vdash \psi] \rangle_{0 \leqslant i < n}$

The effect of MCCP of UPDATE is depicted in Figure 10 and the process so far is summarized in (51).

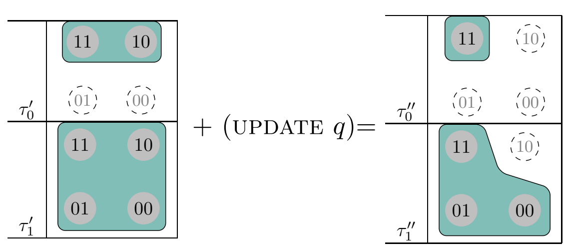


Figure 10: Update of the consequent declarative

(51) $\tau + (\text{if } p) + (\text{UPDATE } q) = \langle \tau_i[\tau_0 \star p \vdash q] \rangle_{0 \leqslant i \leqslant n}$

Finally, if the subsequent discourse will not refer to the temporary context, it will be discarded by the following pop operation:[15]

[14] See (17e) for the definition of $\to$.
[15] See Isaacs & Rawlins (2008, (45), p. 292).

(52) **Definition:** pop operator
$\langle \mathcal{C}, \tau \rangle + \text{pop} := \tau$ if $\tau \neq \langle\rangle$; $\mathcal{C}$ otherwise.

The only member of the final macro context τ_0 has the same structure as the context that is updated with $p \to q$, i.e., $\mathcal{C} \cap [p \to q]_M$:

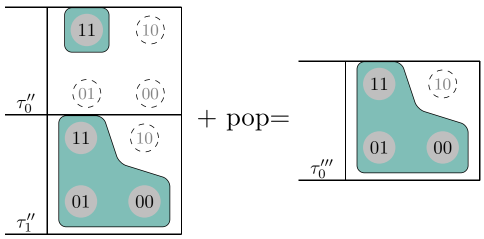


Figure 11: Popping

4.1.3 Conditional Questions

Let us now turn to the conditional question:

(53) If the party is at Emma's place, will it be fun?

The first step is the same as the conditional declarative: The MCCP of an *if*-clause pushes a temporary context on top of the macro-context and updates it with the propositional content of the antecedent.

The next step should update this temporary context with the consequent interrogative. Unlike Isaacs & Rawlins (2008), who propose distinct MCCPs for assertions and questions, I claim that the same MCCP of UPDATE carries over to question acts. Thus, as is the case with assertions, issues raised by questions also percolate down the stack:[16]

(54) $\tau + (\text{if } p) + (\text{UPDATE } ?q) = \langle \tau_i[\tau_0 \star p \vdash ?q] \rangle_{0 \leqslant i \leqslant n}$

Remember that the party is fun in w_{11}, and the party is not fun in w_{10}. Since w_{11} and w_{10} resolve the question in different ways, the two worlds are disconnected. In other words, $\{w_{11}, w_{10}\} \not\models ?q$, thus $\{w_{11}, w_{10}\} \notin \tau_0 \star p \star ?q$. Therefore, the state that contains the two worlds, $\{w_{11}, w_{10}\}$, is removed, and the temporary context is *partitioned* into two maximal elements as can be seen in Figure 12.

[16]Note further that in Isaacs & Rawlins (2008), the distinction between assertive and inquisitive updates is already made at the level of (non-macro) context. In contrast, in inquisitive semantics, the update procedure, i.e., non-macro CCP, for interrogative and declarative clauses is the same, that is, the update intersects the input context set $\mathcal{C}$ with the propositional content of the clause.

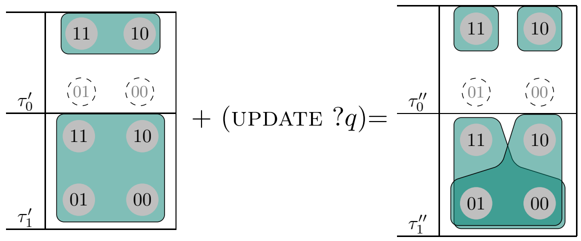


Figure 12: $\tau + (\text{if } p) + (\textsc{update } ?q)$

The effect also percolates down the stack, thus all the states that contain $\{w_{11}, w_{10}\}$ as their subsets are removed from the bottom context. In effect, the bottom context has overlapping possibilities:

(55) $\mathcal{C}[\mathcal{C} \star p \vdash ?q] = \{s \in \mathcal{C} \mid \text{ for all } t \subseteq s,\, t \in \mathcal{C} \star p \text{ implies } t \in \mathcal{C} \star p \star ?q\ \}$

In I&R's system, the effect of question update should not percolate down the stack since they define the semantics of an interrogative clause as a partition on as set of possible worlds, hence overlapping possibilities would be an illegitimate question. In inquisitive semantics, on the other hand, overlapping possibilities are not problematic, although the current paper argues that at least Group 1 speakers observe the mutual exclusivity of questions (See Section 4.1.4 below for more discussions). Crucially, the issues represented in the topmost active context are mutually exclusive, which can be handled by both Group 1 and Group 2 speakers discussed above in (38) in Section 3.2.

Now, at this moment, our active topmost context is inquisitive, that is, the questioner is waiting for an answer. Let us say that a particle *yes* means *Yes, it will be fun* $(= q)$. Thus, the utterance of the answer is the MCCP of UPDATE with percolation. removing all the states that do not support the answer in the temporary context, i.e., $\{w_{10}\}$ and the effect percolates down the stack.

(56) $\tau + (\text{if } p) + (\textsc{update } ?q) + (\textsc{update } q) = \langle \tau_i[\tau_0 \star p\star ?q \vdash q] \rangle_{0 \leqslant i \leqslant n}$

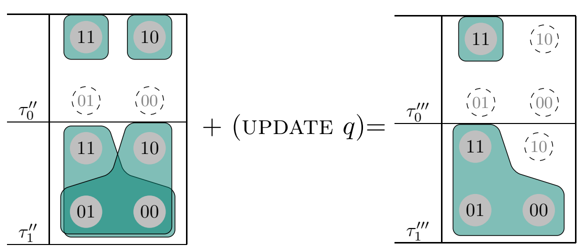


Figure 13: A yes answer given to a conditional question

After the question is resolved, so that the temporary context is no longer inquisitive, the temporary context can be popped off the stack according to the pop operation (52).

In general, derived contexts are discarded after the interpretation of *declarative* conditionals. Subsequent utterances do not refer back to the temporary contexts. In contrast, Isaacs and Rawlins propose that derived contexts are not discarded after the interpretation of *interrogative* conditionals, since the derived contexts are still inquisitive, that is, they contain at least two maximal elements. This requirement is formulated as the INQUISITIVE CONSTRAINT.

(57) INQUISITIVE CONSTRAINT
A macro-context may not be popped if the top element is inquisitive.
(Isaacs & Rawlins, 2008, (49), p. 294)

Note that the definition in (52) itself does not determine when the pop operation applies. The INQUISITIVE CONSTRAINT (57) prohibits a pop operation from applying to a stack with an inquisitive context.

4.1.4 Mutual Exclusivity: Motivating the stack model of conditionals

Isaacs & Rawlins (2008) provide a stack-based analysis of conditional questions, which allows us to maintain mutual exclusivity of questions. One of the main motivations to keep mutual exclusivity is a technical necessity in I&R's model which employs the partition semantics of questions: A question is a partition of a set of possible worlds. The current paper employs inquisitive semantics, which does not enforce mutual exclusivity and makes room for overlapping possibilities like the one depicted in Figure 1(c), but there is a wide range of *empirical* evidence for mutual exclusivity of questions. Thus, partly following Isaacs & Rawlins (2008), I claim that some English speakers (i.e., Group 1 speakers) strictly observe the Hamblin's picture, in particular mutual exclusivity of questions in the active (topmost) context. If the active context is inquisitive, the issues raised by the question need to be resolved by one of the discourse participants. Group 1 speakers who interpret the meaning of a question as a set of mutually exclusive answers could not process the non-active context which represents overlapping possibilities.

Accordingly, I take the observational fact discussed in Section 3.2 that Group 1 speakers do not accept unconditional questions even with the independence assumption as one argument for mutual exclusivity of questions. A number of other arguments are also provided by Isaacs & Rawlins (2008, Sec. 3.2). In the following, I cite one that is the most relevant to the current paper, an argument based on particle answers,

A conditional question like (58) can be answered by particles *yes* or *no*. A non-stack analysis of conditional questions that abandons mutual exclusivity (e.g., Velissaratou, 2000) needs to assume that the *yes* answer means $p \rightarrow q$ while *no* means $p \rightarrow \neg q$.

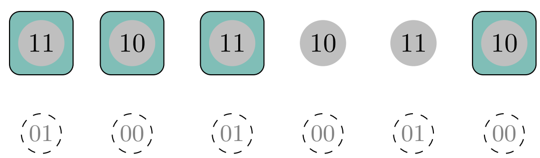
(58) If the party's at Emma's place, will it be fun?
a. Yes.
b. No.

Isaacs & Rawlins (2008, 282) argue that this assumption is "linguistically odd", since it does not explain why *yes* and *no* can be followed by non-conditionalized q (59a) and $\neg q$ (59b), respectively.

(59) If the party's at Emma's place, will it be fun?

a. Yes, it will.
b. No, it won't.
c. Yes, if it's at her place, it will be fun.
d. No, if it's at her place, it won't be fun.

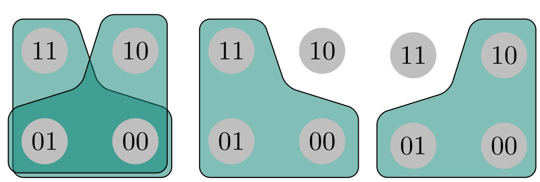
One could assume that there is an elided *if*-clause in (59a) and (59b), which calls for a further validation, but the stack-based analysis readily provides a straightforward explanation. That is, the short answers like (59a) and (59b) serve as answers to the question posed at the top context of the stack (Figure 14(a)).



(a) $\mathcal{C} \star p \star ?q$ (b) $\mathcal{C} \star p \star ?q \star q$ (c) $\mathcal{C} \star p \star ?q \star \neg q$

Figure 14: Stack-version question and answers

In contrast, long, full conditional answers like (59c) and (59d) are answers to the non-stack version of a conditional question (Figure 15(a)).



(a) $\mathcal{C} \star (p \rightarrow ?q)$ (b) $\mathcal{C} \star (p \rightarrow ?q) \star (p \rightarrow q)$ (c) $\mathcal{C} \star (p \rightarrow ?q) \star (p \rightarrow \neg q)$

Figure 15: Non-stack-version question and answers

This explanation is also in line with Hamblin's picture discussed in Section 3—the meaning of a question is a set of possible answers. As can be seen in Figures 14 and 15, $\mathcal{C} \star p \star ?q = (\mathcal{C} \star p \star q) \cup (\mathcal{C} \star p \star \neg q)$ and $\mathcal{C} \star (p \rightarrow ?q) = (\mathcal{C} \star (p \rightarrow q)) \cup (\mathcal{C} \star (p \rightarrow \neg q))$.

4.2 Unconditional statements/questions

Let us now turn to unconditionals. Section 3.2 argued that Group 1 speakers always reject unconditional questions because their semantics involves overlapping possibilities. Section 4.1 presented an improved version of Isaacs & Rawlins' stack-based model of conditional questions which enables Group 1 speakers to process a conditional question without dealing with overlapping possibilities. In order to derive the meaning of unconditional statements and the desired anomaly of unconditional questions, this section provides an extension of the model and notions introduced in Section 4.1. In particular, I introduce the notion of *multi-stack* and the operators n-copy, merge, and MSpop in order to handle the multiple contexts.

4.2.1 Unconditional statements

As sketched in Section 4.1, in the stack-based framework adopted in this paper, an *if*-clause restricts the context for the update of the consequent clause. Now, according to Rawlins' (2008, 2013) static analysis of unconditionals summarized in Section 2, an unconditional statement like (60) is a collection of alternative conditional statements.

(60) Whether or not the party is at Emma's place, it will be fun.

Taken together, I propose that *whether-or-not*-adjuncts create multiple temporary contexts, and the UPDATE operation updates those multiple contexts with the content of the consequent declarative.

In implementing this proposal, I introduce the notion of multi-stack, as in (61). A multi-stack is a sequence of stacks.

(61) **Definition:** multi-stack
$\mathcal{T} := \langle \tau^{(0)}, \tau^{(1)}, \tau^{(2)}, ...\tau^{(n)} \rangle$ is a multi-stack, where $\tau^{(i)}$ is a macro-context and $|\tau^{(0)}| = ... = |\tau^{(n)}|$.

The context can be rendered into a multi-stack by using the n-copy operator (62) when necessary, i.e., when multiple updates are performed on multiple contexts.

(62) **Definition:** n-copy operator
For any macro-context τ:
$\tau + n\text{-copy} := \langle \tau^{(0)}, ..., \tau^{(n-1)} \rangle$, where $\tau = \tau^{(0)} = ... = \tau^{(n-1)}$.

This n-copy operation can be understood as playing the role of the F-feature in Rooth (1985, 1992) or the [Q] operator in Rawlins (2008, 2013). Like them, it generates a set of Hamblin alternatives, A. When the alternative set takes scope over a speech act operator, a multi-stack $\mathcal{T}$ is created ($|\mathcal{T}| = |A|$) and each member of the alternative set creates a hypothetical context on top of each stack in $\mathcal{T}$.

To illustrate, take the same context as before: $V(p) = \{w_{11}, w_{10}\}$, and

$V(q) = \{w_{11}, w_{01}\}$, where $p =$'The party is at Emma's place' and $q =$'It will be fun'.

The initial context has the form of a single stack. When the *whether-or-not*-adjunct is processed, the interpreter realizes that two stacks will be created.[17] In other words, a *whether-or-not*-adjunct denotes a macro-context change potential which creates a multi-stack and performs an update over the created multi-stack:

(63) **Definition:** MCCP of an *whether-or-not* α, φ
For a macro-context τ and an unconditional statement ((whether or not α) φ):
τ + ((whether or not α) φ) :=
$\langle \tau^{(0)}$+(if α)+$\varphi, \tau^{(1)}$ + (if $\neg\alpha$)+$\varphi\rangle$,
where $\langle \tau^{(0)}, \tau^{(1)}\rangle = \tau +$ 2-copy.

Thus, the main macro-context is first rendered into a sequence of macro-contexts and (63) performs the MCCP of an *if*-clause (47) in each of the macro-contexts. The definitions of an *if*-clause (47) and the push operator (46) are directly carried over to the current framework.

In effect, one temporary context is created in each stack, the top member $\tau_1'^{(0)}$ of $\tau'^{(0)}$ is updated with p, and $\tau_1'^{(1)}$ is updated with $\neg p$:

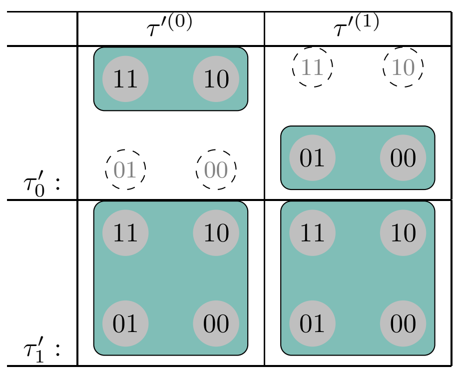


Figure 16: τ + (whether or not p)

The consequent of (60), 'it will be fun', removes all the states that contain w_{10} from $\tau_1'^{(0)}$ and the pairs that contain w_{00} from $\tau_1'^{(1)}$. This information can percolate down to the original member of the stack by the operation of the MCCP of UPDATE (50), That is, the states that contain w_{10} are removed from

[17]More than two stacks can be created with other kinds of unconditionals:

(i) a. Whenever the party is at Emma's place, it will be fun.
b. Whoever throws the party, it will be fun.

In any case, the set of propositions denoted by the adjunct is a Hamblin set, so the set exhausts the context set.

both $\tau_1''^{(0)}$ and $\tau_0''^{(0)}$, and the sets that contain w_{00} are removed from both $\tau_1''^{(1)}$ and $\tau_0''^{(1)}$.

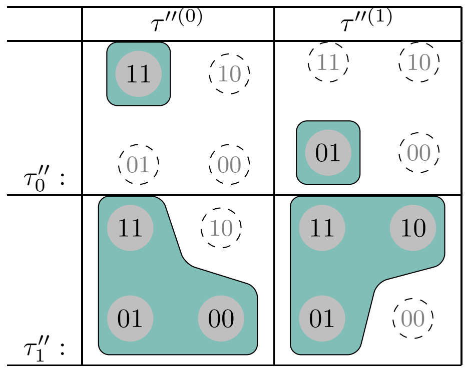


Figure 17: τ + (whether or not p) + (UPDATE q)

After the percolation, i.e., the UPDATE on the entire macro-context, the temporary contexts are popped from the multi-stack. I now define MSpop, an operator which performs the pop operation (52) on each member of the multi-stack.

(64) **Definition:** MSpop (multi-stack pop)
For any multi-stack $\mathcal{T}$:
$\mathcal{T} + \text{MSpop} := \langle \tau^{(0)} + \text{pop}, ..., \tau^{(n)} + \text{pop} \rangle$.

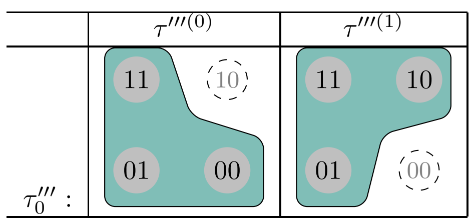


Figure 18: τ + (whether or not p) + (UPDATE q) +MSpop

Now, as discussed in Sections 2, in Rawlins' (2008, 2013) static analysis, the unconditional or independence meaning of unconditionals comes from universal quantification over the alternative conditional statements. In the current stack-based framework, the same effect is obtained from a merge operator defined in (65) on the basis of (66).

(65) **Definition:** merge operator
For a multi-stack $\langle \tau^{(0)}, \tau^{(1)} \rangle$:
$\langle \tau^{(0)}, \tau^{(1)} \rangle + \text{merge} := \tau^{(0)} \cap \tau^{(1)}$

(66) **Definition:** stack intersection
For any stacks τ, υ, $\tau \cap \upsilon$ is defined if $|\tau| = |\upsilon|$.
If defined, $\tau \cap \upsilon := \chi$ such that for all χ_i and $0 \leq i \leq |\tau|$,
$\chi_i := \tau_i \cap \upsilon_i = \{s | s \in \tau_i \wedge s \in \upsilon_i\}$

The merge operator collapses the sequence of macro-contexts into a single one as depicted in Figure 19.

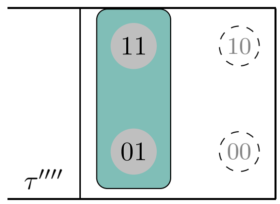


Figure 19: $\langle \tau'''^{(0)}, \tau'''^{(1)} \rangle$ + merge

As a result, we end up with the same information state as the case where the initial context simply updated with the simple declarative q, i.e., (67), since the UPDATE removes all the sets that contain w_{10} and w_{00} which make the sentence false.

(67) The party will be fun.

This is as desired. The unconditional *whether-or-not* p, q entails q, hence the consequent entailment.

4.2.2 Unconditional questions

Now, let us turn to the cases with question consequents. As we have seen in Section 4.1.3, the conditional question (68) creates non-overlapping, i.e., mutually exclusive, issues at the topmost active context created by the antecedent. If an answer is given, the information brought by the answer percolates down the stack and the temporary context is popped.

(68) If the party is at Emma's place, will it be fun?

In cases of questions with a *whether-or-not*-clause like (69), the *whether-or-not*-clause creates a sequence of stacks in the same fashion as depicted in Figure 16 for the assertion case.

(69) *Whether or not the party is at Emma's place, will it be fun?

The UPDATE of the consequent then operates over those contexts. Figure 20 illustrates the creation of temporary contexts and how the entire multi-stack is updated:

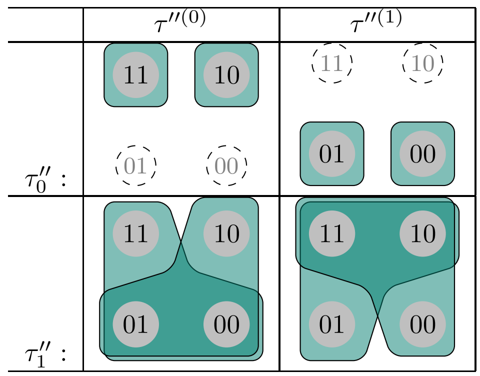


Figure 20: τ + (whether or not p) + $?q$

Now, let us go back to the main puzzle of the paper: An unconditional question (69) is anomalous for Group 1 speakers even with the independence assumption. In Sections 3 and 4.1.4, I argued that Group 1 speakers strictly observe mutual exclusivity of questions, thus they always reject unconditional questions. Section 4.1.3 presented a modified version of I&R's system which circumvents overlapping possibilities in the active context. The previous section augmented the system to calculate the meaning of unconditional statements. Thus, our next and final step is to show that we indeed end up having overlapping possibilities in calculating the meaning of an unconditional question.

We apply the merge operator (65) to the the multi-stack $\langle \tau''^{(0)}, \tau''^{(1)} \rangle$ in Figure 20 where each of the topmost contexts represents mutually exclusive issues. The application of merge, i.e., merge$(\tau''^{(0)}, \tau''^{(1)})$, would yield the stack on the left in Figure 21. Since each of the topmost members in Figure 20 is a block of a partition, the intersection of them is the empty set. Thus, the merged topmost member τ'''_0 is now an absurd context. τ'''_0 is not an inquisitive context, so it can be popped:

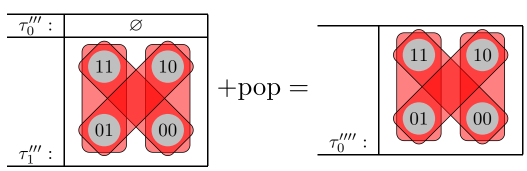


Figure 21: τ + (whether or not p) + $?q$ + merge + pop

The active topmost context of the resulting stack represents overlapping possibilities, which cannot be processed by Group 1 speakers. As already discussed in Section 3, Group 2 speakers, who can deal with overlapping possibilities, reject the active context in the final macro-context in Figure 21 since some of the possibilities (the diagonal blocks) represented in the active context are not possible answers, violating Hamblin-Issue 2. If a discourse context is such that the antecedent p and the consequent q are independent, the diagonal dependent possibilities are removed from the context, hence the meaning of the question becomes a set of unconditional answers. Thus, Group 2 speakers accept the unconditional question given the independence assumption.

5 Conclusion

5.1 Summary

We have observed that questions are more constrained than assertions and that English speakers can be divided into two groups. Group 1 strictly follows the Hamblin's picture and reject processing overlapping possibilities. Group 2 relaxes the constraint and only requires the meaning of a question to be possible answers. Group 1 always rejects unconditional questions because their semantics yield overlapping possibilities. Group 2 rejects unconditional questions without the independence assumption between the "antecedent" and "consequent" propositions because the semantics of an unconditional question ends up including impossible answers in its denotation.

In addition, the paper supports for the stack-based analysis of conditional statements and questions. Thanks to the stack-based system, Group 1 speakers can process conditional questions without dealing with overlapping possibilities in the topmost context. Furthermore, as already discussed by Isaacs & Rawlins (2008), the stepwise treatment of conditional questions is desirable in that it provides straightforward interpretations for particle answers: Intuitively, the *yes*-answer to 'If the party's at Emma's place, will it be fun?' can mean either 'Yes, it will' or 'Yes, if it's at her place, it'll be fun.' The stack-based system can readily identify the short answer as one of the blocks in the topmost active context.

5.2 Future directions

There are several future directions for research related to this analysis. First, it would be fruitful to investigate the Hamblin's picture cross-linguistically. In particular, the current paper treats English *if*-clauses as context-shifters, i.e., Austinian (1950) topics. When a language has overt topic-marking, do we observe a similar interaction with question acts? The answer is yes. Just like English *if*-sentences, the Japanese topic-marking *wa* serves to shift the context. For instance, the assertion of the non-*wa*-marked (70a) could be about a general situation in an airport, so the sentence is pragmatically implausible because it expresses a requirement that everyone at the airport has to be a dog-carrier. In contrast, the phrase *inu-wa* in (70b) restricts the context of the assertion to cases where there is a dog, so the sentence can reasonably be used in (for example) a sign in the airport.

(70) a. Inu-o kakae nakerebanaranai.
dog-ACC carry must
'You must carry a dog.'

b. Inu-wa kakae nakerebanaranai.
dog-TOP carry must
'As for dogs, you must carry them.'≈'If there is a dog, you must carry it.'

Wa-marked declaratives can be rendered into interrogatives without any problem as in (71).[18]

(71) a. Inu-wa kakae nakerebanarimasen-ka?
dog-TOP carry must.HON-Q
'If there is a dog, do I have to carry it?'
b. John-wa ki-masi-ta-ka?
John-TOP come-HON-PAST-Q
'As for John, did he come?'

But a familiar asymmetry obtains when another particle *dake* 'only' is added to the *wa*-marked noun phrase. Following Rooth (1995), *dake* can be analyzed as a focus particle which generates a Hamblin set of alternative propositions and denies the truth of the alternatives except for the asserted one:

(72) John-dake-ga kita.
John-only-TOP came
'Only John came.' (Others didn't come. ≈ {Mary didn't come, Bill didn't come,... })

When *dake* is used with *wa*, what is being denied is not alternative propositions but alternative assertion acts. That is, multiple contexts varying the value of the sentence topic are created, and by using *dake*, the speaker makes it explicit that among the alternative acts, the one with the prejacent topic is the only assertion that the speaker is willing to make. Thus, the whole construction seems to express exhaustification over possible assertion acts, as illustrated in (73).

(73) John-dake-wa ki-masi-ta.
John-only-TOP come-HON-PAST
'Only as for John, he came.' (I don't make assertions about other individuals; only>assertion)

As can be seen, an assertion with *dake-wa* involves the creation of multiple contexts and denial of the rest of the alternative acts. (74) shows that this complicated operation over speech acts is not available for questions:

(74) *John-dake-wa nani-o kai-masi-ta-ka?
John-only-TOP what-ACC buy-HON-PAST-Q

Although there is a difference between merging and denial of the alternative acts, the parallel between English unconditional adjuncts and Japanese *dake*-

[18]Honorific forms are added in order to make the examples pragmatically more natural.

wa constructions suggests that the Hamblin's picture is one of the universal principles of questionhood.

The treatment of commands is also an important outstanding issue within this approach to the dynamics of speech acts and clause types. A command can co-occur with unconditional adjuncts (75) and the *dake-wa* construction (76b).

(75) a. Whether the sign says it's OK or not, smoke outside!
b. Whenever you leave, remember to call me.
c. Whenever you have the time, come over and help us.

(76) a. Eigo-dake-o benkyo-siro!
English-only-ACC study-do.IMP
'Study only English!' (Don't study other subjects; command>only)
b. Eigo-dake-wa benkyo-siro!
English-only-CON study-do.IMP
'Study at least English!' (I don't make orders about other subjects; only>command)

Also, note that if the question is not an information-seeking one, it is possible to have an interrogative with an unconditional adjunct (77), and a question with wide-scope exhaustification as in (78). Here, the question is interpreted as a request for action (like an imperative) rather than a request for information.

(77) a. Whether the sign says it's OK or not, can you smoke outside, please?
b. Whenever you leave, can I ask you to turn off the lights?

(78) Denki-dake-wa keshi teoite-kure-masu-ka?
light-only-TOP off leave-BEN-HON-Q
'Could you make sure that at least lights are off?'
(I don't make other requests; only>request)

This data suggests that commands and requests should be treated as analogous to assertions. Future research on this topic will shed new light on the taxonomy of speech acts.

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