A unified existential semantics for bare conditionals[1]

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Abstract. Bare conditionals show an unexpected quantificational variability contingent on whether they are embedded in an Upward Entailing context (universal import) or a Downward Entailing context (existential import). Contra Herburger (2015a, b)'s ambiguity theory, we argue in favor of a unified semantics for bare conditionals based on their behavior in VP ellipsis constructions and in non-monotonic contexts. We show that a similar pattern exists with Free Choice phenomena, and consequently suggest a parallel analysis to Fox (2007)'s treatment of such phenomena. We propose that bare conditionals have a basic existential semantics which is obligatorily strengthened into a universal meaning in UE contexts, while being preserved in DE contexts. Our claim that bare conditionals are underlyingly existential is further supported by Conditional Perfection data with bare and non-bare conditionals.

Keywords: conditionals, homogeneity, exhaustivity, alternatives, conditional perfection, quantification, free choice

1. Higginbotham's puzzle and existing solutions

A bare conditional as in (1a) involves *universal* (or universal-like) generalization over cases (or worlds).[2] As first observed by Higginbotham (1986), this meaning is preserved when the conditional is embedded in the scope of *every*, as in (1b), but when embedded in the scope of *no* as in (1c) it seems as though the conditional contributes an *existential* force.[3] Having a universal meaning for the conditional in (1c), as in (1c-ii), will result in a too-weak meaning which is compatible with someone having a case where they goof off and succeed.

(1) a. If you work hard you succeed.
  $\approx$ In **all** cases where you work hard, you succeed.
 b. Everyone will succeed if they work hard.
  $\approx$ For every x, in **all** cases where x works hard, x succeeds.
 c. No one will succeed if they goof off.
  (i) $\approx$ There is no x s.t. **there is** a case where x goofs off and x succeeds.
  (ii) $\not\approx$ There is no x s.t. in **all** cases where x goofs off, x succeeds.

Higginbotham (1986) presents the paradigm in (1) as a problem for compositionality, and this surprising behavior has troubled semanticists ever since (see Kratzer 2015; Leslie 2008; Herburger 2015a, b, a.o.).

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[2] We limit ourselves here to conditionals that have some intensional import, and ignore quantified conditionals of the kind discussed in Kratzer (2015) which seem to only care about the actual world.

[3] Higginbotham's own description is in terms of material implication vs. conjunction, but the puzzle persists in a more standard framework where conditionals aren't truth-functional but involve quantification over worlds.

It has been argued by von Fintel and Iatridou (2002) (and more recently by Herburger 2015a) that the behavior of the embedded conditional in (1c) is not unique to conditionals in the scope of *no*, but extends to other Downward Entailing (DE) environments, for example when a bare conditional is embedded under *doubt*:

(2) I doubt that Mary will come if John comes.
  a. $\approx$ I doubt that **there is** a case where John comes and Mary comes.
  b. $\not\approx$ I doubt that in **all** cases where John comes Mary comes.

The generalization that emerges is that systematically, bare conditionals contribute universal quantification in UE environments and existential quantification in DE environments. To conclude, we are left with a puzzle, which we'll call Higginbotham's puzzle:

(3) **Higginbotham's puzzle**: How can bare conditionals contribute universal quantification in UE environments and existential quantification in DE environments compositionally?

Two main lines of compositional analyses with a unified semantics for conditionals have been proposed: (i) Analyses in which conditionals obey Conditional Excluded Middle (CEM) (Stalnaker 1968, von Fintel 1997, von Fintel and Iatridou 2002, Klinedinst 2011); (ii) proposals along the lines of the restrictor analysis of conditionals, according to which the quantificational force in question is supplied by a surrounding quantifier, with the *if*-clause serving as a domain restrictor (Leslie 2008; Kratzer 2015).

For reasons of space, we cannot discuss at length the advantages and shortcomings of those analyses.[4] Instead, our discussion in this paper will mainly relate to an alternative analysis which was recently advanced by Herburger (2015a, b). Herburger's solution to Higginbotham's puzzle is that conditionals are simply ambiguous:

(4) **Herburger's hypothesis**: Bare conditionals are lexically ambiguous.
  a. In UE environments they contribute universal quantification.
  b. In DE environments they contribute existential quantification.[5]

In this paper we argue against Herburger's ambiguity hypothesis and provide a novel unified semantics that deals with Higginbotham's puzzle. Our empirical motivation for rejecting the ambiguity hypothesis comes from the observation that bare conditionals don't behave like classical ambiguities in VP ellipsis constructions and in non-monotonic contexts (section 2). We adopt Herburger's idea (which is already entertained in von Fintel 1997) that existential bare conditionals exist, and contend that *only* they exist: bare conditionals are *existential across the board*. We present an analogy between bare conditionals and Free Choice disjunction in different contexts as a motivation for this assumption (section 3). To derive the universal im-

[4]See Leslie (2008); Herburger (2015a, b) for arguments against CEM analyses, and von Fintel and Iatridou (2002); Huitink (2010) for a problematization of the restrictor analysis. We hope to conduct a more thorough comparison between these approaches and ours in future work.

[5]One might wonder about the principle that governs the distribution of the two possible meanings as characterized in (4). Even though Herburger herself doesn't explicitly suggests this, it seems natural to think of the Strongest Meaning Hypothesis (Dalrymple et al. 1994) as a relevant principle. See also footnote 13.

port of bare conditionals in UE contexts from their basic existential meaning, we utilize the grammatical strengthening mechanism proposed by Fox (2007) for the analysis of Free Choice inferences, using exhaustification over sub-domain alternatives (as in Chierchia 2013) (section 4). We further show that Conditional Perfection data, which pose a difficulty for Herburger's ambiguity approach (as well as for standard universal semantics approaches), are naturally explained by our proposal, and that comparing Conditional Perfection in bare and non-bare conditionals provides another evidence for the existentiality of bare conditionals (section 5).

2. Shortcomings of an ambiguity theory

Herburger's hypothesis in (4) straightforwardly accounts for Higginbotham's puzzle. However, in this paper we argue that it cannot be maintained and that a unified analysis is called for. The basis on which we make this claim consists of the considerations in (5):

(5) a. Bare conditionals do not behave like ambiguities in ellipsis constructions where the antecedent and the elided material are in environments of different monotonicity.
b. When embedded in non monotonic contexts, bare conditionals give rise to a universal interpretation in the UE component of the meaning and an existential interpretation in the DE component of the meaning, which is an unexpected behavior for ambiguities.
c. To derive the phenomenon known as Conditional Perfection, an ambiguity approach is forced to assume that the meaning of a bare conditional is resolved universally in computing the assertion and existentially in computing its implicature.

In this section we elaborate on (5a) and (5b), deferring the discussion of (5c) to section 5. The common core of all of these arguments is that in cases where one occurrence of a bare conditional is involved in some way in both UE and DE parts of the interpretation, the meaning it contributes splits: universality for the UE part, and existentiality for the DE part. This is not the way ambiguities usually behave, and an ambiguity analysis clearly misses a generalization here. This pattern is above all reminiscent of Higginbotham's (1986) characterization of *if*'s behavior as "chameleon-like".

Let us discuss (5a) first. A familiar test for ambiguity is ellipsis: when an ambiguous phrase is elided, the ambiguity is resolved uniformly in the antecedent VP and the elided VP (Sag 1976; Heim 1996). However, bare conditionals fail this test: when bare conditionals are elided and the antecedent VP and the elided VP are in contexts with different monotonicity (namely when one of them is in a UE context and the other in a DE context), as in (6), they give rise to different quantificational forces. The conditional in the antecedent VP, which is in a UE context, is interpreted universally (6a), while the elided one, which is in a DE context, existentially (6b).

(6) Every boy calls his mother if he gets an A, and no girl does. ≈
a. For every boy x, in **all** cases where x gets an A, x calls x's mother, and
b. there is no girl x s.t. **there is** a case where x gets an A and x calls x's mother.

An ambiguity analysis would predict either a universal meaning for both VPs, or an existential meaning for both. However, none of these meaning is in fact attested, while the attested meaning is not predicted.

Turning to (5b), when a bare conditional is embedded in a non-monotonic context as in (7), the salient reading is one where the conditional seems to contribute a universal meaning for the UE component of the meaning and an existential meaning for the DE component.

(7) Exactly two students call their mother if they get an A. ≈
   a. **UE component**: There are two students x, s.t. in **all** cases where x gets an A, x calls x's mother.
   b. **DE component**: There are no more than two students x s.t. **there is** a case where x gets an A and x calls x's mother.

Here too, an ambiguity analysis would presumably predict either a universal meaning for both components or an existential meaning for both, but not the attested reading where each component draws a different quantificational force from the bare conditional.

This is the puzzling situation in which we find ourselves now: In UE contexts bare conditionals behave like universal quantifiers, and in DE contexts they behave like existential quantifiers. An ambiguity analysis then seems appealing, but their behavior in VP ellipsis constructions and in non-monotonic contexts suggests that it is not on the right track.[6] A more promising direction is to assume one basic meaning and derive the other one from it. But which one should we choose as the basic meaning, the universal or the existential one, and how to derive the one from the other?

It might seem intuitive to choose the universal meaning as the starting point. However, we see no empirical or theoretical reason to assume that the basic semantics of bare conditionals surfaces in UE contexts rather than DE contexts. Our proposal will in fact follow the less intuitive strategy, and take the weak existential meaning to be the basic one. To prepare the ground, in the next section we provide a preliminary reason for this choice, based on the similar behavior of bare conditionals and Free Choice disjunction which is standardly assumed to involve a basic weak semantics. In section 5.4 we provide evidence supporting an existential semantics from comparing Conditional Perfection with bare and non-bare conditionals.

3. Towards a unified account: Analogy with Free Choice disjunction

Embedding the disjunctive marker *or* under an existential modal gives a stronger-than-expected conjunctive inference. This phenomenon is known as Free Choice (FC) and is illustrated in (8a). Since at least Kratzer and Shimoyama (2002), it has been argued that the FC inference of

[6] Note, however, that to account for (6) and (7) one can salvage the ambiguity analysis with a more involved story such as the supervaluationist one suggested in Spector (2013) for homogeneity in definite plurals. Very roughly, the idea would be that for a sentence containing a bare conditional to be super-true, it should be true under both possible meanings. Even though we have no argument to show against this kind of analysis, our proposal in section 4 avoids assuming an unwarranted ambiguity, and instead utilizes mechanisms that are independently argued for. We leave a thorough comparison between the two approaches to further research.

(8a) has the status of a scalar implicature, since it tends to disappear under DE operators, (8c):

(8) a. John is allowed to eat ice-cream or cake $\Diamond(A \vee B)$
≈ John is both allowed to eat ice-cream **and** allowed to eat cake $\Diamond A \wedge \Diamond B$
b. Everyone is allowed to eat ice-cream or cake $\forall x[\Diamond(A(x) \vee B(x))]$
≈ Everyone is both allowed ice-cream **and** allowed cake $\forall x[\Diamond A(x) \wedge \Diamond B(x)]$
c. No one is allowed to eat ice-cream or cake $\neg\exists x[\Diamond(A(x) \vee B(x))]$
≉ No one is both allowed ice-cream **and** allowed cake $\neg\exists x[\Diamond A(x) \wedge \Diamond B(x)]$

The pattern in (8) parallels the data from bare conditionals in (1). In both, a universal/conjunctive meaning appears in UE contexts and disappears in DE contexts. Moreover, consider the ellipsis example in (9) and the non-monotonic example in (10) in comparison to (6) and (7).

(9) Every boy is allowed to eat ice cream or cake, and no girl is. ≈
a. For every boy x, x is both allowed to eat ice cream **and** allowed to eat cake, and
b. there is no girl x s.t. x is allowed to eat ice cream **or** cake.

(10) Exactly two children are allowed to eat ice cream or cake. ≈
a. **UE component**: There are two children x, s.t. x is both allowed to eat ice cream **and** allowed to eat cake.
b. **DE component**: There are no more than two children x s.t. x is allowed to eat ice cream **or** cake.

In both FC and bare conditionals, then, whenever one occurrence is involved in providing meaning to both UE and DE components of the meaning, we get a conjunctive/universal meaning for the UE component and a disjunctive/existential meaning for the DE component. This similarity points towards a unified treatment of both phenomena. We follow Fox (2007) and others in assuming that FC disjunction involves the regular weak semantics of disjunction, and consequently assume a weak existential semantics for bare conditionals in analogy to it (for a more direct motivation see section 5.4). In the next section we propose an account of the quantificational split in bare conditionals using the same mechanism that derives FC inferences in Fox (2007), namely grammatical strengthening via recursive exhaustification. For reasons of space, we cannot spell out a full derivation of FC, rather we refer the reader to Fox (2007) for details and move on to present our analysis of bare conditionals.[7]

4. Proposal

4.1. The plot

We propose that bare conditionals not only *can* have existential semantics as Herburger (2015a) has it, but rather this is the *only* semantics they have. The universal interpretation of bare conditionals in UE contexts is arrived at by grammatical strengthening, via recursive exhaustification over alternatives. Our answer to Higginbotham's puzzle is summarized in (11).

[7] Embedded FC data as in (8b) (and also (9) and (10)) don't follow from Fox's analysis without additional assumptions (see, e.g., Chemla 2009). We will return to this issue later (see footnote 15).

(11) **Proposal in a nutshell**:
   a. Bare conditionals are underlyingly existential across the board.
   b. In UE contexts they undergo grammatical strengthening and become universal.
   c. In DE contexts their basic existential meaning is preserved.

In section 4.2 we lay out the details of the proposal. We do so in steps: we first introduce our assumptions about the core existential meaning of a bare conditional and the alternatives it triggers. Then we proceed to show how, with the help of recursive exhaustification, we can get from the basic existential meaning to the stronger universal meaning in UE environments, while preserving the basic existential meaning in DE environments. In section 4.3 we show how the analysis deals with the challenges from section 2. In section 4.4 we discuss the structure of alternatives we're assuming and its implications on the difference between bare and non-bare conditionals.

4.2. A unified existential semantics

We assume a semantics in which bare conditionals quantify existentially over antecedent worlds, restricted by a domain of quantification D_s. As can be seen in (12), we assume that D_s is syntactically realized and serves to restrict the domain of quantification for *if*:[8]

(12) $[\![If_{D_s}\ p,\ q]\!] = 1\ \mathit{iff}\ \exists w \in [\![p]\!] \cap D_s [\,[\![q]\!](w) = 1\,]$

(12) straightforwardly accounts for the cases where existential quantification was needed, such as (2). To derive the universal meaning in UE contexts, we hypothesize that bare conditionals trigger Sub-Domain Alternatives (SDAs) of the conditional, in the spirit of Chierchia (2013)'s analysis of Polarity Sensitive Items (see also Bar-Lev and Margulis 2014).

(13) **Hypothesis**: if_{D_s} gives rise to Sub-Domain Alternatives (SDAs).

The SDAs we assume are derived by replacing the original domain variable D_s with its subsets:

(14) **Sub-Domain Alternatives:** $Alt(if_{D_s}\ p,\ q) \supseteq \{if_{D'_s}\ p,\ q \mid D'_s \subseteq D_s\}$

By way of illustration, take (1a) (repeated in (15)) as an example and assume a toy model with a set $\{h_1,h_2\}$ of two working hard worlds, in (16a), and a set $\{nh_1,nh_2\}$ of two non-working hard worlds, in (16b). Then the basic meaning of (15) is in (17a), and its domain alternatives, generated by replacing the D_s with its subsets (as prescribed by (14)), are in (17b):

(15) If you work hard you succeed. [=(1a)]

(16) $D_s = \{h_1, h_2, nh_1, nh_2\}$

[8] We will have nothing to say here about how the domain of quantification D_s is determined. We also don't commit to what exactly is quantified over: it could be worlds, situations, events, etc. For concreteness we stick to worlds throughout our discussion.

a. $[\![\textit{You work hard}]\!] = \{h_1, h_2\}$
b. $[\![\textit{You don't work hard}]\!] = \{nh_1, nh_2\}$

(17) a. **Basic meaning of (15)**
$\exists w \in [\![\textit{You work hard}]\!] \cap D_s[\text{you succeed in } w]$
$= \exists w \in \{h_1, h_2\}[\text{you succeed in } w]$
$=$ You succeed in h_1 $\vee$ You succeed in h_2 (*in short:* $\mathbf{a} \vee \mathbf{b}$)
b. **Sub-Domain Alternatives of (15)**
$\left\{\text{if}_{D'_s} \text{ you work hard you succeed} \,\middle|\, D'_s \subseteq \{h_1, h_2, nh_1, nh_2\}\right\}$

Looking at the denotations of the elements in (17b), we can translate (17b) to (18).[9] Note that the relationship between the basic meaning (17a) and the SDAs (18b-c) can be rendered in terms of the relationship between a disjunction and its disjuncts. For this reason, we shorten the former to $\mathbf{a} \vee \mathbf{b}$ and the latter to **a** and **b**.

(18) **Sub-Domain Alternatives of (15)**
a. $\exists w \in \{h_1, h_2\}[\text{you succeed in } w]$ (= (17a))[10] $\mathbf{a} \vee \mathbf{b}$
b. $\exists w \in \{h_1\}[\text{you succeed in } w]$ = You succeed in h_1 **a**
c. $\exists w \in \{h_2\}[\text{you succeed in } w]$ = You succeed in h_2 **b**

The domain alternatives have to be used up by an alternative sensitive operator, i.e., they are *obligatorily exhaustified* (as in Chierchia 2013).[11] Following Fox (2007), we assume a covert EXH operator as defined in (19). EXH takes the prejacent and a set of alternatives and returns the prejacent conjoined with the negation of all INNOCENTLY EXCLUDABLE (IE) alternatives. Informally, the restriction to IE alternatives amounts to the requirement that exclusion of alternatives does not contradict the prejacent and that the choice of alternatives to exclude is not arbitrary.

(19) $[\![\text{EXH}]\!](Alt(p))(p)(w) \Leftrightarrow p(w) \wedge \forall q \in \text{IE}(p, Alt(p))[\neg q(w)]$
(Where $Alt(p)$ is the set of alternatives of the prejacent p)

(20) $\text{IE}(p, Alt(p)) = \bigcap\{Alt(p)' \subseteq Alt(p) : Alt(p)'$ is a maximal set in $Alt(p)$, s.t.
$\{\neg q : q \in Alt(p)'\} \cup \{p\}$ is consistent$\}$

The parse we propose for bare conditionals that yields universal interpretation contains two EXH operators:

[9] Here and throughout we neglect SDAs in which the sub-domain D'_s is such that $[\![p]\!] \cap D'_s = \varnothing$. These alternatives are not represented because they are contradictory, and therefore don't affect the alternative computation mechanism (to be discussed shortly).

[10] This is technically a SDA because by definition, the prejacent is a SDA of itself. But when talking about SDAs, we will sometime mean only "proper" sub-DAs, i.e. excluding the prejacent.

[11] It is crucial that exhaustification here would be obligatory and that the SDAs cannot be ignored ('pruned'), since otherwise we would wrongly predict that the universality of bare conditionals could be cancelled:
(i) #If you work hard you succeed, and if you work hard you might fail.
We leave open the important issue of how to motivate and implement this obligatoriness, and refer the reader to the discussion in Chierchia (2013). See also footnote 23.

(21) $\text{EXH}_{C'}$ [$_\alpha$ EXH_C [if$_{D_s}$ you work hard you succeed]]

(Where C in EXH_C [ϕ] is the set of alternatives of ϕ, namely $Alt(\phi)$)

The semantic computation of (21) is given in (22), using the toy model and the abbreviations introduced above. The final step of (22) reveals that the basic existential meaning of the conditional was strengthened via double exhaustification to a universal meaning.

(22)
a. $[\![\textit{If}_{D_s} \textit{ you work hard you succeed}]\!] = 1$ *iff* $\exists w \in \{h_1, h_2\}[\text{You succeed in } w] =$ You succeed in $h_1 \vee$ You succeed in h_2 $= \mathbf{a} \vee \mathbf{b}$ (cf. (17a))
b. $C = Alt(\mathbf{a} \vee \mathbf{b}) = \{\mathbf{a} \vee \mathbf{b}, \mathbf{a}, \mathbf{b}\}$ (cf. (18))
c. $[\![\alpha]\!] = \text{EXH}_C[\mathbf{a} \vee \mathbf{b}] = \mathbf{a} \vee \mathbf{b}$ (EXH is vacuous because the SDAs are not IE)
d. $C' = Alt(\text{EXH}_C[\mathbf{a} \vee \mathbf{b}])$
$= \{\text{EXH}_C[\mathbf{a} \vee \mathbf{b}], \quad \text{EXH}_C[\mathbf{a}], \quad \text{EXH}_C[\mathbf{b}]\}$
$= \{\mathbf{a} \vee \mathbf{b}, \quad \mathbf{a} \wedge \neg \mathbf{b}, \quad \mathbf{b} \wedge \neg \mathbf{a}\}$
e. $[\![\textit{(21)}]\!] = \text{EXH}_{C'}[\text{EXH}_C[\mathbf{a} \vee \mathbf{b}]] = (\mathbf{a} \vee \mathbf{b}) \wedge \neg(\mathbf{a} \wedge \neg \mathbf{b}) \wedge \neg(\mathbf{b} \wedge \neg \mathbf{a})$
(All the alternatives in C' except $\mathbf{a} \vee \mathbf{b}$ are IE)
$= (\mathbf{a} \vee \mathbf{b}) \wedge (\mathbf{a} \leftrightarrow \mathbf{b}) = \mathbf{a} \wedge \mathbf{b}$
f. $= \forall w \in \{h_1, h_2\}[\text{you succeed in } w]$[12]

Let us go through the steps in (22). Applying EXH once with respect to the set of alternatives in (22b) is in (22c), which corresponds to the phrase we named ”α” in (21). Since no alternative is Innocently Excludable (cf. (20)), the result equals to the input—the prejacent. However, the set of alternatives of α is different from the one in (22b); this set is provided in (22d). The set in (22d) turns out to contain the original sentence ($\mathbf{a} \vee \mathbf{b}$), and in addition, ‘only **a**’ ($\mathbf{a} \wedge \neg \mathbf{b}$), and ‘only **b**’ ($\mathbf{b} \wedge \neg \mathbf{a}$). Finally, applying EXH for the second time, this time with respect to the set in (22d), yields (22e). The derived meaning is, roughly, **a** *or* **b***, and not only* **a***, and not only* **b**, which is equivalent to $\mathbf{a} \wedge \mathbf{b}$. We have started with a disjunctive assertion, equivalent to an existential one, and ended up with a conjunctive meaning, that is—a universal one, (22f). The derivation straightforwardly extends to models with more than two antecedent worlds.

Importantly, the strengthening mechanism does not make the wrong predictions for the DE cases that initially motivated the existential semantics assumption, as in (1c) and (2). DE environments flip entailment relations, so that the prejacent entails (rather than entailed by) all the domain alternatives, see (23c). Therefore Applying matrix EXH (any number of times) would not contribute anything to the semantics, cf. (23d). Thus, no strengthening from existential to universal applies when the bare conditional is embedded in a DE environment.[13]

[12] In (22f) and throughout the paper, we omit the prejacent's contribution, namely $\exists w \in \{h_1, h_2\}$[you succeed in w], whenever we provide a strengthened meaning for it. This is harmless, since we assume as is standard that quantification triggers a non-vacuity presupposition. Furthermore, given this presupposition, the antecedent of a conditional becomes a Strawson-DE environment after the application of recursive EXH. This makes our analysis in line with the generalization that NPIs are licensed in the antecedent of a conditional, if the mechanism responsible for NPI licensing applies above the exhaustivity operators.

[13] One might wonder what blocks recursive EXH to appear in an embedded position under the DE operator, which would give us the $\neg\forall$ meaning we claim is absent. On our analysis, this question reduces to the issue of *embedded implicatures* in DE environments (Fox and Spector 2013, Chierchia 2013 a.o.), which are known to arise only in special, non-neutral contexts, and require a specific intonation.

(i) a. He didn't talk to Mary or Sue. # He talked to both

(23) a. No one will succeed if they goof off [=(1c)]

b. $[\![$*no one will succeed if$_{D_s}$ they goof off*$]\!]$
$\Leftrightarrow \neg\exists x[\exists w \in [\![\textit{goof off}]\!](x) \cap D_s[x \text{ succeeds in } w]]$

c. (23b) $\Rightarrow \forall D'_s \subseteq D_s[\neg\exists x[\exists w \in [\![\textit{goof off}]\!](x) \cap D'_s[x \text{ succeeds in } w]]]$
(All domain alternatives of (23b) are entailed by (23b))

d. $[\![$*no one will succeed if$_{D_s}$ they goof off*$]\!]$
$\Leftrightarrow [\![$(EXH) EXH *no one will succeed if$_{D_s}$ they goof off*$]\!]$
$\Leftrightarrow \neg\exists x[\exists w \in [\![\textit{goof off}]\!](x) \cap D_s[x \text{ succeeds in } w]]$
(Any matrix EXH attached to (23b) is vacuous)

What about cases where the bare conditional is in the scope of a universal quantifier, such as (24a)? To derive the right result for these, we must assume that the recursive EXH is embedded under the universal quantifier, (24b). The resulting semantics is in (24c), which is essentially just the embedding of (21) under *everyone*.[14]

(24) a. Everyone will succeed if they work hard [=(1b)]

b. Everyone λx [EXH [EXH [x will succeed if$_{D_s}$ x works hard]]].

c. $[\![$*(24b)*$]\!] \Leftrightarrow \forall x[\forall w \in [\![\textit{work hard}]\!](x) \cap D_s[x \text{ succeeds in } w]]$

For now the assumption of local exhaustification under *every* is admittedly a stipulation.[15] However, the same stipulation is needed to account for Free Choice disjunction embedded under universal quantification as in (8b), given Fox (2007)'s analysis (see Chemla 2009; Singh et al. 2016).

4.3. VP ellipsis resolution and non-monotonic contexts

We saw in section 2 that a lexical ambiguity theory along the lines of Herburger (2015b) runs into problems in the face of the behavior of conditionals in VP ellipsis constructions and in non-monotonic contexts. Regarding the VP-ellipsis data, recall that the problem was how to predict that in a case like (25) the conditional in the antecedent contributes universal semantics, and the one in the ellided VP existential semantics. On our proposal, the LF of (25) is in (26).

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b. He didn't talk to Mary OR Sue. He talked to both.

The general dispreference of embedded implicatures is taken by many to result from a violable (pragmatic) principle that prohibits implicatures from weakening the global meaning of the sentence. We thus take such a principle to be responsible for the general inavailabililty of $\neg\forall$ intepretations of negated bare conditionals.

Herburger (2015a) argues that universal bare conditionals in DE contexts do exist, based on examples such as (ii).

(ii) a. It is not true that if a fair coin is flipped it will come up heads.

b. If a fair coin is flipped it will NOT come up heads.

We take the fact that such readings, if exist, are only available with what is arguably "meta-linguistic negation" as in (iia) or special intonation as in (iib) to parallel the facts in (i) and thus to be in line with our approach.

[14] And here too, just like in (21), we ignore the SDAs that yield contradictory propositions, see footnote 9. That is, for each individual x quantified over by *everyone*, the SDAs that end up being entailed by the recursive EXH in (24b) are only those for which $D'_s \cap [\![p]\!](x) \neq \varnothing$.

[15] This stipulation can be dispensed with if we use the exhaustification mechanism proposed by Bar-Lev and Fox (in prep.), who provide an analysis of the embedded Free Choice inference of (8b) that doesn't rely on embedded exhaustification, and instead uses only matrix EXH. In this paper we preferred to use the more familiar mechanism of recursive exhaustification from Fox (2007) over Bar-Lev and Fox's solely due to the unfamiliarity of the latter.

(25) Every boy calls his mother if he gets an A, and no girl does. ≈ [=(6)]

a. For every boy x, in **all** cases where x gets an A, x calls x's mother, and

b. there is no girl x s.t. **there is** a case where x gets an A and x calls x's mother.

(26) Every boy λx EXH EXH [$_{\text{VP}}$ x calls x's mother if$_{D_s}$ x gets A], and
(EXH) no girl does λx ~~[$_{\text{VP}}$ x calls x's mother if$_{D_s}$ x gets A]~~.

(26) produces the desired quantificational split between the antecedent and the elided VP, and at the same time both are LF-identical.[16] The crucial assumption is that the EXH operators can be outside the VPs, which allows the two VPs to be semantically identical even though we ultimately derive a different quantificational force for each bare conditional. This is similar to the way that generally EXH operates in VP ellipsis constructions. For example, in (27a) the antecedent VP contains *some* which is intuitively interpreted exhaustively as *some but not all*, while in the elided VP *some* is interpreted non-exhaustively under negation (see Fox 2004 for a similar data point, attributed to Tamina Stephenson, p.c.). This is explained if the representation of (27a) is (27b).

(27) a. John solved some of the problems and Mary didn't.

b. EXH John [$_{\text{VP}}$ solved some of the problems], and
(EXH) Mary didn't ~~[$_{\text{VP}}$ solve some of the problems]~~.

The proper analysis of the non-monotonic example in (7) within our framework requires some elaboration which for space limitations we cannot provide here. However, given the close analogy between (7) and the FC disjunction example (10) discussed in section 3, and given that we proposed that FC disjunction and bare conditionals share an underlying mechanism, the facts in (7) will fall out from an exhaustification-based analysis of (10). Under an ambiguity theory, on the other hand, it is not clear how the facts in (7) can be explained, given the way ambiguities usually behave.

4.4. The structure of alternatives in bare vs. non-bare conditionals

For the derivation of universality in (22) to be successful, it was crucial that the bare conditional didn't have a universal alternative (which amounts to $\mathbf{a} \wedge \mathbf{b}$ in our toy model above), as schematized in (28). Had it been present, EXH would have negated it, and we would have achieved the opposite of what our goal is.

[16] We are aware that the representation in (26) is problematic in light of established constraints on binding in parallelism contexts. Specifically, (26) does not respect the standard requirement that the binder of any elided bound variable be inside the parallelism domain for ellipsis (e.g. Heim 1996; Hartman 2011. See Crnič 2015 for arguments showing that EXH enters into parallelism considerations). We aim to avoid this obstacle in future work by using a mechanism that can derive universal Free Choice globally and assuming the representation in (i) (see footnote 15).

(i) [EXH Every boy [$_{\text{VP}}$ λx x calls x's mother if$_{D_s}$ x gets A], and
(EXH) no girl does ~~[$_{\text{VP}}$ λx x calls x's mother if$_{D_s}$ x gets A]~~]

We thank Luka Crnič for bringing up this issue.

(28) $\quad Alt((1a)) = Alt(\mathbf{a}\vee\mathbf{b}) = \{\mathbf{a}\vee\mathbf{b},\mathbf{a},\mathbf{b}\ \cancel{,\mathbf{a}\wedge\mathbf{b}}\}.$ (cf. (22b))

We justify the assumption that bare conditionals don't have the universal meaning as an alternative by the fact they don't seem to have a lexical scalar alternative at all. In this we follow other analyses that make use of the lack of a strong alternative for strengthening a weak element. See a.o. Meyer (2016); Bar-Lev and Margulis (2014); Bowler (2014); Singh et al. (2016); Oikonomou (2016). Moreover, potential stronger alternatives like *if p, must q* would involve adding lexical material to the prejacent, an operation which is ruled out by structural (complexity-based) approaches to alternatives, see Katzir (2007); Fox and Katzir (2011).

This perspective has interesting consequences when we consider *non*-bare conditionals (i.e., conditionals with an overt quantificational element, exemplified in (29)): it allows us to capture the semantic difference between bare and non-bare conditionals solely based on the kinds of alternatives they generate. We assume along with the Kratzerian tradition (Kratzer 1986) that the quantification in non-bare conditionals is contributed by the overt quantifier (and there is no additional layer of quantification).

(29) a. If you work hard you **sometimes** succeed.
b. If you work hard you **always** succeed.

Of course, (29a) is not interpreted universally like (29b), and moreover it gives rise to the inference that (29b) is false. We capture this by the fact that crucially, and differently from bare conditionals, the overt quantifier in a non-bare conditional can be replaced with a stronger/weaker quantifier without making the structure more complex. Namely, (29a) has (29b) as an alternative. Given our toy model from above, this feature of non-bare conditionals amounts to admitting $\mathbf{a}\wedge\mathbf{b}$ into the set of alternatives of (29a), in contrast to bare conditionals:

(30) $\quad Alt((29a)) = Alt(\underbrace{\mathbf{a}\vee\mathbf{b}}_{(29a)}) = \{\mathbf{a}\vee\mathbf{b},\mathbf{a},\mathbf{b},\underbrace{\mathbf{a}\wedge\mathbf{b}}_{(29b)}\}$

Thus, only bare conditionals undergo strengthening into a universal meaning, due to the absence of a universal alternative; non-bare existential conditionals cannot undergo such strengthening, since they generate a universal alternative which blocks this derivation. We return to non-bare conditionals in the context of Conditional Perfection in section 5.4.

5. *Only if* and Conditional Perfection

In section 2 we presented data from VP ellipsis (6) and non-monotonic contexts (7) showing that when one occurrence of a bare conditional is involved in some way in both UE and DE contexts, the meaning it contributes splits: universality for the UE context, and existentiality for the DE context. In this section we provide one more piece of evidence showing the same behavior, from Conditional Perfection. Furthermore, we argue that Conditional Perfection data provides additional support to the conjecture that bare conditionals are underlyingly existential. Before we get to that, however, we have to take a small detour and discuss the analysis of *only if* sentences.

5.1. *Only if*

Only if sentences as in (31) have been argued to show another instance of a bare conditional interpreted existentially (see von Fintel 1997; Herburger 2015a). Since *only* is standardly assumed to presuppose its prejacent and assert the negation of its alternatives, the prejacent is in a Strawson-DE environment (von Fintel 1999). The existential interpretation is then expected given the generalization stated in section 1 upon which Higginbotham's puzzle is based.

(31) Only if you work hard you succeed.

What are the compositional details of (31) that produce the correct result? Since *only* takes a prejacent and a set of alternatives, we have to decide what alternatives are in this set. For simplicity, let us follow von Fintel (1997)'s assumption, according to which the alternative that's negated by *only* in a sentence of the form *only if p, q* is *if not-p, q*.[17] In our case, the relevant alternative for the prejacent of *only* in (31) would be *If you don't work hard you succeed*. The interpretation of (31) can then be paraphrased as in (32). The important observation here is that to get the right result for the assertive component, the alternative conditional that *only* negates cannot contribute a universal meaning, but must contribute an existential meaning; otherwise we would only derive the too-weak meaning in (32b-ii), which is compatible with there being cases where you don't work hard and succeed.

(32) Only if you work hard you succeed. [=(31)]
- a. **Presupposition**: If you work hard you succeed. (See fn. 18)
- b. **Assertion**: $\neg$ if you don't work hard you succeed.
  - (i) $\approx \neg$ **there is** a case where you don't work hard and you succeed.
  - (ii) $\not\approx \neg$ in **all** cases where you don't work hard you succeed.

Herburger shows that the case of *only if* is predicted by the ambiguity analysis: since *only* creates a Strawson-DE environment, the prejacent *if p, q* is interpreted existentially. According to her, this correctly captures the presupposition triggered by *only if* sentences.[18] Crucially, since the prejacent *if p, q* is existential, the alternative *if not-p, q* which is derived from it is

[17] Instead of having *if not p, q* as the alternative, a more plausible assumption from the perspective of the theory of alternative formation (Katzir 2007) is that we have a set of alternatives of the form *if r, q*, where *r* is a relevant alternative to *p*. The two options ultimately boil down to the same thing (for reasons we can't go over here), so for ease of exposition we work with the single alternative *if not-p, q*. We thank Andreas Haida for pointing this out.

[18] Our main focus here is capturing the assertive component of *only if*, and we take no stance on whether the presupposed prejacent of *only* should indeed be existential. Herburger argues that it should be existential based on contrasts like (i). Famously, whereas (ia) is non-contradictory, (ib) is not (von Fintel 1997):

(i) a. Only if you work hard do you succeed, and even if you work hard you might fail.
  b. #If you work hard you succeed, and even if you work hard you might fail.

However, we do not know whether this is a strong argument in favor of the existentiality of the prejacent, since *only* independently gives rise to presuppositions that are weaker than its prejacent, as the felicity of (ii) shows:

(ii) Only John_F can speak French, and maybe not even he can. (Ippolito 2008: ex. 37)

Furthermore, in some environments *only* does seem to presuppose its prejacent (for ill-understood reasons), e.g., under negation (as can be seen in (iiia)). And accordingly, when embedding *only if p, q* under negation, it is also much harder to cancel the universal inference that *if p, q*. Compare (ia) with (iiib):

(iii) a. #Not only John_F can speak French, and maybe he can't. (Ippolito 2008: ex. 38)
  b. #Not only if you work hard do you succeed, and if you work hard you might fail.

interpreted existentially as well.

Note, however, that for Herburger the existentiality of the alternatives only follows from the assumption that the prejacent is existential. This point will be crucial in the following discussion of Conditional Perfection inferences, where the prejacent is unarguably interpreted universally, but the alternatives are still interpreted existentially.

5.2. Conditional Perfection (CoP)

When an *if p, q* sentence is uttered, we often understand it as the 'perfected' conditional *if and only if p, q*. For example, utterance of *if you work hard you succeed* (=(1a)) "invites the inference" (as Geis and Zwicky 1971 put it) that *only if you work hard you succeed* (=(31)). The Conditional Perfection (CoP) inference is cancellable, (33a), and it disappears under negation, (33b). Therefore, it is widely accepted that CoP should be analyzed as an implicature (Geis and Zwicky 1971; von Fintel 2001, a.o.).

(33) a. If you work hard you succeed, and you might succeed even if you don't.
b. No one will succeed if they goof off. [=(1c)]
$\not\approx$ No one will succeed if *and only if* they goof off

The existence of CoP raises a theoretical difficulty for previous analyses of conditionals, given standard theories of implicature calculation. The challenge, as can be seen by the descriptive characterization of CoP in (34), is to derive an existential meaning at the level of the implicature, while retaining universality for the assertion. One can already see that the issue here is very similar to what we have seen with ellipsis and non-monotonic contexts in section 2: in all three cases, from one occurrence of a bare conditional we want to derive different quantificational forces for different ingredients of the overall meaning.

(34) If you work hard you succeed. [=(1a)]
a. **Assertion**: In **all** cases where you work hard, you succeed.
b. **Implicature**: $\neg$ **there is** a case where you don't work hard and you succeed.

To appreciate the problem, assume (i) that the prejacent *if p, q* triggers the alternative *if not p, q*, (ii) that this alternative is derived from *if p, q* by replacing *p* with *not p*, and (iii) that this alternative is (optionally) negated, supposedly giving us the inference *only if p, q*. Hence: If the prejacent *if p, q* has universal meaning, then *if not p, q* also has universal meaning. Namely, we should expect the implicature to be the negation of a universal meaning, contrary to fact.

For these considerations, we do not rely on the presupposition of (31) to determine the quantificational force of a bare conditional under *only*. The relation between this kind of data and FC disjunction embedded under *only* (see Alxatib 2014) calls for further investigation given our view. We thank Danny Fox and Sam Alxatib for very helpful discussions on this issue.

It is not straightforward to achieve the right results for CoP in analyses that posit a uniform universal semantics for bare conditionals.[19] Even under an ambiguity analysis, it is not clear why the alternative *if not p, q* is interpreted existentially: Unlike the case of *only if* sentences, in CoP the prejacent is definitely not interpreted existentially, but rather universally as can be seen in (34a). The alternative *if not p, q*, which is generated on the basis of the prejacent, is then also expected to be interpreted universally, contrary to fact.[20]

5.3. Deriving Conditional Perfection

The assumption that bare conditionals are existential provides a simple account of CoP. We assume that *if not p, q* is an additional (and optional) alternative to *if p, q* (but see footnote 17). Namely, (34) has the alternative in (35). Being a bare conditional, its basic meaning is existential, (35a). Negating this meaning would then yield the desired CoP inference in (34b).

(35) If you don't work hard you succeed.

a. $[\![\textit{If}_{D_s} \textit{ you don't work hard you succeed}]\!] = 1$ *iff*
$\exists w \in [\![\textit{You don't work hard}]\!] \cap D_s[\text{you succeed in } w]$

Let us show the derivation in some more detail, illustrating with our toy model from (16) in which $[\![\textit{You work hard}]\!] = \{h_1, h_2\}$ and $[\![\textit{You don't work hard}]\!] = \{nh_1, nh_2\}$. The alternatives we generate for (34) when we add (35) are listed in (36). (36a) repeats from (18) the by-now familiar SDAs of (34). (36b) is the meaning of the new alternative (35) given our toy model. This alternative is logically independent from the prejacent in (36a-i) and the other SDAs in (36a-ii,iii), since its domain of quantification is disjoint from theirs, and we can thus name it **c**. The resulting set of alternatives, which we call C^+, is in (36c).

(36) a. **Sub-Domain Alternatives of (34)** (see (18))

(i) $\exists w \in \{h_1, h_2\}[\text{you succeed in } w]$ (= (17a)) $\quad \mathbf{a} \vee \mathbf{b}$

(ii) $\exists w \in \{h_1\}[\text{you succeed in } w]$ = You succeed in h_1 $\quad \mathbf{a}$

(iii) $\exists w \in \{h_2\}[\text{you succeed in } w]$ = You succeed in h_2 $\quad \mathbf{b}$

[19] See for instance von Fintel (2001)'s analysis, in which CoP is derived when *if p, q* has alternatives of the form *if r, q* where *r* denotes any proposition, and importantly propositions that pick out a singleton set of worlds. This essentially reduces universal quantification into existential one. On the cost of such reduction see footnote 22.

[20] Herburger (2015b) adopts a non-standard way of implicature calculation to get the right result within her ambiguity approach. For her, an implicature for a sentence *S* is derived by adjoining to *S* a covert ~~*and only S*~~. Effectively, the result is that the prejacent and its alternatives are in environments of different monotonicity. Thus CoP is derived with the structure *if p, q* ~~*and only if p, q*~~, where there are two occurrences of *if p, q*: the overt one is in a UE environment, hence we get a universal prejacent, and the covert one is in a DE environment, hence we get existential alternatives.

This kind of analysis faces some problems. First, recall our argument against ambiguity from ellipsis (section 2), which was based on the fact that ambiguities cannot be interpreted differently in the antecedent material and the elided material. However, Herburger's analysis of CoP essentially relies on an ellipsis construction, and on the idea that the overt *if p, q* can be interpreted universally while the elided *if p, q* is interpreted existentially. Thus our argument from ellipsis extends to her treatment of CoP. Second, it is not clear to us what motivation there is for such an analysis of implicatures other than the CoP data. Third, since the CoP data mirrors the chameleonic behavior of bare conditionals in ellipsis constructions and in non-monotonic contexts, for which such an analysis is not available, a principled analysis for all of these cases is called for.

b. ***If not p, q* alternative of (34)**
$\exists w \in \{nh_1, nh_2\}$[you succeed in w] = You succeed in nh_1 $\vee$ You succeed in nh_2 **c**

c. **Enriched set of alternatives of (34)**
$C^+ = \{\mathbf{a} \vee \mathbf{b}, \mathbf{a}, \mathbf{b}, \mathbf{c}\}$

Given C^+, the result of recursive EXH is in (37). The *if not p, q* alternative **c** is negated by the lower EXH without affecting the workings of the higher EXH. Namely, adding the *if not p, q* alternative to the set of alternatives of *if p, q* does not interfere with the generation of universality for the latter, essentially because their domains of quantification are disjoint.

(37) $$[\![\text{EXH}_{C^{+\prime}}\ \text{EXH}_{C^+}\ \textit{if}_{D_s}\ \textit{you work hard you succeed}]\!] = 1\ \textit{iff}$$
$$\underbrace{\forall w \in \{h_1, h_2\}[\text{you succeed in } w]}_{\text{Universal strengthening (matrix EXH) } (\approx(34a))} \wedge \underbrace{\neg\exists w \in \{nh_1, nh_2\}[\text{you succeed in } w]}_{\text{CoP inference (embedded EXH) } (\approx(34b))}$$

In sum, the fact that bare conditionals give rise to a universal meaning in their assertion and an existential meaning in their implicature is predicted under our analysis.

5.4. Conditional Perfection with non-bare conditionals as evidence for an existential semantics for bare conditionals

In section 2 we have presented arguments against an ambiguity analysis of bare conditionals, and in section 3 we proposed a unified existential semantics based on the analogy with FC disjunction. In the previous section we have shown that the existential semantics assumption correctly predicts the CoP inferences of bare conditionals with no further complications. In what follows we present another motivation for the assumption that the basic semantics of bare conditionals is existential, coming from the behavior of CoP with *non*-bare conditionals.

A fact that (to our knowledge) has been largely unnoticed is that the behavior of non-bare conditionals is different from that of bare conditionals with respect to CoP. As Herburger (2015b) observes, when the conditional contains an overt universal adverb that the *if*-clause restricts, as in (38), we get a weaker CoP implicature than with bare conditionals, namely (38a) rather than (38b).[21] This difference between (38a) and the CoP inference of bare conditionals in (34b) is already surprising if we assume that bare conditionals are universals.[22]

(38) If you work hard, you **always** succeed.
a. $\rightsquigarrow$ **Weak CoP**: if you don't work hard, you don't **always** succeed.
b. $\not\rightsquigarrow$ **Strong CoP**: if you don't work hard, you don't succeed.

[21] An issue that arises is why (38) doesn't have (i) as an alternative, the negation of which would produce the unattested strong CoP in (38b).
(i) If you don't work hard, you **sometimes** succeed.
A possible way to avoid it is to assume a non-weakening constraint on the generation of alternatives, as suggested in Fox (2007: fn. 35) (see also Romoli 2012; Trinh and Haida 2015), such that (i) would not be generated.

[22] Under von Fintel (2001)'s analysis of CoP (see footnote 19), for instance, there is no apparent reason why non-bare universal conditionals should not generate alternatives where the antecedent picks out singleton sets of worlds, while this option would be available for bare conditionals.

Even more striking is the fact that existential non-bare conditionals like (39) give rise to strong CoP, in (39a), just like bare conditionals do.

(39) If you work hard, you **sometimes** succeed.
  a. $\rightsquigarrow$ **Strong CoP**: if you don't work hard, you don't succeed.

We take this pattern as further evidence that the basic semantics of bare conditionals should be existential, in light of their resemblance to existential rather than universal non-bare conditionals in terms of the kind of implicatures they give rise to. Admittedly, this is indirect evidence. However, as we have seen the chameleonic behavior of bare conditionals leaves little room for direct evidence.

6. Concluding remarks

Higginbotham's puzzle casts doubts on views according to which bare conditionals are uniformly interpreted universally. We have shown however that a simple ambiguity theory such as Herburger's is also questionable given the behavior of bare conditionals in VP ellipsis constructions and in non-monotonic contexts, as well as Conditional Perfection data. We argued for a unified existential semantics for bare conditionals, based on (i) the similarity in distribution between their quantificational force and the availability of Free Choice inferences for disjunction under an existential modal, and (ii) the fact that their Conditional Perfection inferences pattern with those of existential non-bare conditionals rather than universal ones.

Following the analogy with FC disjunction, we proposed an analysis that derives the universality of bare conditionals in UE contexts using the same mechanism of grammatical strengthening utilized by Fox (2007) to derive FC inferences. The crucial assumptions for this derivation to go through are (i) that bare conditionals give rise to sub-domain alternatives which are obligatorily exhaustified (as in Chierchia 2013's analysis of NPIs), and (ii) that bare conditionals don't have a universal alternative.

One might wonder about the seemingly stipulative nature of assuming obligatory sub-domain alternatives for bare conditionals. We have no direct evidence for this assumption, and that it is currently justified only in so far as it (together with independently suggested mechanisms) predicts the correct pattern of behavior. However, an interesting line of research worth pursuing is that sub-domain alternatives are generated for the restrictor of *every* quantificational operator, but their effect is mainly noticeable when there is no scalar alternative (see section 4.4). If this is developed successfully, then the assumption that bare conditionals give rise to sub-domain alternatives would be just a special case of this hypothesis.[23]

The analysis presented here opens up a new line of investigation into the research of homogeneity phenomena in general, of which Higginbotham's puzzle is arguably only one manifestation.

[23] The assumption that these alternatives are *obligatorily* exhaustified requires further justification, which we are unable to provide yet. A promising direction, though, is to relate it to Singh et al. (2016)'s independently motivated proposal that applying EXH is highly preferred when it provides the complete answer to the Question Under Discussion. Note that the universal meaning we derive for (1a) by applying EXH provides the complete answer to the question *under what circumstances do you succeed?*, while the basic existential meaning doesn't.

A notable case in point is definite plurals: it has been suggested by Magri (2014), following Spector (2007), that definite plurals bear existential semantics which is strengthened in UE environments, on similar lines to what we propose. Independently, Schein (2003) and Schlenker (2004) have suggested an analysis of conditionals as definite plurals. Brought together, these approaches may lead to a new perspective on homogeneity phenomena. In future work we hope to compare this perspective with other approaches, most notably Križ (2015).

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