Be surprised whether: question-to-cleft reduction*

Ziling Zhu[1] and Yimei Xiang[2]

[1] Rutgers University, New Brunswick, New Jersey, U.S.A.
ziling.zhu@rutgers.edu
[2] Rutgers University, New Brunswick, New Jersey, U.S.A.
yimei.xiang@rutgers.edu

Abstract

We propose a question-to-cleft reduction account to explain why emotive factives (e.g., *be surprised*) cannot embed *whether* questions. First, drawing on the distinct anaphor-licensing patterns of *wh-* and *whether*-questions, we discern discourse referents that may serve as short answers to questions, termed 'answer discourse referents (ans-drefs)'. Next, we argue that questions embedded under emotive factives are always reduced to clefts. This reduction requires to extract a unique ans-dref from the embedded question, which is possible in *wh*-embeddings but not in *whether*-embeddings.

1 Introduction

Cognitive factives (e.g., *know*) and emotive factives (e.g., *be surprised*, *be happy*) have different selectional patterns (Karttunen 1977): as exemplified in (1) and (2), while both types of factives can embed *wh*-questions (*wh*Qs), only cognitive factives can embed *whether*-questions, which can be interpreted either as polar questions (PolQs) or alternative questions (AltQs).

(1) a. Jane knows who danced.
b. Jane knows whether Andy or Billy danced.

(2) a. Jane is surprised who danced.
b. *Jane is surprised whether Andy or Billy danced.

Existing analyses typically attribute this distinction to semantic restrictions of the factive predicates (d'Avis 2002; Abels 2004; Romero 2015) or to a pragmatic competition among forms of questions (Sæbø 2005; Guerzoni 2007; Roelofsen et al. 2019). In contrast, drawing on facts about anaphoricity, focus-sensitivity, and existential presuppositions, we explain this contrast in terms of 'question-to-cleft reduction'.

The rest of this paper is organized as follows. Section 2 presents three observations setting apart *wh*-questions from *whether*-questions, as well as cognitive factives from emotive factives. Section 3 outlines the core assumptions and motivates our question-to-cleft reduction account. Section 4 formalizes this account with dynamic inquisitive semantics (Roelofsen and Dotlačil 2022). Section 5 concludes.

2 Three Observations

Wh- and *whether*-questions differ in anaphoricity, whereas cognitive and emotive factives differ in focus-sensitivity and existential presuppositions.

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Anaphoricity. Matrix *wh*-questions support discourse anaphora with *wh*-phrases as antecedents (Comorovski 1996; van Rooy 1998; Groenendijk 1998; Aloni and van Rooy 2002; Haida 2007; Dotlačil and Roelofsen 2018; Li 2021; a.o.): in (3a) the pronoun *him* refers to the person that the addressee likes between Andy and Billy. In contrast, as seen in (3b), matrix *whether*-questions do not support anaphora with *wh*-antecedents, no matter whether they are interpreted as alternative questions (*Do you like Andy or [do you like] Billy?*) or as polar questions (*Do you like [or not like] Andy or Billy?*).

(3) a. [Who]^1 do you like between Andy and Billy? You should work with him$_1$.
b. Do you like [Andy or Billy]^1? #You should work with him$_1$.

Similarly, *wh*-embeddings support anaphora, while *whether*-embeddings do not, as seen in (4).

(4) a. I know [who]^1 you like between Andy and Billy. You should work with him$_1$.
b. I know whether you like [Andy or Billy]^1. #You should work with him$_1$.

Unlike other questions, polar questions only accept direct answers like *Yes*/*No*, which shows that the *wh*-antecedents they introduce are propositional. For example, in (5) the anaphor *so* is licensed by the propositional *wh*-antecedent *you like Andy*. The anaphor *him*, in contrast, has a non-*wh*-antecedent *Andy*, licensed in the same way as how it would be in any non-interrogatives.

(5) [Do you like [Andy]^2?]^1 If so$_1$, you should work with him$_2$.

Focus-sensitivity. Embedding emotive factives are focus-sensitive (Romero 2015): in (6a), focus-marking in the embedded declarative must be consistent with the contrast presented in the given context. In contrast, cognitive factives are not focus-sensitive per se, as seen in (6b).

(6) Context: Jane expected Andy to teach semantics. Then she found out that Billy taught semantics.
a. Jane is surprised that BIlly$_F$ taught semantics/#Billy taught seMANtics$_F$.
b. Jane knows that BIlly$_F$ taught semantics/Billy taught seMANtics$_F$.

In parallel, as shown in (7), *wh*-embeddings in Mandarin with an emotive factive require the *wh*-expression (e.g., *shei* 'who') to be associated with an overt focus marker *shi*, in contrast to those with a cognitive factive.

(7) a. Zhangsan hen jingxi #(**shi**) shei gei ta mai-le hua.
Zhangsan very surprised SHI who give him buy-ASP flower.
Zhangsan is very surprised who bought him flowers.
b. Zhangsan zhidao (**shi**) shei gei ta mai-le hua.
Zhangsan know SHI who give him buy-ASP flower.
Zhangsan knows who bought him flowers.

Existential presupposition. *Wh*-embeddings with an emotive factive are subject to an existential (∃-)presupposition (Roelofsen et al. 2019). In (8a) the continuation *if anyone* is infelicitous because it contradicts the presupposition of the preceding question embedding clause that someone won the game. In contrast, in (8b) the continuation is felicitous, which shows that *wh*-embeddings with a cognitive factive do not trigger an ∃-presupposition.

(8) a. Jane is happy who won the game, #if anyone.
b. Jane knows who won the game, if anyone.

3 A Question-to-Cleft Reduction Account

Section 2 presented three observations contrasting *wh-* and *whether-* questions as well as contrasting cognitive and emotive factives. Based on these observations, we propose a question-to-cleft reduction account, which explains the selectional patterns of the two types of factives. This account has two major ingredients: (i) *wh*Qs introduce a unique ans-dref, while AltQs and PolQs introduce multiple ans-drefs and no ans-dref, respectively; (ii) questions embedded under emotive factives must be reduced into clefts.

We call discourse referents introduced by questions that may serve as short answers to questions 'answer discourse referents (ans-drefs)'. The availability and the number of discourse referents vary by question types. First, *wh*Qs introduce one and only one ans-dref (as in (9a)). This assumption resembles what has been commonly assumed for existential statements in dynamic theories as in (9b), that is, indefinites introduce a unique discourse referent (Karttunen 1977; Groenendijk and Stokhof 1991; Dekker 1993; Veltman 1996; a. o.).

(9) a. Which^1 man came to the party? He$_1$ must be bored.
b. A^1 man came to the party. He$_1$ must be bored.

Second, AltQs introduce more than one ans-dref, similar to disjunctions of referential expressions. Simons (1996) observes that in (10a) a disjunction of two non-specific indefinites allows a *whichever* interpretation of the pronoun *she*, while in (10b) a disjunction of two proper names does not. This contrast, however, does not extend to AltQs: neither (11a) nor (11b) supports anaphora.

(10) a. Either a soprano or an alto will sing. She$_{(=\text{whoever sings})}$ will stand on that platform.
b. Either Jane or Maud will sing. #She$_{(=\text{whoever sings})}$ will stand on that platform.

(11) a. Will [a soprano or an alto]^1 sing? #She$_1$ will stand on that platform.
b. Will [Jane or Maud]^1 sing? #She$_1$ will stand on that platform.

Third, PolQs do not introduce any ans-drefs, since they admit only short answers like *Yes* and *No*. In (12) (repeated from (5)), the pronoun *him* takes *Andy* as its antecedent, which however is not a short answer to the polar question.

(12) Do you like Andy^1? You should work with him$_1$.

As the core assumption of our analysis, we argue that questions must be reduced to clefts when embedded under emotive factives. These clefts state that it is the value of the unique ans-dref that satisfies the topical property (Chierchia and Caponigro 2013) of the embedded question. For example, *Jane is surprised who^d won* means that Jane is surprised that it is d (the unique ans-dref introduced by *who*) that won.

This reduction assumption is motivated by the aforementioned facts on focus-sensitivity and ∃-presupposition in embeddings with an emotive factive. Clefts are typical focus constructions, as exemplified in (13). Moreover, clefts trigger an ∃-presupposition: in (14b), the use of *nobody* is odd because it contradicts the cleft's ∃-presupposition (Aravind et al. 2018).

(13) a. It was [Andy's sister]$_F$ who won the lottery.
→ No other people won the lottery.
b. It was [Andy's]$_F$ sister who won the lottery.
→ Nobody else's sister won the lottery.

(14) a. It is Andy who won the lottery. ⇝ *Someone won the lottery.*
b. *It's nobody that won the lottery.

Note that our reduction assumption diverges from Fox's (2020) Question–Cleft Matching Principle, which mandates questions in all types of embeddings to be reduced to clefts. In contrast to Fox, we restrict the mandatory question-to-cleft reduction to only embeddings with emotive factives, based on the fact that embeddings with cognitive factives do not exhibit focus-sensitivity (see (6b) and (7b)) or existential presuppositions (see (8b) and (15)). Moreover, the optionality of reduction in embeddings with cognitive factives is supported by (15): reducing the embedded question in (15a) to a cleft would yield an ungrammatical sentence like (15b), where the ungrammaticality comes from the incompatibility between a *no*-NP and a cleft.

(15) Context: No stocks went up, and Fred knows that.
   a. Fred knows which of the three stocks went up.
   b. *Fred knows that it is no stocks that went up.

With the two assumptions argued above, we are now ready to explain why emotive factives admit *wh*-complements but not *whether*-complements. In short, forming a cleft meaning from an interrogative complement requires to extract a unique ans-dref. This uniqueness requirement is satisfied by *wh*-complements but not by alternative or polar *whether*-complements.

4 Formalizations

Our question-to-cleft reduction account requires a formal theory that captures anaphora across question types. Many attempts have been made to bridge question semantics and anaphoricity, especially in dynamic theories (Jäger 1996; Ginzburg 1996; Hulstijn 1997; Erteschik-Shir 1997; Groenendijk 1999; Aloni and van Rooy 2002; Li 2021; Roelofsen and Dotlačil 2022; a.o.). We follow the framework of dynamic inquisitive semantics developed by Roelofsen and Dotlačil (2022), which captures anaphora in declaratives and all relevant question types.

4.1 Formal Background

In the framework of dynamic inquisitive semantics by Roelofsen and Dotlačil (2022), sentence meanings are composed of atomic '**context update functions (cufs)**'. Cufs can be conjoined via function composition: as in (16a), conjoining two cufs (viz., $\mathcal{U}_1$ and $\mathcal{U}_2$) means applying them to the input context c in sequence. Cufs can also be disjoined, as in (16b), by taking the union of the output contexts yielded by applying each cuf to the input context.

(16) a. $\mathcal{U}_1;\mathcal{U}_2 \coloneqq \lambda c.\mathcal{U}_2(\mathcal{U}_1(c))$
   b. $\mathcal{U}_1 \sqcup \mathcal{U}_2 \coloneqq \lambda c.\mathcal{U}_1(c) \cup \mathcal{U}_2(c)$

Declaratives take the form of a cuf $!\mathcal{U}$, where the !-operator removes any potential inquisitiveness from $\mathcal{U}$. In existential statements, the !-operator applies trivially, since the cuf it scopes over is non-inquisitive. For example, (17) introduces a dref u (represented as a cuf $[u]$) and specifies that u is a person and that u danced. In this formalization, for any predicate R and a dref u, their predication relation is represented as $R\{u\}$, which corresponds to $R(u)$ in the standard predicate logic.

(17) $[\![\textit{Someone danced}]\!] = !([u];\mathsf{person}\{u\};\mathsf{dc}\{u\})$

Roelofsen and Dotlačil assume that disjunctions are inquisitive, unlike existential statements. In (18), the use of the !-operator is non-trivial — it rids the disjunction of its inquisitiveness and renders a non-inquisitive declarative meaning.

(18) $[\![\textit{Either Andy or Billy danced}]\!] = !(([u_1];\mathsf{A}\{u_1\};\mathsf{dc}\{u_1\}) \sqcup ([u_2];\mathsf{B}\{u_2\};\mathsf{dc}\{u_2\}))$

Interrogatives take the form $\langle ? \rangle \mathcal{U}$. The $\langle ? \rangle$-operator, as defined in (19), ensures the inquisitiveness of questions: it returns a disjunction if the cuf it scopes over is non-inquisitive.

(19) $\langle ? \rangle \mathcal{U} \coloneqq \begin{cases} \mathcal{U} & \mathcal{U} \text{ is inquisitive;} \\ \mathcal{U} \sqcup \neg \mathcal{U} & \text{otherwise.} \end{cases}$

The *wh*Q in (20) introduces a unique ans-dref u (represented as $\ulcorner u \urcorner$, in contrast to $[u]$),[1] specifies that u is a person and that u danced, and requests u's identity (represented as $?u$). Here the $\langle ? \rangle$-operator applies trivially, since $?u$ is inquisitive.

(20) $[\![\textit{Who danced?}]\!] = \langle ? \rangle(\ulcorner u \urcorner; \mathsf{person}\{u\}; \mathsf{dc}\{u\}; ?u)$

The AltQ in (21) introduces two ans-drefs (viz., u_1 and u_2) and specifies their properties in each disjunct. Here the $\langle ? \rangle$-operator also applies trivially, since disjunctions are inquisitive.

(21) $[\![\textit{Did Andy or Billy dance?}]\!] = \langle ? \rangle((\ulcorner u_1 \urcorner; \mathsf{A}\{u_1\}; \mathsf{dc}\{u_1\}) \sqcup (\ulcorner u_2 \urcorner; \mathsf{B}\{u_2\}; \mathsf{dc}\{u_2\}))$

In PolQs, however, the $\langle ? \rangle$-operator applies non-trivially: it returns a disjunction as the question meaning. Crucially, no ans-dref is introduced; (22) has only a regular/non-ans dref specified to be Andy.

(22) $[\![\textit{Did Andy dance?}]\!] = \langle ? \rangle([u];\mathsf{A}\{u\};\mathsf{dc}\{u\}) = ([u];\mathsf{A}\{u\};\mathsf{dc}\{u\}) \sqcup \neg([u];\mathsf{A}\{u\};\mathsf{dc}\{u\})$

Parthood relations. To extract atomic cufs from a sentence, we define two *part-of* relations, formalized as in (23). Relation (23b) is important for tackling AltQs and PolQs.

(23) a. $\mathcal{U}' \sqsubseteq_c \mathcal{U}$ is true iff $\exists \mathcal{U}_1, \mathcal{U}_2.\ \mathcal{U}_1(\mathcal{U}'(\mathcal{U}_2(c))) = \mathcal{U}(c)$
b. $\mathcal{U}' \sqsubseteq_d \mathcal{U}$ is true iff $\exists \mathcal{U}''.\ \mathcal{U}'(c) \sqcup \mathcal{U}''(c) = \mathcal{U}(c)$
(where $\mathcal{U}_1, \mathcal{U}_2, \mathcal{U}''$ can be semantically vacuous, i.e., identity functions.)

4.2 Formal Account

First, we define two question-reduction operators, namely, a **QC** (question-to-cleft) operator and a **QP** (question-to-proposition) operator. The **QC** operator reduces a dynamic question to a cleft answer to this question: (a) for any dynamic question $\mathcal{U}$, $\mathbf{QC}(\mathcal{U})$ is defined only if $\mathcal{U}$ introduces a unique ans-dref v; (b) when defined, $\mathbf{QC}(\mathcal{U})$ returns a cleft meaning of $\mathcal{U}$[2], which consists of (i) a presupposition that there exists a unique entity that satisfies all the predicates in $\mathcal{U}$ and (ii) an assertion that the value of this entity is simply the ans-dref introduced by $\mathcal{U}$.

(24) $\mathbf{QC} \coloneqq \lambda \mathcal{U} : \exists! v. \exists \mathcal{U}' \sqsubseteq_d \mathcal{U}. \ulcorner v \urcorner \sqsubseteq_c \mathcal{U}'.$ (a)
$\lambda w : \exists d. \forall d'. (\forall R. (\exists v'. (R\{v'\} \sqsubseteq_c \mathcal{U}) \to R(w)(d')) \to d' \leq d).$ (b-i)
$\forall R. (\exists v. (R\{v\} \sqsubseteq_c \mathcal{U}) \to R(w)(\mathbf{AD}(\mathcal{U})))$ (b-ii)

The value of the ans-dref is extracted by the **AD**-operator, defined as in (25): $\mathbf{AD}(\mathcal{U})(w)$ returns the unique entity that satisfies all the predicates in $\mathcal{U}$ in the world w.

(25) $\mathbf{AD} \coloneqq \lambda \mathcal{U}. \lambda w. \iota d. (\forall R. (\exists v. (R\{v\} \sqsubseteq_c \mathcal{U}) \to R(w)(d)))$

[1] While Roelofsen and Dotlačil (2022) represent discourse referents uniformly as $[u]$, we represent ans-drefs as $\ulcorner u \urcorner$ to distinguish them from other drefs. This paper only makes a notational difference; we need a more refined formal theory to account for the distinctions.

[2] We follow Szabolcsi's (1981) analysis of cleft meaning. Our proposal can be adjusted to adopt other semantic analyses of clefts. See also Bolinger 1972; Atlas and Levinson 1981; Velleman et al. 2012; a.o.

The **QP** reduces a dynamic question to a regular Hamblin answer. Unlike **QC**, **QP** doesn't trigger a unique ans-dref presupposition; $\mathbf{QP}(\mathcal{U})$ simply asserts that the strongest true short answer to $\mathcal{U}$ satisfies all the predicates in $\mathcal{U}$ (if $\mathcal{U}$ is a *wh*Q) or a disjunct of $\mathcal{U}$ (if $\mathcal{U}$ is an AltQ or a PolQ, which denotes a disjunction of question alternatives, as seen in (21) and (22)).

(26) $\mathbf{QP} \coloneqq \lambda\mathcal{U}.\lambda w.\exists\mathcal{U}' \sqsubseteq_d \mathcal{U}.\forall R.(\exists v.(R\{v\} \sqsubseteq_c \mathcal{U}') \to R(w)(\mathbf{SA}(\mathcal{U})))$

The strongest true short answer is extracted by the **SA**-operator, defined as in (27) (c.f. Dayal 1996; Li 2021): $\mathbf{SA}(\mathcal{U})(w)$ returns the unique entity d such that the inferences derived by applying the predicates in (one disjunct of) $\mathcal{U}$ to d are true in w and are the strongest.

(27) $\mathbf{SA} \coloneqq \lambda\mathcal{U}.\lambda w.\iota d.(\exists\mathcal{U}' \sqsubseteq_d \mathcal{U}.(\forall R.(\exists v.(R\{v\} \sqsubseteq_c \mathcal{U}') \to R(w)(d) \wedge \forall d'.(R(w)(d') \to R(d) \subseteq R(d')))))$

Next, we incorporate **QP** and **QC** into the lexical entries of *know* and *be surprised*, as in (28) and (29), respectively (c.f. Uegaki 2015, 2022; Theiler et al. 2018; Fox 2020; a.o.). Both lexical entries make reference to the propositional answer yielded by applying **QP**. *Know* presupposes the truth of this answer and asserts that the attitude holder believes this answer; *be surprised* presupposes the truth of this answer as well as that the attitude holder believes this answer. Crucially, the emotive part of *be surprised* involves the **QC** operator: it asserts that the attitude holder expects the negation of the cleft answer to the embedded question. For example, *Jane is surprised who*^{d} *danced* asserts that Jane previously expected that it isn't d that danced.

(28) $[\![know]\!] = \lambda\mathcal{U}.\lambda x.\lambda w : \mathbf{QP}(\mathcal{U})(w).\textsc{dox}_x^w \subseteq \mathbf{QP}(\mathcal{U})$

(29) $[\![\textit{be surprised}]\!] = \lambda\mathcal{U}.\lambda x.\lambda w : \mathbf{QP}(\mathcal{U})(w) \wedge \textsc{dox}_x^w \subseteq \mathbf{QP}(\mathcal{U}).\textsc{exp}_x^w \subseteq \neg\mathbf{QC}(\mathcal{U})$

As a desirable prediction of the presented account, when a *wh*Q is embedded under *be surprised*, it introduces a unique ans-dref and satisfies the uniqueness presupposition of **QC**; in contrast, an embedded *whether* question introduces either multiple ans-drefs or no ans-dref, causing a presupposition failure to the use of **QC**.

5 Conclusion

This paper investigates why emotive factives do not embed *whether*-questions. First, drawing on evidence from anaphoricity, we argued that different question types vary in the number of ans-drefs they can introduce. Next, motivated by facts on focus-sensitivity and ∃-presuppositions, we argued that questions must be reduced to clefts when embedded under emotive factives. Finally, we formalized our account with the framework of dynamic inquisitive semantics.

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