Fragment Functional Answers

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There are usually two grammatical ways to provide an answer to a question: a full clause reply (e.g., *John left*, as a reply to *Who left?*) and a fragment reply (e.g., *John*, as a reply to the same question). Some fragment replies, however, are well-formed as answers to some types of questions but not to others, and some full clause replies are well-formed as answers to some types of questions but not to others. We account for this fact with a variant of a theory of questions according to which fragment replies are basic semantic answers, and full-clause replies are parasitic on them.

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<u>The puzzle</u>. *Wh*-Questions with *every N* in subject position are ambiguous, but *wh*-questions with *no N* in subject position are not. This is evidenced by the fact that both the full clause pair-list expression in (2a) and the full clause "functional" expression in (2b) may be acceptable replies to (1a) (Engdahl 1986, Groenendijk & Stokhof 1984, Chierchia 1993, and others) but (2b') is an acceptable reply to (1b) while (2a') is not. Multiple-*wh* questions appear to be ambiguous just like *wh*-questions with subject *every N*, but only full clause replies reflect this apparent ambiguity; fragment replies do not. On the one hand, (2a) and (2b) may both be acceptable replies to (1c) (Comorovski 1996, and others). On the other hand, while the fragment pair-list expression in (3a) may be an acceptable reply to (1a) and, for many speakers, to (1c) (Merchant 2004), but <u>not</u> to (1b), the fragment "functional" expression in (3b) may be an acceptable reply to (1a) and to (1b) (Engdahl 1986, and others), but <u>not</u> to (1c) (Kang 2012).

(1) a. Which paper did every student turn in?
b. Which paper did no student turn in?
c. Which student turned in which paper?

(2) a. Marv turned in Binding, Fred turned in Anaphora, (and) Sam turned in Tense — FCPL
a'. Marv didn't turn in Binding, Fred didn't turn in Anaphora — FCPL
b. Every student turned in his term paper. — FCF
b'. No student turned in his term paper. — FCF

(3) a. Marv, Binding; Fred, Anaphora; (and) Sam, Tense. — FPL
b. His term paper. — FF

We explain why the contrasts illustrated in (1)-(3) are a puzzle, and offer a solution to the puzzle.

<u>A challenge for Answers-are-Fragments</u>. According to Jacobson (to appear), semantic answers are supplied by fragment replies (cf. Ginzburg & Sag 2000, Groenendijk & Stokhof 1984). A root question and its fragment reply form a syntactic unit that denotes a structured proposition whose first element is the question denotation and whose second element is the fragment reply denotation. For example, for any world w, if LEAVE(w)(**m**) = 1, ⟦ [$_{Q\text{-}A}$ [*who left*][*Marv*]] ⟧^{w} = <LEAVE, **m**>. The full clause reply *Marv left* lives off the fragment reply *Marv*. This theory over-generates: since (2b) may be an acceptable reply to (1c), it must live off (3b) (whatever the denotation of (3b) is) and so, (3b) should be an acceptable reply to (1c).

<u>A challenge for Answers-are-Full-Clauses</u>. According to Merchant (2004), which presupposes the sets-of-propositions analysis of questions (Hamblin 1973/Karttunen 1977), semantic answers are supplied by full clause replies, and fragment replies are derived from full clause replies by movement and ellipsis. Accordingly, (3a) is acceptable as a reply to (1a) and to (1c) because *Marv*, *Binding*, *Fred* etc. may move as in (5b), and TP in (5b) may be elided under identity with TP in both (4b) and (4c) (TP = TenseProjection). By contrast, (3b) is acceptable as a reply to (1a) but not to (1c) because *his term paper* may move as in (5a), and TP in (5a) may be elided under identity with TP in (4a), but TP in (5a) is not identical to TP in (4c).

(4) a. [which paper$_i$ [$_{TP}$ every student turned in _$_i$]] — (1a) "functional"
b. [every student$_i$ [which paper$_n$ [$_{TP}$ _$_i$ turned in _$_n$]]] — (1a) pair-list
c. [which student$_i$ which paper$_n$ [$_{TP}$ _$_i$ turned in _$_n$]] — (1b)

(5) a. [his term paper$_i$ […[$_{TP}$ ~~every student turned in _$_i$~~]]]
b. [Marv$_i$ Binding$_n$ […[$_{TP}$ ~~_$_i$ turned in _$_n$~~]]] [Fred$_i$ Anaphora$_n$ […[$_{TP}$ ~~_$_i$ turned in _$_n$~~]]] …

This theory over-generates (cf. Kang 2012): *Every student, his term paper* is only marginally acceptable – if at all – as a reply to (1a) or (1b), yet TP in (6) is identical to TP in (4b,c).

(6) [every student$_i$ [his term paper$_n$ […[$_{TP}$ ~~_$_i$ turned in _$_n$~~]]]]

<u>Our take on the puzzle</u>. We adopt a theory of questions according to which (1a) expresses both a “functional” question and a pair-list question, (1b) unambiguously expresses a “functional” question, and (1c) unambiguously expresses a pair-list question. We propose a version of Answers-are-Fragments according to which (3b) denotes a possible semantic answer to $[\![(1a)^{functional}]\!]$ and to $[\![(1b)]\!]$, but not to $[\![(1c)]\!]$; (3a) denotes a possible semantic answer to $[\![(1c)]\!]$ and a family of possible semantic answers to $[\![(1a)^{pair\text{-}list}]\!]$, but not to $[\![(1b)]\!]$. Thus, (2a) lives off (3a), and (2b/b’) live off (3b) only as replies to (1a/b); as a reply to (1c), (2b) lives off (3a).

<u>The proposal</u>

<u>Part 1: what a possible semantic answer is.</u> We assume that a question denotes a set of structured propositions (see Krifka 2001a, and others). Specifically, a *wh* question-intension Q is a function from possible worlds to sets of structured propositions of the form $\{<P_Q, x>, <P_Q, x'>, <P_Q, x''>, \ldots\}$ (i.e., a set of possible Jacobsonian question-answer pairs). For any common ground k, z is a possible semantic answer to Q in k *iff* for every $w \in k$, $<P_Q, z> \in Q(w)$ and $P_Q(w)(z)$ is defined. In addition, a root question is prefixed with a question act operator (as in Krifka 2001b, and others), and a root reply is prefixed with an answer act operator. This means that a common ground – which is a set of worlds – is always updated with a set of worlds, even when the update is triggered by a question-intension or a possible semantic answer (neither of which is a set of worlds). Simplifying considerably, for any discourse participant x reliable in k, updating k with $[\lambda w.\ ASK_{w,x}(Q)]$ means removing from k all worlds w such that there is a z such that z is a possible semantic answer to Q in k and: (i) x is opinionated in w about $<P_Q, z>$ (i.e., x believes $[\lambda w.\ P_Q(w)(z) = 1]$ in w or x believes $[\lambda w.\ P_Q(w)(z) = 0]$ in w), or (ii) x does not want in w to become informed about $<P_Q, z>$. For any discourse participant y reliable in k and any z such that z is a possible semantic answer to Q in $k+[\lambda w.\ ASK_{w,x}(Q)]$, updating $k+[\lambda w.\ ASK_{w,x}(Q)]$ with $[\lambda w.\ ANS_{w,y,Q}(z)]$ means removing from $k+[\lambda w.\ ASK_{w,x}(Q)]$ any w such that $P_Q(w)(z) = 0$.

<u>Part 2: what (1a)-(1c) mean.</u> We assume that a *wh*-phrase <u>always</u> introduces salient natural functions (a natural function is a function whose “value can be computed for any new individual added to the world … A random list of ordered pairs … is not a recipe in the same sense”; Jacobson 1999, Fn. 23). For any w, $\mathbf{NAT}_w$ is the set of natural functions salient in w.

Thus, the “functional” meaning of (1a) (relativized to discourse participant *a*) is (7) (cf. Engdahl 1986, Chierchia 1993, Groenendijk & Stokhof 1984, Sharvit 1999 and others): “which natural paper-valued function h is such that every student x turned in the output of h relative to x?”. In a similar fashion, the “functional” meaning of (1b) is (7’).

(7) $\lambda w.\ ASK_{w,a}(\lambda w'.\ \{<P, h> \in D_{<s,<<s,<e,e>>,t>>} \times D_{<s,<e,e>>} |\ h \in \mathbf{NAT}_{w'}\ \&\ Ran(h(w')) \subseteq \text{PAPER}_{w'}\ \&$
$P = \lambda w \lambda f^{<s,<e,e>>}.\ \forall y \in \text{STUDENT}_w\text{: TURN-IN}_w(y, f(w)(y))\})$

(7’) $\lambda w.\ ASK_{w,a}(\lambda w'.\ \{<P, h> \in D_{<s,<<s,<e,e>>,t>>} \times D_{<s,<e,e>>} |\ h \in \mathbf{NAT}_{w'}\ \&\ Ran(h(w')) \subseteq \text{PAPER}_{w'}\ \&$
$P = \lambda w \lambda f^{<s,<e,e>>}.\ \forall y \in \text{STUDENT}_w\text{: } \neg \text{TURN-IN}_w(y, f(w)(y))\})$

According to Krifka (2001b), the pair-list meaning of (1a) arises as a result of quantification into the question act, roughly: “for each student z, (*a* wants to know) which paper x is such that z turned in x?”. We adopt (8) instead, where for each student z, the question relative to z is not “looking for” a paper, but rather for a natural function from worlds to papers.

(8) $\lambda w.\ \forall z \in \text{STUDENT}_w\text{: } ASK_{w,a}(\lambda w'.\ \{<P, g> \in D_{<s,<<s,e>,t>>} \times D_{<s,e>} |\ g \in \mathbf{NAT}_{w'}\ \&$
$Ran(g) \subseteq \text{PAPER}_{w'}\ \&\ P = \lambda w \lambda f^{<s,e>}.\ \text{TURN-IN}_w(z, f(w))\})$

Krifka argues that quantification into the question act is not possible with *no student*, for independent reasons. This is why (1b) does not have a pair-list meaning.

According to Dayal (1996, 2002), the pair-list meaning of (1c) is roughly this: "which (possibly random) list g of ordered student-paper pairs is such that every x in the domain of g turned in the output of g relative to x?". The domain and range of g are introduced, respectively, by the first and second *wh*-phrases. We modify Dayal (1996, 2002) as in (9), where the question is "looking for" a (possibly random) list g in $D_{<<s,e>,<s,e>>}$ (rather than $D_{<e,e>}$); the domain and range of g are sets of natural functions.

(9) $\lambda w.\ \mathrm{ASK}_{w,a}(\lambda w'.\ \{<P, g> \in D_{<s,<<<s,e>,<s,e>>,t>>} \times D_{<<s,e>,<s,e>>} |\ \mathrm{Dom}(g) = \{f \in D_{<s,e>} |\ f \in \mathbf{NAT}_{w'}\ \&\ \mathrm{Ran}(f) \subseteq \mathrm{STUDENT}_{w'}\}\ \&\ \mathrm{Ran}(g) \subseteq \{f \in D_{<s,e>} |\ f \in \mathbf{NAT}_{w'}\ \&\ \mathrm{Ran}(f) \subseteq \mathrm{PAPER}_{w'}\}\ \&\ P = \lambda w \lambda f^{<<s,e>,<s,e>>}.\ \forall h \in \mathrm{Dom}(f){:}\ \mathrm{TURN\text{-}IN}_w(h(w), f(h)(w))\})$

The question-denotation in (9) does not have a "functional" counterpart. We argue that this is because the domain of a "natural" function is never restricted to student-valued functions (or even to students; see Sharvit 1999). Consequently, (1c) does not have a "functional" meaning.

Note, for the sake of completeness, that (10) is the meaning of *Who left*. Consistently with (7)/(7')-(9), the question is "looking for" a natural function (in this case, of type <s, e>).

(10) $\lambda w.\ \mathrm{ASK}_{w,a}(\lambda w'.\ \{<P, h> \in D_{<s,<<s,e>,t>>} \times D_{<s,e>} |\ h \in \mathbf{NAT}_{w'}\ \&\ P = \lambda w \lambda f^{<s,e>}.\ \mathrm{LEFT}_w(f(w))\})$

Part 3: what (3a) and (3b) mean. A natural function whose type ends in e is typically denoted by a definite DP. In the spirit of Jacobson (1999), we assume that the basic type of the definite (3b) is <s, <e, e>>; its derived type is <e, e>. Thus, the basic denotation of (3b) is TRMPPR (namely, that function h such that Dom(h) = W & for all w' ∈ Dom(h): (i) Dom(h(w')) = {y ∈ D_e| y has a unique salient term paper in w'} & (ii) for all x ∈ Dom(h(w')), h(w')(x) is the unique salient term paper of x in w'). The basic type of a name is <s, e>; its derived type is e. Accordingly, (3a) may denote the function {<**m**, **B**>, <**f**, **A**>, <**s**, **T**>}, which is a possibly random list of ordered pairs <x, g> where x ∈ D_e and g ∈ $D_{<s,e>}$. (3a) may also denote the function {<**M**, **B**>, <**F**, **A**>, <**S**, **T**>}, which is a possibly random list of ordered pairs of <s, e>-functions. For simplicity, we assume that for every world w, **M**(w) = **m**, **F**(w) = **f**, **S**(w) = **s**, etc.

Part 4: predictions. For any common ground k such that *a* and *b* are reliable in k:

(I) If for all w ∈ k, TRMPPR is a member of $\mathbf{NAT}_w$, then TRMPPR is a possible semantic answer in k to $Q_{(7)}$, the question argument of $\mathrm{ASK}_{w,a}$ in (7). Updating k+(7) with [λw. $\mathrm{ANS}_{w,b,Q(7)}$(TRMPPR)] removes from k+(7) any w such that some student y in w did not turn in TRMPPR(w)(y) in w. In a similar fashion, TRMPPR is a possible semantic answer in k to $Q_{(7')}$.

(II) If for all w ∈ k, {**m**, **f**, **s**} = $\mathrm{STUDENT}_w$ and {<**m**, **B**>, <**f**, **A**>, <**s**, **T**>} maps each z ∈ $\mathrm{STUDENT}_w$ to a member of {g ∈ $D_{<s,e>}$| g ∈ $\mathbf{NAT}_w$ & Ran(g) ⊆ PAPER_w}, then {<**m**, **B**>, <**f**, **A**>, <**s**, **T**>} is a (possibly random) mapping of each z ∈ $\mathrm{STUDENT}_w$ to a possible semantic answer in k to $Q_{(8)\text{-}(z)}$, the question argument of $\mathrm{ASK}_{w,a}$ in (8) (in which z is a free variable). Updating k+(8) with [λw. ∀z ∈ $\mathrm{STUDENT}_w$: $\mathrm{ANS}_{w,b,Q(8)\text{-}(z)}$([{<**m**, **B**>, <**f**, **A**>, <**s**, **T**>}](z))] removes from k+(8) any w such that some z ∈ $\mathrm{STUDENT}_w$ did not turn in [{<**m**, **B**>, <**f**, **A**>, <**s**, **T**>}](z)(w) in w.

(III) If for all w ∈ k, {f ∈ $D_{<s,e>}$| f ∈ $\mathbf{NAT}_w$ & Ran(f) ⊆ $\mathrm{STUDENT}_w$} = {**M**, **F**, **S**}, and {**B**, **A**, **T**} ⊆ {g ∈ $D_{<s,e>}$| g ∈ $\mathbf{NAT}_w$ & Ran(g) ⊆ PAPER_w}, then {<**M**, **B**>, <**F**, **A**>, <**S**, **T**>} is a possible semantic answer in k to $Q_{(9)}$, the question argument of $\mathrm{ASK}_{w,a}$ in (9). Updating k+(9) with [λw. $\mathrm{ANS}_{w,b,Q(9)}$({<**M**, **B**>, <**F**, **A**>, <**S**, **T**>})] removes from k+(9) any w such that for some h ∈ {**M**, **F**, **S**}, it is the case that h(w) did not turn in [{<**M**, **B**>, <**F**, **A**>, <**S**, **T**>}](h)(w) in w.

Thus, (3b) may be an acceptable reply to (1a) on its (7)-reading, and an acceptable reply to (1b) on its (7')-reading (which is the only reading of (1b)); (3a) may be an acceptable reply to (1a) on its (8)-reading, and an acceptable reply to (1c) on its (9)-reading (which is the only reading of (1c)). Usually, (2a) lives off (3a) and (2b/b') live off (3b). But when (2a) and (2b) happen to be k-equivalent, (2b) can also live off (3a) (i.e., *b* may utter (2b) to trigger updating k+(9) with [λw. $ANS_{w,b,Q(9)}([\![(3a)]\!]^w)$]).

Crucially, (3b) – which is of type <s, <e, e>> or <e, e> – cannot be an acceptable reply either to (1a) on its (8)-reading (such a reply denotes an element of $D_{<e,<s,e>>}$) or to (1c) (such a reply denotes an element of $D_{<<s,e>,<s,e>>}$). Notice that if we didn't assume that a *wh*-phrase must introduce natural functions, and adopted the original analysis in Dayal (1996, 2002), (3b) – on its <e, e> interpretation – would wrongly come out an acceptable reply to (1b).

Part 5: the role of pragmatics. When *the tall student* and *the hip student* happen to pick out the same individual in every w ∈ k, independent principles of informativity and salience determine whether the FPL *The tall student, Binding; the hip student, Tense* (type: <<s, e>, <s, e>>) may be an acceptable reply to (1b) (similar principles govern acceptable replies to *Who left?*). In addition, the marginal acceptability of *Every student, his term paper* as a reply to (1a) and (1b) is explained as combining the echo-question *EVERY student?* with the fragment reply *his term paper* (a combination that is accompanied by an intonational change).

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