Making *wh*-phrases dynamic: A case study of Mandarin *wh*-conditionals

**Introduction:** This paper is a modest attempt to bring together two lines of research on *wh*-questions (*wh*-Qs) to shed light on Mandarin *wh*-conditionals. On one hand, many studies argue that short answers to *wh*-Qs, such as (1), are not reducible to ellipsis and hence must be semantically represented (Groenendijk & Stokhof 1989; Jacobson 2016; Xiang 2016). On the other hand, Honcoop (1998) and Haida (2007) suggest that *wh*-phrases have dynamic discourse contributions in the sense of introducing discourse referents (drefs), as evidenced by cross-sentential binding (2). In this paper, I propose that the drefs introduced by a *wh*-phrase can be used to model the short answer to the corresponding *wh*-question. I then discuss how this proposal provides a novel analysis for Mandarin *wh*-conditionals (3), which are conditionals with co-referring *wh*-phrases showing up in the antecedent clause and the consequent clause (*jiu* is a conditional marker).

1. A: Who enters?  
   B: Ahn.
2. Who1 won the game? What’s his1 score?  
   ‘Whoever enters first eats first.’

Non-interrogative uses of *wh*-phrases are generally taken to be indefinites. The obligatory coreference of *who*’s in (3) is puzzling and violates the novelty condition of indefinites (Heim 1982).

**Update with centering:** Following Bittner (2014) and Murray (2010), I assume that a context *c* is a set of structured sequences *s* of drefs (cf. Dekker 1994). Specifically, *s* := ⟨*T*, ⊥⟩, in which *T* is the top sequence representing drefs in the center of attention, while ⊥ is the bottom sequence representing drefs in the periphery of attention. Sentences denote context change potentials, i.e., functions from context to context. The table below lists some sample lexical items. Proper names can add drefs to *T* (when notated with †) or ⊥. *T* + *a* is a shorthand for ⟨*T* + *a*, ⊥⟩ and ⊥ + *b* for ⟨⊥, ⊥ + *b*⟩, where + is sequence extension. Proper names are modeled as generalized quantifiers (GQ). The denotation of *Ahn invites Bill* is composed as in (4).

<table>
<thead>
<tr>
<th>items</th>
<th>denotation</th>
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<tbody>
<tr>
<td><em>Ahn†</em></td>
<td>λαλc.P(a)(⟨<em>T</em> + <em>a</em></td>
</tr>
<tr>
<td><em>Bill</em></td>
<td>λαλc.P(b)(⊥ + <em>b</em></td>
</tr>
<tr>
<td><em>invite</em></td>
<td>λαλyλc.⟨<em>s</em> ∈ <em>c</em></td>
</tr>
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(4)  

\[ \text{[Ahn invites Bill]} = \text{[Ahn†} \lambda x. (\text{Bill} \lambda y. \text{invite(y)}(x)) = \lambda c. \{\langle \text{T} + \text{a}, \perp + \text{b} \rangle | \langle \text{T}, \perp \rangle \in c, \text{invite(b)}(\text{a})\} \]

**Questions:** We follow the spirit of Karttunen’s (1977) semantics of *wh*-Qs and propose that *wh*-phrases denote GQs quantifying over proper names, i.e., dynamic GQs, as in (5).

(5)  

\[ \text{[who enters]} = \text{[who†} \lambda \mathcal{P}. \mathcal{C}(\mathcal{P} \lambda x. (\text{enter}(x))) = \{\lambda c. \{\langle \text{T} + \text{a}, \perp \rangle | \langle \text{T}, \perp \rangle \in c, \text{enter(a)}\} | \lambda c. \{\langle \text{T} + \text{b}, \perp \rangle | \langle \text{T}, \perp \rangle \in c, \text{enter(b)}\} \}

\]

**Short answers:** We can extract possible short answers to a *wh*-Q from the set of possible sentential answers to it by using an operator Λ that takes a question *Q* and returns a dynamic property of sequences *i*. *T* *i* − *T* delivers the sequence that is part of *T* *i* but not *T* *i*. Any sequence *i* that has the property consists of drefs introduced by a possible sentential answer *p* in *Q* (see Figure 2).

(6)  

\[ \Lambda(Q) := \lambda i \lambda c. \bigcup_{p \in Q} \{s' | s' \in p(c), \exists s \in c. s \leq s' \& \ T_s - T_s = i \} \]

**Quantification over short answers:** The present proposal accounts for many phenomena that call for the use of short answers to *wh*-Qs—*wh*-conditionals being one of them. Concretely, I propose
that the two wh-clauses in (3) are questions, (see also Liu 2016), denoting the set $Q_1$ and $Q_2$ respectively, and each of them is operated on by $\Lambda$. The conditional introduced by jiu expresses adverbial quantification: a covert adverbial akin to always ($\Lambda$) takes the antecedent clause as restriction and the consequent clause as scope (Kratzer 1981; Cheng & Huang 1996; Chierchia 2000). (3), translated as (8), involves a dynamic universal quantification over sequences. In prose, (8) says: all the sequences that are possible short answers to $Q_1$ are possible short answers to $Q_2$.

$$A_i \left( (\Lambda(Q_1)(i)) \left( \Lambda(Q_2)(i) \right) \right) = \lambda c. \{ s \in c \mid \forall i. \Lambda(Q_1)(i)(c) \neq \emptyset \rightarrow \Lambda(Q_2)(i)(\Lambda(Q_1)(i)(c)) \neq \emptyset \}$$

As a result, if Ahn is the short answer to who enters first, then it is also the short answer to who eats first (see Figure 3). This is the underlying reason for why the two who’s seem to co-refer.

**Pair-list readings:** In multiple wh-conditionals, the wh-phrases in the antecedent clause establish a list of pairs, and the wh-phrases in the consequent clause give rise to the same list.

(9) Shéi ná-le ná dào cài. shéi jiu yào bā ná dào cài chǐ-wán.

‘Everyone who took a dish must finish it.’

(If Ahn took bread and Dufu corn, Ahn must finish beef and Dufu corn; and if Ahn took corn and Dufu bread, Ahn must finish corn and Dufu bread)

Our proposal is compatible with the quantifying-into-question approach in which a multiple wh-question can be understood as a conjunction of two questions. For example, the denotation of who took which dish is derived in (10). $\sqcap$ is to pointwisely apply dynamic conjunction $\land$ to two sets. Finally, different pair lists correspond to different sequences (cf. Bumford 2015).

$$\sqcap \{ \text{who took which dish} \} = \sqcap \{ \text{Ahn took which dish} \} \sqcap \{ \text{Dufu took which dish} \} =$$

$$\{ \{ \text{A took beef} \} \land \{ \text{D took corn} \} \} = \lambda c. \{ \text{T}_s + b + a + c + d \mid s \in c, \text{take(b)}(a), \text{take(c)}(d) \}$$

The wh-conditional in (9) expresses: for any sequence $i$ that is a possible short answer to who took which dish, $i$ is also a possible short answer to who must finish which dish. Given (10), if $i = b + a + c + d$ is a short answer to the first question, then it is a short answer to the second question, i.e. Ahn must finish beef and Dufu must finish corn.

**Coordination:** It is well known that the categorial approach (Hausser & Zaefferer 1979) represents the meaning of a wh-Q as a set of short answers. However, it cannot represent coordination of wh-Qs as sets of short answers (Groenendijk & Stokhof 1989; Xiang 2016). For this reason, it fails to predict the well-formedness of wh-conditionals with coordinated wh-phrases.

(11) Nǐ chī shēnme, hē shēnme, wǒ jiu yào chī shēnme, hē shēnme.

‘No matter what you eat and what you drink, I must eat and drink the same things.’

My proposal can easily capture (11). In the antecedent clause, you eat what via $\sqcap$. The short answer is a sequence consisting of a food and a drink. The same mechanism is applied to the consequent clause.

**Conclusion:** I have proposed a novel way to derive short answers to wh-Qs from propositional answers using dynamic semantics. The proposal not only offers an adequate analysis for Mandarin wh-conditionals, but can also be extended to English free relatives and quantificational variability effects of wh-Qs, which Xiang (2016) has used to motivate the semantic necessity of short answers.
**Figure 1:** who^1 undergoes Quantifier Raising, leaving a ‘trace’ $\mathcal{P}$ which is itself typed a dynamic GQ and normally takes scope. In this sense, who^1 is a higher order dynamic GQ. C is the complementizer in the sense of Karttunen (1977), mapping a proposition to a singleton set of the proposition.

(a) Suppose the sequence $i$ is $a$ that consist of only Ahn.

(b) Suppose the sequence $i$ is $b$ that consist of only Bill.

**Figure 2:** Consider (6). The sequences $a$ and $b$ can make $\Lambda(\llbracket\text{who enters}\rrbracket)$ ‘true’ ($\neq 0$) relative to the input context.

**Figure 3:** The sequence $a$ (only involving Ahn) is a possible short answer to who enters first and is also a possible short answer to who eats first. $\llbracket\langle T + a + a, \bot\rangle\rrbracket$ indicates Ahn enters first and eats first.

**Selected references**