**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 (wh-Cond). On one hand, it’s been argued that short answers to wh-Qs, e.g., (1), are not reducible to ellipsis and should be semantically represented (Groenendijk & Stokhof 1989; Jacobson 2016; Xiang 2016). On the other hand, it’s been suggested that wh-phrases have dynamic discourse contributions in the sense of introducing discourse referents (drefs) (Honcoop 1998, Haida 2007), 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 a wh-question. I then discuss how this proposal provides a novel analysis for Mandarin wh-Cond (3), which are conditionals with co-referring wh-phrases in the antecedent clause and the consequent clause (jiu is a conditional marker). Non-interrogative uses of wh-phrases are generally taken to be indefinites. The obligatory co-reference of the two instances of shei ‘who’ in (3) is puzzling and violates the novelty condition of indefinites (Heim 1982).

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

**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 add drefs to T (notated with †) when used as sentential focus; otherwise to ⊥. Tᵢ+a is a shorthand for ⟨T+a, ⊥⟩ and ⊥+b for ⟨T, ⊥+b⟩, where + is sequence extension. Proper names are modeled as generalized quantifiers (GQ). The denotation of Bill invites Ahnᵢ is composed as in (4).

<table>
<thead>
<tr>
<th>items</th>
<th>denotation</th>
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<tbody>
<tr>
<td>Ahn†</td>
<td>λPc.P(a)⟨{Tᵢ+a</td>
</tr>
<tr>
<td>Bill</td>
<td>λPc.P(b)⟨{⊥+b</td>
</tr>
<tr>
<td>invite</td>
<td>λcxλyλc. {s ∈ c</td>
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(4) \[ \text{Bill invites Ahn}_F^* = \text{Bill } \lambda y. (\text{Ahn}_F^* \lambda x. \text{invite}(x)(y)) \]

**Short answers:** 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) \[ \text{who}^* := \lambda f. \{ f(Q) | Q \in \{ \text{Ahn}_F^*, \text{Bill}_F^* \} \} \]

We assume that in wh-Qs only wh-phrases introduce drefs to T (cf. Murray 2010), since they are focus and provide the foreground information (von Stechow & Zimmerman 1984; Krifka 2001; a.o.). Who enters denotes a set of context change potentials, i.e., possible sentential answers (6).

(6) \[ [\text{who enters}] = \text{who}^* \lambda P. \{ \text{C}(\lambda x. \text{enter}(x))) \}\]

We can extract possible short answers to a wh-Q from the set of possible sentential answers by using an operator ans⁸ that takes a question Q and returns a dynamic property of sequences i. Tᵢ⁺−Tᵢ delivers the sequence that is part of Tᵢ⁺ but not Tᵢ. Any sequence i that has the property must consist of drefs introduced by a possible sentential answer p in Q, as in Figure 1.

(7) \[ \text{ans}^8(Q) := \lambda i c. \bigcup_{p \epsilon Q} \{ s' | s' \epsilon p(c), \exists s \epsilon c. s \leq s' \& Tᵢ⁺−Tᵢ = i \} \]
Quantification over short answers: The present proposal accounts for various phenomena that call for the use of short answers—wh-conditions being one. 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 $\text{ans}^S$. The conditional introduced by jiu expresses adverbial quantification: a covert adverbial akin to always ($A_h$) 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 $Q_2$.

$$\begin{align*}
(8) \quad & A \ i \ (\text{ans}^S(Q_1)(i)) (\text{ans}^S(Q_2)(i)) = \lambda c \ \{ \text{vi. } \text{ans}^S(Q_1)(i)(c) \neq \emptyset \rightarrow \text{ans}^S(Q_2)(i) (\text{ans}^S(Q_1)(i)(c) \neq \emptyset) \}
\end{align*}$$

As a result, if $A_h$ is a short answer to who enters first, then it is also a short answer to who eats first (see Figure 2). This is the underlying reason for why the two who’s seem to co-refer.

$$\begin{align*}
(\{\tau, \bot\}) & \text{ans}^S(\text{who enters})(\text{x})(\{\tau + a, \bot\}) = \text{ans}^S(\text{who eats first})(\text{x})(\{\tau + a, \bot\}) \cup \\
(\{\tau, \bot\}) & \text{ans}^S(\text{who enters})(\text{x})(\{\tau + b, \bot\}) = \text{ans}^S(\text{who eats first})(\text{x})(\{\tau + b, \bot\}) \cup \\
\end{align*}$$

Figure 2: The sequence $a$ (only involving $A_h$) is a possible short answer to who enters first and is also a possible short answer to who eats first. $\{\tau + a + a, \bot\}$ indicates Ahn enters first and eats first.

Coordination: The categorial approach (Hausser & Zaefferer 1979) represents the meaning of a wh-Q as a set of short answers, but 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.

(9) Nǐ chí shěnme, hē shěnme, wǒ jū yào chí shěnme, hē shěnme. you eat what drink what I then must eat what drink what

‘No matter what you eat and what you drink, I must eat and drink the same things.’ My proposal can capture (9). In the antecedent clause, you eat what is conjoined with you drink what via $[\sqcap]$, which pointwisely applies dynamic conjunction $\land$ to two sets, as in (10). The short answer is a sequence consisting of a food and a drink. The same mechanism is applied to the consequent clause. (9) expresses: for any sequence $i$ that is a possible short answer to you eat what, drink what, $i$ is also a possible short answer to I eat what, drink what. If $i = b + w$ is a short answer to the first $Q$, then it is a short answer to the second one, i.e. I eat beef and drink wine.

$$\begin{align*}
(10) \quad [\text{you eat what}] \sqcap [\text{you drink what}] &= \{ [\text{you eat beef}] \land [\text{you drink wine}] \} \land \{ [\text{you eat corn}] \land [\text{you drink milk}], \ldots \} = \\
&\lambda c. \{ \text{eats} + b + w \mid s \in c, \text{eats}(b)(you), \text{drinks}(w)(you) \} \\
&\lambda c. \{ \text{eats} + c + m \mid s \in c, \text{eats}(c)(you), \text{drinks}(m)(you), \ldots \}
\end{align*}$$

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