

### Echo *wh*-questions: A scope analysis

**Introduction:** Echo *wh*-questions (EWHQs), as a type of non-canonical question, are known to exhibit properties not amenable to the standard composition of *wh*-questions (WHQs). However, I argue that these properties do not stand in way for unifying WHQs and EWHQs. As long as we allow both **content** and **sentential force** in compositional semantics, the many differences between WHQs and EWHQs reduce to where a *wh*-phrase takes scope: in canonical WHQs *wh*-phrases take scope within the content level, whereas in EWHQs they scope over a sentential force.

**Widest scope:** An intriguing property of EWHQs is that echo *wh*-phrases always take the widest scope, superimposing a question meaning on a variety of speech acts (Artstein 2002; Dayal 1996; Beck & Reis 2018; a.o.). In the following examples, the echo *wh*-phrases (in small capitals) scope over a question-selecting predicate *know*, a *yes-no* question and an imperative, respectively.

- (1) A: Lee knows who lived in Turpan. B: Lee knows who lived WHERE?  
 (2) A: Did Peter lend Sue his laptop? B: Did Peter lend Sue WHAT?  
 (3) A: Let's move to New York! B: Let's move to WHERE?

Moreover, scope taking of echo *wh*-phrases is not blocked by superiority effects. In (4), WHO takes scope over the WHQ with *what*, as evidenced by the fact that only the WHO-question can be answered, i.e., answering the *what*-question (4–iii) and answering both the *what*-question and the WHO-question (4–ii) are not allowed.

- (4) A: What did Centaurus buy? (ii) #Centaurus bought a book and Al-  
 B: What did WHO buy? ixia bought a pencil.  
 A: (i) Centaurus. (iii) #A pencil.

**Similarities with canonical *wh*:** Despite the distinguishing features between WHQs and EWHQs, there are reasons to believe that the *wh*-phrases in them have the same semantics (Beck & Reis 2018). First, cross-linguistically, all echo *wh*-phrases are morphologically the same as *wh*-phrases in WHQs. Second, the use of echo *wh*-phrases is constrained by their restrictions, just like *wh*-phrases in WHQs. For example, since the information that the *wh*-phrase in (5)-b echoes is clearly about a place, the form of the *wh*-phrase must be *where* rather than *what*.

- (5) A: Lee went to Turpan. B: Lee went to WHERE/\*WHAT?

**Proposal:** I propose that echo *wh*-phrases are *wh*-phrases that take scope over a sentential force. The proposal relies on the following two assumptions:

(I) A sentential force is part of compositional semantics (Krifka 2001; Davis 2011; a.o.). The meaning of a sentence is divided into **content** and **force**. The content is truth-conditional, whereas the force represents discourse dynamics. The declarative **Decl** and interrogative **Int** force are defined as follows. They are modeled as functions mapping content to context-update proposals.

- (6) a. **Decl** :=  $\lambda p \lambda c. \{c \cap p\}$  b. **Int** :=  $\lambda Q \lambda c. \{c \cap p \mid p \in Q\}$   
 $c$  is the Stalnakerian context set. **Decl** takes a proposition  $p$  and returns a function mapping an input context  $c$  to a singleton set containing only one context update  $c \cap p$ . **Int** takes a question  $Q$ , a set of propositions, and returns a function mapping  $c$  to a set of context updates. (6-a) and (6-b) capture the intuition that both assertion and question are to propose updates, instead of directly updating contexts (Farkas & Bruce 2010).

(II) *Wh*-phrases denote sets of alternatives, as in (7) and take scope via the Set monad  $\langle S, \gg, \eta \rangle$  (Charlow to appear), which consists of a 'type-constructor'  $S$  mapping any type  $a$  to a corresponding type  $Sa$  (abbreviating  $a \rightarrow t$ ), a polymorphic  $\eta$  function (type  $a \rightarrow Sa$ ) mapping any element  $x$  into a singleton set containing only  $x$ , and a polymorphic  $\gg$  operation (type  $Sa \rightarrow (a \rightarrow Sb) \rightarrow Sb$ ) allowing any set  $m$  to take scope.

- (7) **what** :=  $\{x \mid x \in \text{thing}\}$  (8) a.  $\gg := \lambda m \lambda f. \bigcup_{x \in m} f(x)$  b.  $\eta := \lambda x. \{x\}$

The composition of a canonical WHQ is illustrated as follows. *What* operated on by  $\gg$  undergoes Quantifier Raising and  $\eta$  is applied to its scope, generating a set of proposition, type  $St$  ( $t$  stands for the type of a set of worlds). Notice that **buy** abbreviates the intensional meaning  $\lambda x \lambda y \lambda w. \text{buy}_w x y$ . This process is essentially the same as Karttunen's (1977) composition.

$$(9) \quad \llbracket \text{what did Lee buy} \rrbracket = \boxed{\text{Int}} \left( \text{what}^{\gg} \lambda x. \eta(\text{buy } x \text{ I}) \right) = \boxed{\text{Int}} \left( (\lambda f. \cup_{x \in \text{what}} f x) \lambda x. \{\text{buy } x \text{ I}\} \right) = \\ \boxed{\text{Int}} \left( \{\text{buy } x \text{ I} \mid x \in \text{thing}\} \right) = \lambda c. \{c \cap p \mid p \in \{\text{buy } x \text{ I} \mid x \in \text{thing}\}\}$$

Deriving EWHQs: Since both  $\gg$  and  $\eta$  are polymorphic, the scope of a *wh*-phrase is not restricted to type St objects. In an EWHQ, therefore, the *wh*-phrase can take scope over the sentential force in the same way as it does in a canonical WHQ, as in (10). The type of the echo *wh*-phrase with  $\gg$  is  $(e \rightarrow S(\text{ccp})) \rightarrow S(\text{ccp})$  ( $\text{ccp} :: S\omega \rightarrow S(S\omega)$ ;  $\omega$  is the type of possible worlds). Finally, a set of interrogative sentences is generated.

$$(10) \quad \llbracket \text{what did WHO buy} \rrbracket = \text{echo} \left( \text{who}^{\gg} \lambda y. \eta \left( \boxed{\text{Int}} \left( \text{what}^{\gg} \lambda x. \eta(\text{buy } x y) \right) \right) \right) = \\ \text{echo} \left( \left\{ \boxed{\text{Int}} \left( \text{what}^{\gg} \lambda x. \eta(\text{buy } x y) \right) \mid y \in \text{human} \right\} \right)$$

Since the sentential force is the root of a sentence, echo *wh*-phrase scoping over the force operator must take the widest scope.

**Echo:** An **echo** operator, defined in (11), is applied to the resulting set, generating the echo interpretation. **echo** is interpreted relative to an antecedent sentence  $A'$  (a context-update proposal) and adds an answerhood condition (cf. Dayal 1996). The condition requires that there must be exactly one sentence  $A$  in  $\mathcal{Q}$  that echoes the antecedent sentence  $A'$  in a context. Specifically, for any context  $c$ ,  $(A c)$  echoes  $(A' c)$  iff each of the proposed updates in  $(A c)$  is entailed by some proposed update in  $(A' c)$ , as in (12). Then, the addressee picks out  $A$  to answer an EWHQ.

$$(11) \quad \text{echo}_{A'} := \lambda \mathcal{Q} \lambda c. \mathcal{Q} \text{ defined only if } \exists! A \in \mathcal{Q} \text{ s.t. } (A c) \text{ echoes } (A' c)$$

$$(12) \quad (A c) \text{ echoes } (A' c) \text{ iff } \forall p \in (A c) \exists q \in (A' c). q \subseteq p$$

The existence of **echo** is evidenced by the fact that in some languages, like Cantonese and Japanese, EWHQs host specific sentence final particles. The ‘entailment’ relation in (12) can predict that echo *wh*-Qs don’t always share the same structure as its antecedent (Beck & Reis 2018).

**Island insensitivity:** The challenge for a scope-taking analysis is that echo *wh*-phrases are insensitive to scope islands (Artstein 2002), as in (13), where the echo *wh*-phrase is embedded in the tensed adjunct clause. However, the current analysis incorporating the Set monad predicts that echo *wh*-phrases should pattern like indefinites, which also uses the Set monad and are insensitive to islands according to (Charlow to appear). In (14), WHO first shifts into a scope taker via  $\gg$  and takes scope at the edge of the island. Then, the whole clause is turned into a scope-taker by  $\gg$  and takes scope over the **Decl** operator.

$$(13) \quad \text{A: Lee'll be angry if Ann is invited.} \quad \text{B: Lee'll be angry if WHO is invited?}$$

$$(14) \quad \text{echo} \left( \left( \text{who}^{\gg} \lambda x. \eta(\text{be.invited } x) \right) \lambda p. \eta \left( \boxed{\text{Decl}} \left( \text{if } p \text{ then } (\text{angry I}) \right) \right) \right)$$

**Metalinguistic inquiry:** EWHQs can be used to ask for information below word level (Janda 1985; Artstein 2002). In (15), WHAT is used to request a repetition of the syllable *ortho*. I propose that the word with WHAT is quoted, i.e., ‘WHAT-dontist’. Following Maier 2014 and Koev 2017, a quoted word introduces a non-issue meaning. I assign the denotation in (16) to ‘orthodontist’. In particular, the quoted word takes scope over the sentential force, which brings a context  $c$  into the compositional process, and requires  $c$  to entail that the word *orthodontist* has been uttered (cf. Barker et al. 2010).

$$(15) \quad \text{A: Bill is an orthodontist.} \quad \text{B: He is a WHAT-dontist?}$$

$$(16) \quad \text{'orthodontist'} = \lambda f \lambda c. f \llbracket \text{orthodontist} \rrbracket c \quad ((e \rightarrow t) \rightarrow \text{ccp}) \rightarrow \text{ccp} \\ \text{defined only if } c \subseteq \{w \mid \text{the word } \textit{orthodontist} \text{ is uttered in } w\}$$

For the EWHQ in (15), WHAT denotes a set of syllables, which are part of the quoted word. The quoted word scopes over **Decl** and WHAT continues to take scope. By contrast, in a canonical WHQs, the *wh*-phrase cannot take scope over the sentential force. As a result, the LF in (18) is ill-formed: the quoted word scopes above **Decl**, while **what** under **Decl**; **what** cannot bind the variable  $x$ .

$$(17) \quad \text{echo} \left( \text{what}^{\gg} \lambda x. \eta \left( \text{'x-dontist'} \lambda p. \boxed{\text{Decl}} (P \text{ he}) \right) \right)$$

$$(18) \quad \text{'x-dontist'} \lambda p. \boxed{\text{Int}} \left( \text{what}^{\gg} \lambda x. \eta (P \text{ he}) \right) \quad \times$$