

ZUGÄNGLICHKEIT UND LOKALITÄT IN WH-FRAGEN

Linguistic Evidence

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Overview

- *Some* syntactic variations (dative alternation, HNPS, active vs. passive) have been analyzed in terms of preferred orders given the relative complexity of the involved participants/constituents, (e.g. Bock, 1986; Wasow 1997; Hawkins, 1994, 2004; van Nice & Dietrich, 2003; Bresnan et al., 2005)
- **Today:** What does such an approach reveal about another kind of syntactic variation, usually not analyzed in such terms: wh-phrase ordering in multiple wh-questions
- Our research complements other psycholinguistic inquiries into this topic (Featherston, 2005; Clifton et al., to appear; Fedorenko & Gibson, 2006)

Locality Constraints on Long-distance Dependencies

- Effect of distance (=locality) on both the acceptability, frequency and grammaticalization of long-distance dependencies observed in Gibson (1991;1998;2000) Hawkins (1994; 1999), and many others
- *Wh*-phrase fillers pose the additional challenge of lacking a specified, identifiable referent (sometimes never established in discourse), potentially accounting for their high cognitive cost (Fanselow et al., 1999)

Accessibility Constraints on Wh-dependencies: Filler

- Pesetsky's (1987; 2000) theory of d(iscourse)-linking to explain contrast between (1) & (2):

(1) Which class of drug will which patient get?

(2) What will who get?

- In short, morphophonological content, information, and discourse salience impacts acceptability of wh-dependencies
 - Interestingly, which-NPs make better antecedents for pronouns than bare wh-words (Frazier & Clifton, 2002)
- ⇒ *Which*-NPs as higher accessibility (=memory activation level) markers than bare *wh*-words (cf. Ariel 1990; 2001)

~~Accessibility Constraints on Wh-dependencies:~~

Intervenor

- Similarly, words associated with high cognitive cost (=low accessibility) between filler and gap impair integration of *wh*-phrases (Gibson, 1998; Alexopoulou & Keller, 2003)
- Effect of intervenor accessibility evident in center-embedding examples:

(3a) The boy [the girl [the host knew] brought] left.

(3b) The boy [the girl [I knew] brought] left.

Superiority Violations

- These factors in *wh*-dependencies are perhaps at their most visible in multiple *wh*-questions—even more particularly, “superiority violations”:
 - (4) What did who read?
- Their effect may be marginal or invisible in many dependency types which do not pose substantial cognitive difficulty
- Examples like (4) traditionally ruled out on principles of Universal Grammar such as ‘Superiority’ (Chomsky, 1973) or Minimal Link Condition (Chomsky, 1995: 296)

Superiority Violations

- Converging evidence, though, favors the idea that these configurations are not categorically ruled out
 - Arnon et al. (2005) point out ‘Superiority’-violating examples occurring naturally in corpora, e.g.

What changed recently? If the system has been working until the last month or so, and suddenly is going beserk [sic], something has changed to trigger the corruption. What did who do (with or without your knowledge) to these systems.

- Clifton et al., (to appear) report a similar set of examples drawn from the WWW
- Featherston (2005) presents evidence for ameliorating effects in German and English

Wh-processing hypothesis (WPH)

- These considerations lead us to propose the following hypothesis which, along with existing models of processing complexity (Gibson, 1998, 2000) lead to several predictions:
- ***WH-Processing Hypothesis:*** *Given the choice between several grammatical wh-orders, speakers disprefer those which (given the context) are associated with a greater processing cost*
 - I. Gaps that are further from the filler are harder to process
 - II. Less accessible fillers are harder to process
 - III. Less accessible intervenors are harder to process

Outline of Talk

- Test wh-processing hypothesis in multiple wh-questions
- Assumption: increased processing difficulty reduces acceptability (Fanselow & Frisch, to appear; Gibson, 1998; etc.)
- Three acceptability judgment surveys using M(agnitude) E(stimation) and one self-paced reading-time study
 - ME Experiment 1: Effect of Locality
 - ME Experiment 2: Effect of Accessibility
 - ME Experiment 3: Effect of Filler Accessibility
 - Reading-time Study: Effect of Accessibility
- Discuss cross-linguistic implications and other types of *wh*-constructions

Locality & Accessibility in Wh-Questions

Method

- Judgments were elicited over WWW using Magnitude Estimation (Bard et al., 1996) with WebExp software (Keller et al., 1998)
- Participants set their own continuous scale of acceptability, based on a reference sentence
- Subjects were unpaid; recruited from e-mail lists

Participant and Item Summary for 4 Experiments

	ME1	ME2	ME3	RT1
N1 Participants	41 (1)	42	42	41
N2 Items	36	20	36	20

Experiment 1: Locality

ME1 Study: Locality

Hypothesis

- Longer filler-gap distances (measured in terms of new discourse referents) \Rightarrow higher processing cost \Rightarrow lower acceptability judgments

- *Which man did [~~the girl~~] see ___? >*

Which man did [¹the girl] in [the bar] on [California Ave.] see ___?

3

Locality & Accessibility in Wh-Questions

ME1 Study: Locality

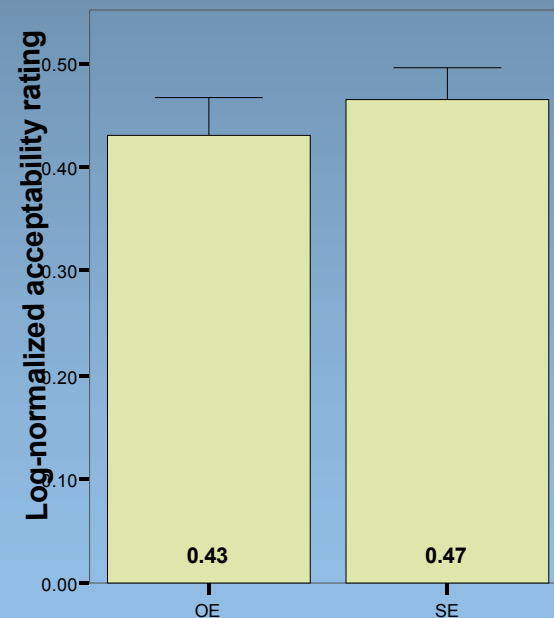
- Examined difference between examples like (a)-(d) below in a Latin square design, varying extraction type and PP attachment
- a. *Which man ___ saw the girl?* (SBJ-WH, 0 INT)
- b. *Which man ___ saw the girl in the bar on California Ave?* (SBJ-WH, 0 INT)
- c. *Which man did the girl see ___?* (OBJ-WH, 1 INT)
- d. *Which man did the girl in the bar on California Ave. see ___?* (OBJ-WH, 3 INT)

Locality & accessibility in Wh-Questions

ME1: RESULTS

- Object extractions (more interveners) are judged as somewhat less acceptable than subject extractions ($F(1,35) = 4.9, p < .05$; non-significant by items, $F(1,35) = 2.5, p = .12$).
- Locality is a good but not perfect predictor of the observed variation in acceptability

Figure 2: Overall Effect of EXTRACTION



Locality & Accessibility in Wh-Questions

ME1 Study: Locality

a. *Which man* ___ *saw the girl?*
WH, 0 INT)

(SBJ-
n.s

b. *Which man* ___ *saw the girl in the bar on California Ave?*
WH, 0 INT)

(SBJ-
*

c. *Which man did the girl see* ___?
INT)

(OBJ-WH, 1

d. *Which man did the girl*
in the bar on California Ave. see ___?
WH, 3 INT)

(OBJ-

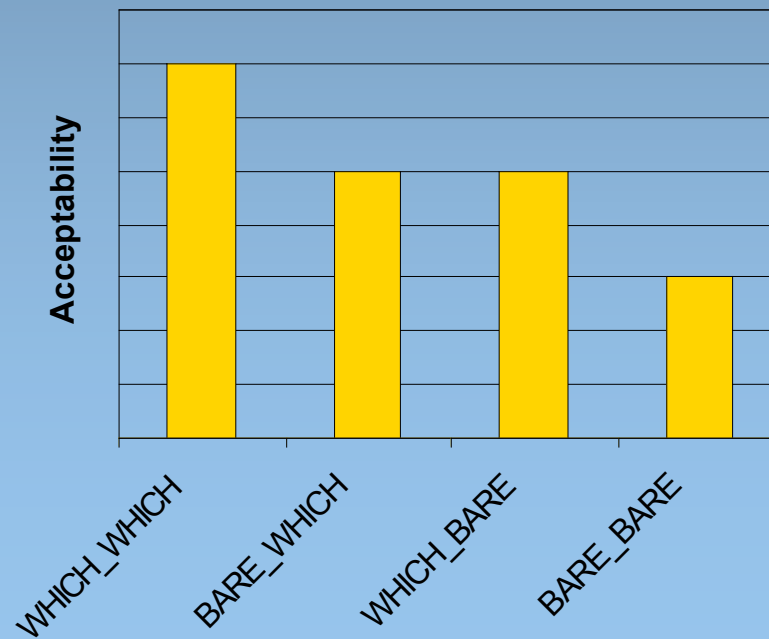
Magnitude estimation Experiment 2: Accessibility

ME2 Study

Hypothesis

- SUVs with high accessibility fillers and intervenors should be preferred to those with low accessibility fillers and intervenors

Prediction for Filler x Intervenor



ME2 Study: Accessibility

Design

2 (subject-*who* vs. subject-*which*) x 2 (object-*what* vs. object-*which*)

Materials

20 SUV items (each in 4 conditions presented below):

- a. *Mary wondered what who read.* (SUBJ-*who*/OBJ-*what*)
- b. *Mary wondered what which boy read.* (SUBJ-*which*/OBJ-*who*)
- c. *Mary wondered which book who read.* (SUBJ-*who*/OBJ-*which*)
- d. *Mary wondered which book which boy read.* (SUBJ-
which/OBJ-*which*)

Locality & Accessibility in Wh-Questions

ME2: RESULTS

- less accessible *intervenors* decrease acceptability significantly

($F1(1,37) = 64.5$, $F2(1,19) = 248.1$, $P_s < .001$)

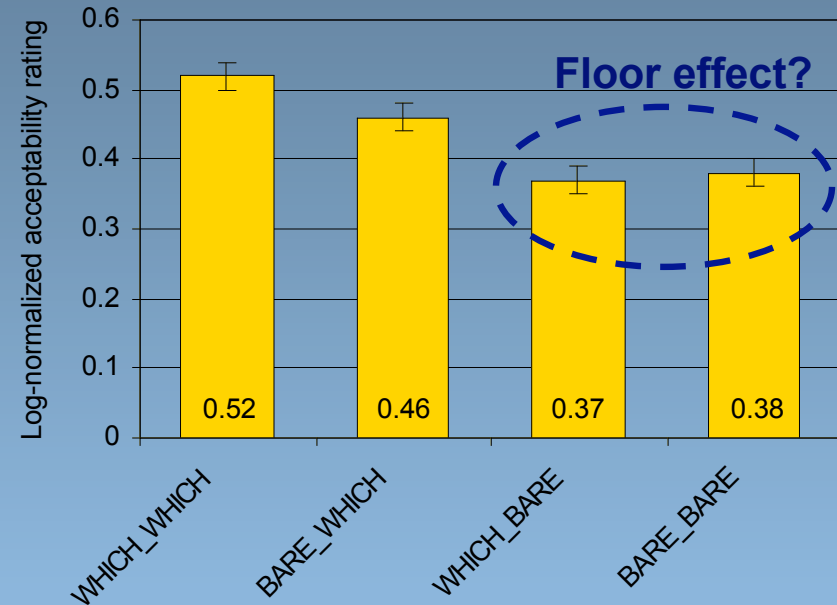
- Effect of *filler* accessibility

($F1(1,37) = 19.2$, $F2(1,19) = 15.7$, $P_s < .001$)

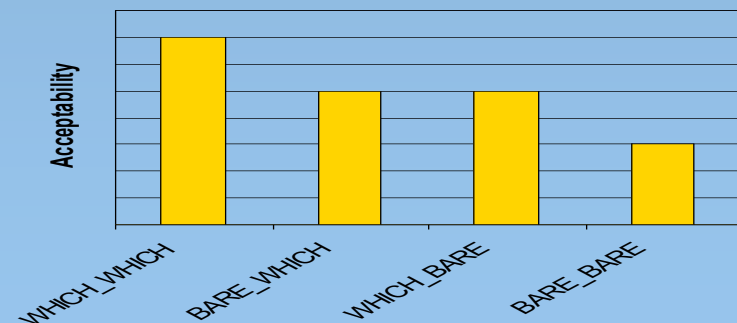
- But this is due to interaction

($F1(1,37) = 9.9$, $F2(1,19) = 9.8$, $P_s < 0.01$)

Accessibility of Filler x Intervenor



Prediction for Filler x Intervenor



ME2: RESULTS

- For *which*-intervenors, less accessible fillers reduce acceptability, but for bare *wh*-intervenors, ME2 did not reveal any effect of filler accessibility
- Sentences with bare *wh*-intervenors were considered worse than those with *which*-intervenors
 - Effect of intervenors actually outweighs effect of filler (contrary to standard assumptions; e.g. Pesetsky, 2000)
- Supports parts II and III of the WPH
 - Some expectations met, but others not—unpredicted interaction

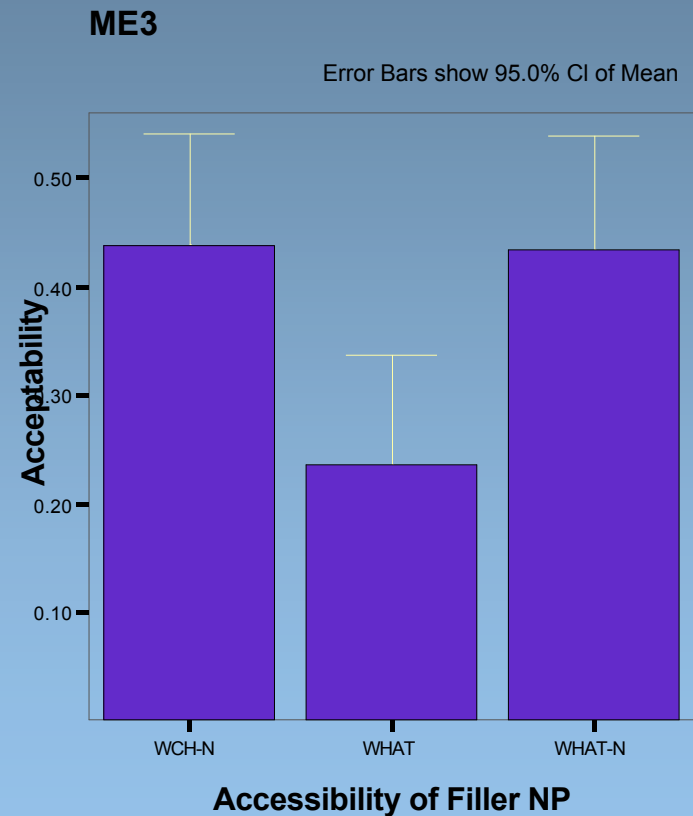
Magnitude estimation Experiment 3: Filler Accessibility

ME3 Study: Filler Accessibility

- Were the interaction results of ME2 due to a floor effect?
- In ME3, we focus only on properties of the filler
- **Prediction:** higher accessibility fillers \Rightarrow lower processing cost \Rightarrow higher acceptability judgments
 - a. *Tom revealed what who invented.* (SUV: *what*)
 - b. *Tom revealed what device who invented.* (SUV: *what-NP*)
 - c. *Tom revealed which device who invented.* (SUV: *which-NP*)

ME3: RESULTS

- *which*-NP and *what*-NP fillers were preferred to bare *what* fillers
(pairwise comparisons highly significant by subject $t_s > 3.0$; marginal by items $t_s > 1.6$)
- acceptability of *which*-NP and *what*-NP fillers in SUVs, though, did not differ from each other
(subject and item $t_s < 0.6$, $P_s > 0.5$)



Reading time
Experiment 1:
Accessibility

Locality & Accessibility in Wh-Questions

RE1: DESIGN

- Assumption that acceptability judgments above relate to processing
- To evaluate how much of the observed differences actually due to processing, we investigated accessibility in self-paced, moving window reading task

~~Mar~~ ~~wondered~~ ~~which~~ ~~book~~ ~~who~~ ~~read~~
y

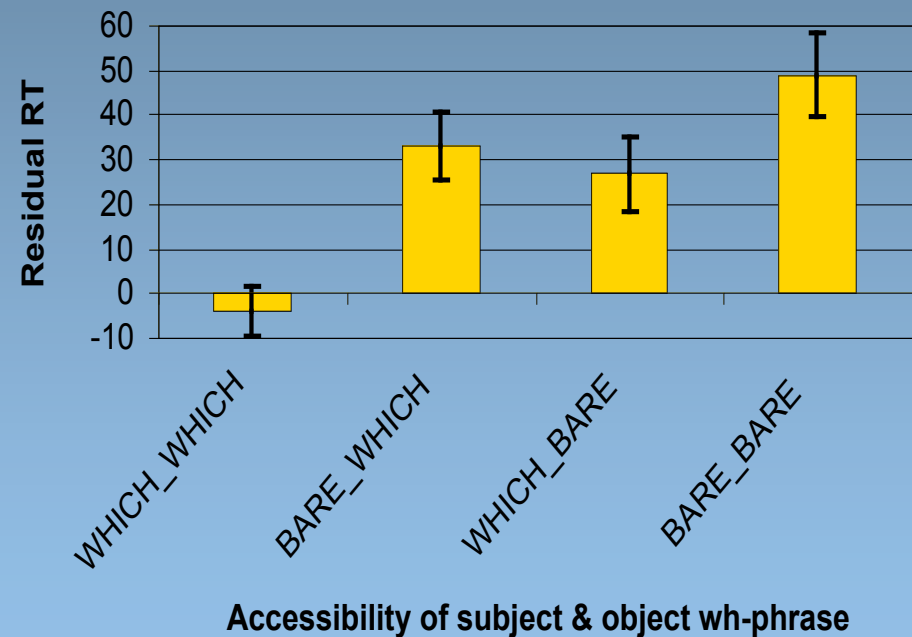
- Stimuli followed by questions testing for comprehension
- Stimuli drawn from ME2 (2 x 2)
- Forms of filler and intervenor expected to influence reading times at embedded verb

Locality & Accessibility in Wh-Questions

RE1: RESULTS, reading times

- less accessible fillers result in slower processing at the verb
($F1(1,40) = 17.7, p < .001,$
 $F2(1,19) = 12.3, p < .003$)
- Same for less accessible intervenors
($F1(1,40) = 10.5, F2(1,19) = 11.5,$
 $P_s < .01$)

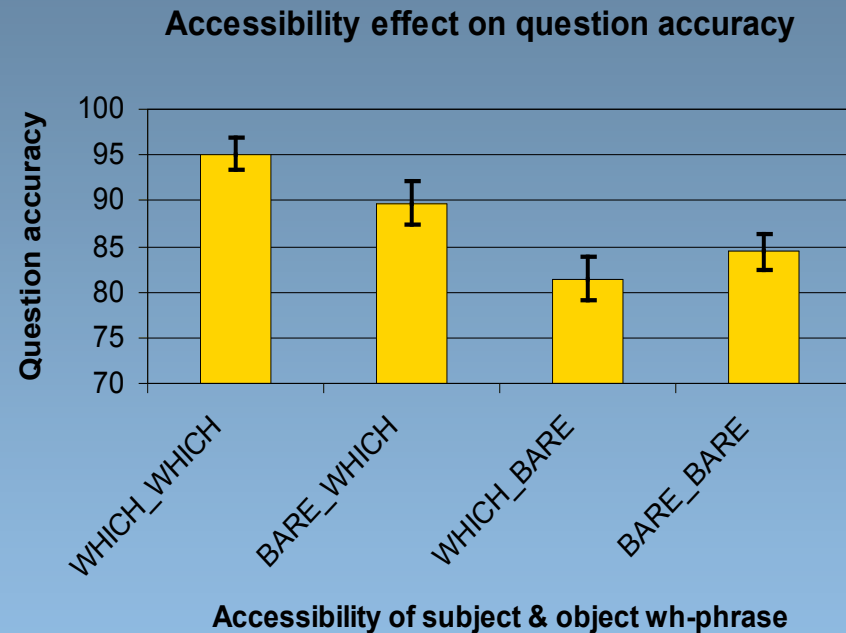
Accessibility effect on reading time



Locality & Accessibility in Wh-Questions

RE1: RESULTS, question accuracy

- Interaction between intervenors and filler accessibility
(marginal by subject, $F(1,40) = 3.6$, $p < 0.07$; significant by item, $F(1,19) = 5.6$, $p < 0.03$)
- *wh*-questions with bare *wh*-intervenors: filler accessibility does not affect question accuracy
- With which-intervenors: high accessibility *which*-fillers result in better question-answer accuracy (95%, SE = 2.5) than low accessibility bare *wh*-fillers (89.9%, SE = 3.1)



OVERALL SUMMARY

- Configurations of multiple *wh*-phrases display gradient acceptability, depending on locality and accessibility of filler and intervening *wh*-phrases
- **Locality:** Longer *wh*-dependencies correlate with lower acceptability
- **Filler Accessibility:** In SUV contexts, high accessibility *wh*-fillers (*which, what*-NPs) improve both acceptability and reading times
- **Intervenor Accessibility:** In SUV contexts, high accessibility *wh*-intervenors improve both acceptability and reading times
- ⇒ **Possible interpretation:** Grammar has fillers-gaps w/ independently motivated processing constraints accounting for space of judgments rather than grammatical constraints

Cross-linguistic Evidence

- Featherston (2005): Superiority effects observed in German
 - Cross-linguistic difference: only accessibility of intervenor influences acceptability in German multiple wh-questions—accessibility of filler not significant
- Fedorenko & Gibson (2006): Partial replication of results for English with acceptability survey; but no observed Superiority effect in Russian
- The results for Russian present a challenge to the proposal we've made
 - *WPH* predicts certain orders should be dispreferred, but Russian speakers do not judge SUV and non-SUV orders differently

Discussion

- Russian: Frequency of object-initial sentences may account for difference—object-subject orders easier to process in scrambling languages like Russian than English
- German: Case-information may reduce processing cost
- The various predictions of the WPH work to minimize cognitive work load, but if the task is already lightened by other mechanisms, we have no expectation of observing the effects of the WPH

Discussion

- Processing implications for various other wh-dependency types that are labeled syntactically ill-formed (e.g. wh-islands, subject islands, adjunct islands) (Kluender, 1992;1998)
 - *What did you wonder whether Marianne saw ___?*
- Factors investigated here intuitively seem to improve this weak island:
 - *Which movie did you wonder whether she saw ___?*
- Kluender suggests processing factors of holding a filler in working memory (=locality) and additional referential processing (=intervenors) “can interact to yield traditional grammaticality effects”

Conclusion

- We have shown that a historically grammatical contrast involves a gradient space of judgments that (partially) depends upon locality and accessibility
- Considerable amount of variation can be explained by processing factors introduced to explain other phenomena in sentence processing
- Our results so far may only account for part of the observed variation
 - frequency effects of verbs (item variation), plausibility, clause boundaries, and contextual factors are likely also relevant
- There are challenges, but any account that predicts only a categorical contrast fares much worse

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