TEMPORAL DYNAMICS OF WEAK-ISLANDS: A SPEED-ACCURACY TRADE-OFF STUDY

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BACKGROUND AND AIMS OF THE STUDY

According to **Featural Relativized Minimality** [1], whenever a long-distance dependency between an **extracted element** and its trace is disrupted by an **intervening element** having identical syntactic featural specification (e.g., +Q), the sentence is perceived as ill-formed (1). In contrast, a sentence is acceptable (2) if the intervener has no feature in common with the extracted element.

(1) *What$_i$ do you wonder who built __$_i$?
+Q +Q

(2) What$_i$ do you believe that John built __$_i$?
+Q +N

However, several acceptability studies conducted both in English and French [2,3] showed that not all cases of feature identity engender the same level of degradation. In particular, sentences containing two lexically restricted wh-elements (3) are more acceptable than sentences containing two bare wh-elements (1), even though in both cases the intervener has the same featural specification of the extracted element.

(3) ?Which building$_i$ do you wonder which engineer built __$_i$?
+Q, +N +Q, +N

As all these sentences involve the ***retrieval*** of the extracted element when the embedded verb is reached, the observed pattern may reflect constraints on retrieval.

According to **Cue-based memory models** [4], syntactic and semantic cues at the retrieval site enable direct access to the memory representation of the extracted element. The probability of successfully retrieving a representation is determined by the feature match between the target and the probe, and by the feature distinctiveness between the target and irrelevant memory representations.

Under the assumption that lexically restricted wh-elements (*which N*) are encoded in a more distinctive manner than bare wh-elements (*wh-*) [5], a Cue-based memory model provides a natural account of the observed pattern: the richer encoding of lexically restricted wh-elements, as compared to their bare counterparts, increases their distinctiveness in memory, which leads to lower retrieval interference and higher acceptability rates.

Here, we tracked response accuracy across the full time-course with the speed-accuracy trade-off (SAT) procedure to investigate how interference affected memory retrieval in resolving multiple, nested long-distance dependencies..

METHOD

Participants:18 French-speaking adults

Material: 36 sets of 16 sentences, each set consists of:

- ***4 sentences with extraction from a wh-island*** in which a sentence-initial wh-element (Wh1) has been extracted from the object position of a verb over a second wh-element (Wh2) serving as the subject of the verb. The lexical restriction of both Wh1 and Wh2 was manipulated in a 2x2 design:

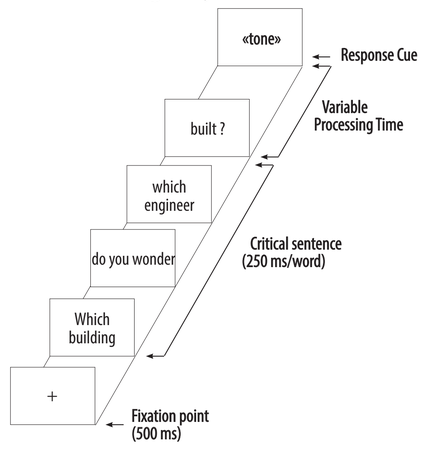
Wh1	Wh2	Sentences	Conditions
Bare	Bare	(a) What do you wonder who built __?	Bare Identity
Bare	Restricted	(b) What do you wonder which engineer built __?	Inverse Inclusion
Restricted	Bare	(c) Which building do you wonder who built __?	Inclusion
Restricted	Restricted	(d) Which building do you wonder which engineer built __?	Complex Identity

- ***4 sentences with extraction from a non-island*** in which a sentence-initial wh-element (Wh1) has been extracted from the object position of a verb over a non-wh subject. The lexical restriction of Wh1 and the subject was manipulated in a 2x2 design (e.g., What/Which building do you believe that he/the engineer built?).

These two conditions were paired with 2 conditions consisting of fully ungrammatical sentences obtained by replacing the transitive embedded verb with an intransitive verb in half of the cases, and with a transitive but semantically infelicitous verb in the other half.

- ***4 ungrammatical sentences with intransitive verbs*** (e.g., What/Which building do you wonder who/which engineer smiled? ; What/Which building do you believe that he/the engineer smiled?).
- ***4 ungrammatical sentences with transitive semantically infelicitous verbs*** (e.g., What/Which building do you wonder who/which engineer terrorized? ; What/Which building do you believe that he/the engineer terrorized?).

The experimental sentences were intermixed with 144 fillers, all grammatical variants of the intransitive sentences (e.g., He/The man wonders who/which boy slept).



Procedure: Sentences were presented one phrase at the time, and participants were asked to make yes/no acceptability judgments at each of 18 tones presented at 250 ms intervals at the onset of the last phrase.

Data Analysis: Full time course SAT functions are modeled as an exponential approach to a limit:

$d'(t) = \lambda(1-e^{-\beta(t-\delta)})$ for $t > \delta$, else 0

λ = **asymptote** (providing a measure of the overall probability of retrieval)

β = **rate of rise** (indicating the rate at which accuracy grows from chance to asymptote)

δ = **intercept** (the point at which information first becomes available)

RESULTS

Negative responses to the wh-island sentences were scaled against a common miss rate derived from the extraction from non-island sentences. In this case, d' measures how distinct the non-island and the island conditions were from one another: hence, lower d' means that islands are less discriminable from non-islands.

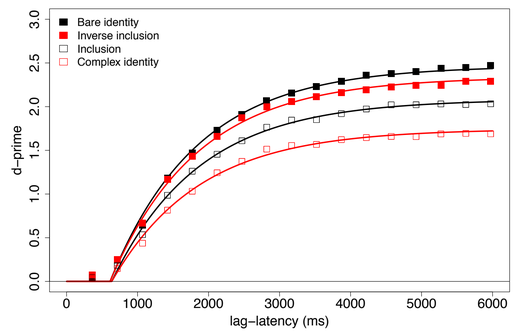


Fig.1. *Average d' accuracy (over subjects) as a function of processing times for the 4 island conditions. Correct rejection rates for islands were scaled against miss rates for non-islands.*

Best fit (of average data): 4λ - 1β - 2δ

λ (d')= 2.47 (Bare Identity), 2.34 (Inverse Inclusion), 2.08 (Inclusion), 1.74 (Complex Identity)

β (s^{-1})= 0.811 (common)

δ (s)= 0.612 (bare extractees), 0.634 (restricted extractees)

Adjusted-R^2: 0.997

Mixed-effects model of individual participant parameters:

ASYMPTOTIC PARAMETER

- Main effect of Lexical Restriction on the extractee (β=0.65, t=4.3): lower d' for restricted than bare
- Main effect of Lexical Restriction on the intervener (β=0.31, t=2.02): lower d' for restricted than bare
- No interaction

DYNAMICS PARAMETERS

- No significant effect in the combined dynamics, although Complex Identity is numerically the fastest

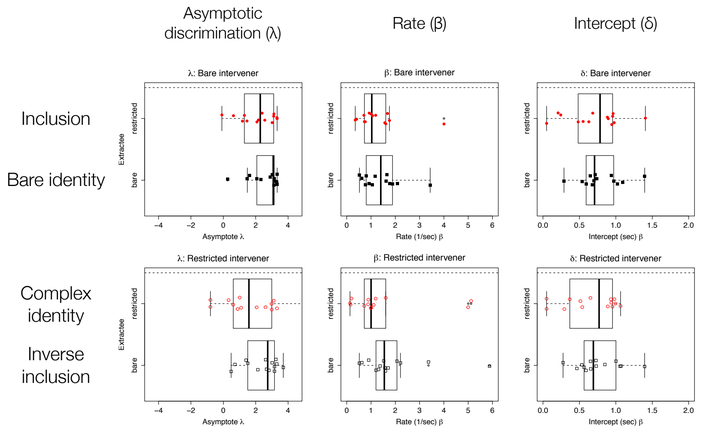


Fig.2. *Parameter fits to each individuals' data in the 4 island conditions.*

CONCLUSIONS

1. Analyses of asymptotic accuracy reveal the pattern: ***Complex Identity > Inclusion > Inverse Inclusion > Bare Identity***.
   Acceptability was highest when the extractee was lexically restricted. In a Cue-based retrieval account, a lexically-restricted extractee is more distinctive in memory, hence more accessible with retrieval cues at the extraction site. Acceptability is further improved when the intervener is also lexically restricted, which, in a Cue-based retrieval account, occasions greater distinctiveness of the intervener from the to-be-retrieved extractee.
2. Analysis of processing speed reveals no obvious differences in the dynamics of the four island structures. The finding that the retrieval dynamics of sentences with semantically richer wh- elements is not slower than that of sentences with bare wh-elements is consistent with semantic and syntactic features of the dependency being processed within the same time window.

References: [1] Rizzi, 2001. In M. Baltin & C. Collins (Ed.), Handbook of Contemporary Syntactic Theory • [2] Atkinson et al., 2013. Talk presented at NELS 44, Storrs, University of Connecticut • [3] Villata et al., 2013. Poster presented at AMLaP 19, Marseille, France • [4] McElree et al., 2006. In B. H. Ross (Ed.), The psychology of learning and motivation, Vol. 46 • [5] Hofmeister et al. 2013. Lang Cogn Process.