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The Role of D-Linking and Lexical Restriction in Locality Violations

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Abstract:

The major contrast discussed in the literature to show an obviation of the wh-island effect often involves a bare wh- element in the role of the intervener (e.g. who) and a "complex" wh-phrase (e.g. which book) in the role of the moved item. This contrast is not minimal, since it is not sufficient to disentangle the role of D-linking (Pesetsky 1987) from that of the so-called "lexical restriction" (Friedmann, Belletti, and Rizzi 2009). In this work we try to fill this gap by contrasting, in an argumental wh- island configuration (e.g. "… [who read …]"), which NP vs. what NP both in English and in Italian (e.g. which/what book and quale/che libro). We argue that while both wh- phrases can be genuinely considered "lexically restricted", the first, and not the second, has properties that make it allegedly D-linked (i.e. a canonical partitive interpretation is available). Our acceptability studies show that (in both languages) no significant difference is revealed in the scores attributed to the two extracted wh-phrases and no significant variance (e.g. indicating a binomial distribution) is observed in the condition what NP. The first result indicates that the "D-linking" hypothesis as an independent source of amelioration is inadequate; the second result suggests that also the hypothesis that the condition what/che NP might be ambiguous between a D-linked and a non-D-linked reading is unlikely.

Keywords: *D-Linking, Featural Relativized Minimality, Intervention, Partitives, Wh-Islands*

Introduction

In locality theory, syntactic islands represent a prototypical case of constraint on the creation of A'-dependencies (Ross 1967; Cinque 1990; Rizzi 1990). A clear partition of this domain has been related to the strength of the extraction prohibition: the classical distinction is expressed by the contrast between strong islands (1), blocking any form of extraction from within their boundaries (but see Bianchi and Chesi 2014; Hofmeister and Sag 2010 a.o.), and weak islands, that seem, to some extent, to tolerate extraction, thus giving more nuanced levels of (un) acceptability, as in the .a vs. b. contrast in (2):

(1) **What* do you believe [the fact [that he bought __]]?
(2) a. **What* do you wonder [*who* bought __] ?
b. ?Which car do you wonder [*who* bought __]?

The reason for such variability is generally attributed to the peculiarities of the extracted *wh*-element with respect to the intervening one. A long tradition of studies (Pesetsky 1987; Comorovski 1989) interprets this extraction facilitation in terms of *D(iscourse)-linking*, i.e., the property that characterizes *wh*-phrases that refer to contextually salient individuals, denoted by the overt NP. This intuition has been formalized in various ways. In some cases, it has been rephrased as Referentiality (Cinque 1990; Rizzi 1990), i.e., an interpretive reflex of a binding-like dependency between the D-linked *wh-* item and its thematic position, rather than a full-fledged displacement as in other A'-dependencies. Other interpretations of this effect, instead, strongly rely on extralinguistic factors: working memory would be at issue in these configurations, and the strength of a "richer" (more specific and better specified, for instance by means of a restrictive relative clausal modification) memory trace associated to the *wh*-filler (Hofmeister and Sag 2010; Hofmeister 2011) would be able to "save" the dependency in the prototypical filler-gap configuration (Fodor, Bever, and Garrett 1974). A further possibility is offered by featural Relativized Minimality (fRM, Rizzi 1990; Starke 2001; Grillo 2008; Friedmann, Belletti and Rizzi 2009): Under this perspective, the higher acceptability of the D-linked phrase would be related to the presence of a "lexical-restriction" (an overt NP) that mitigates the intervention effect by making the extracted item "richer" than the intervener.

While robust crosslinguistic evidence for the contrast in (2) is available in the literature, the majority of studies focused on the contrast between bare (e.g. *what*) and complex *wh*-phrases (e.g. *which NP*), and only a few studies have tried to disentangle the role of D-linking from that of lexical restriction. This paper is intended to fill this gap.

First of all, we will set the stage by summarizing the fundamental theories addressing the notion of D-linking (§ 1.1) and the relevance of the presence of a "lexical restriction" (§ 1.2) in a coherent and testable way also briefly presenting the processing perspective (§1.3). We will then present a significant contrast in Italian and English, *which NP* vs. *what NP*, for which we provide some morphosyntactic evidence supporting the intuition that the first, but not the second, is allegedly D-linked (§ 1.4). This contrast will be then ideal to compare those theories that attribute the role of the amelioration to the presence of D-linking or to the lexical restriction; § 1.5 summarized the predictions in this sense. We will then present in § 2 the novel data gathered from two acceptability judgments in Italian and English. We will conclude (§ 3) that no evidence is found in this study supporting the facilitatory role of D-linking: the presence of a lexical restriction seems then sufficient to induce comparable amelioration in the extracted *wh*-phrases across an argumental *wh*-island.

1. Theoretical background

1.1 D-linking as a composite notion

The notion of D-linking was introduced by Pesetsky (1987) as the property that characterizes *wh*-phrases referring to salient individuals in the discourse, known by both the addresser and the addressee of the question. This interpretation naturally surfaces with *which NP* phrases,

but, as (Pesetsky 2000: 16) notices, it may in principle be triggered by any *wh*-item that can be substituted in context by the overt partitive form "which of the NP". The syntactic effects of D-linking consist in a general ability to circumvent syntactic restrictions like Superiority Constraints (Chomsky 1973), i.e., the requirement for multiple *wh*-questions to have the most prominent *wh*- precede the least prominent one, as exemplified in (3):

(3) a. I wonder *who* saw *what*.
b. *I wonder *what who* saw.
c. I wonder *which man* saw *which movie*.
d. I wonder *which movie which man* saw.

Both (3b) and (3d) violate Superiority in that the object dependency crosses over the subject *wh*-; however, only the object in (3d) conforms to the salient characterization outlined above, and successfully escapes the syntactic rule. Furthermore, and crucially for this work, D-linked *wh*-phrases with strong contextual anchoring are allowed (to some extent) to escape weak island boundaries, as shown by the sentences in (2). Some analyses have tried to capture this freer conduct by assuming that salient (or referential) *wh*-phrases may adopt non-local strategies to bind their surface positions with the gaps they moved from, and assumed the existence of referential indices (Rizzi 1990) or null pronominals (Cinque 1990; Hirose 2003) licensing non-local binding. However, the fact that D-linking can in principle be attributed to any *wh*-phrase in its optimal context has suggested that it may not be an inherent structural property of specific *wh*-items, but rather the manifestation of an interpretive fact expressed in presuppositional terms (a.o.: Comorovski 1989): D-linked phrases make it possible to verify the existential presupposition on the referent of the *wh*-constituent under discussion, thus making the *wh*-question felicitous and answerable (i.e., accessible in the Common Ground, Krifka 2008).

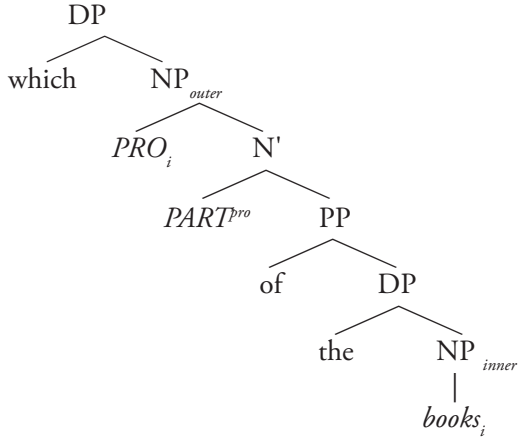
In this spirit, D-linking has been subsumed or associated with the notion of definiteness (Diesing 1992), and in general to the observation that it identifies the DPs referring to objects that have already been introduced in the discourse context, or whose relation to already introduced objects is easily recoverable (Enç 1991), as opposed to new discourse referents. One attempt to provide a semantic characterization of this otherwise rather vague notion of referentiality is offered by Szabolcsi and Zwarts (1997), who define D-linking as the property of *wh*-phrases that range over individuals or discrete entities that can be collected into unordered sets. On the contrary, *wh*-items that naturally range over properties or non-individual entities are not expected to induce D-linking, and in turn to resist extraction from weak island. Based on the naturalness of their "individual" reading, Szabolcsi and Zwarts also suggest an ordering for *wh*- types, *which* being the most natural individual-denoting item and aggressively non-D-linked, *wh-the-hell* expressions, occupying the opposite end of the ordering. A similar referential hierarchy has been proposed for Greek by Anagnostopoulou (1994), as an attempt to account for the observed extractability scale (">" means "more extractable than"):

(4) bare *wh*-phrases (who, what) > what NP (what book) > which NP (which book) > overt partitive *wh*-phrases (which of your books)

All in all, two distinct components seem to be associated with the notion of D-linking: a purely contextual notion and a partitive interpretative counterpart. The first suggests a presupposition of existence of a given, familiar, set of individuals, while the second requires a proper partition which is operated by a partitive (implicit) *of* construction (e.g., "which (of these) books").

From a structural perspective, the analysis we will adopt for proper partitive constructions (*canonical*, in the sense of Falco and Zamparelli, 2019) refines the classic "two NPs" analysis (Jackendoff 1968; Selkirk 1977) consisting essentially of an "outer" (empty) and an "inner" (full) NP ([which [NP_e [of the *NP*]]]). According to Falco and Zamparelli (2019), the outer (pronominal) NP is the projection of a partitive head (*PART*) hosting an empty N (*PRO*) in its specifier, and this latter PRO enters into a matching relation with the inner NP (the "restriction") within the selected partitive PP, as simplified in (5):

(5)



The semantic analysis of the PART phrase allows one to include only proper partitions of the relevant set of individuals, excluding the maximal set (the *supremum*) (e.g., *two of my eyes). It is important to consider a minimal difference with respect to an apparently similar partitive configuration in which the preposition used is not *of* but *among* (e.g., "two (books) among (all) the books"): these constructions are considered semi-partitives (Hoeksema 1984) and present morphosyntactic peculiarities, such as (i) the inner NP is marked by the ablative case instead of genitive in Turkish (von Heusinger and Kornfilt 2017) and (ii) mass partitives are incompatible with *among*, as in "half of/*among the people". According to Cardinaletti and Giusti (2017), the *among* partitives are in fact adjunct and not selected PPs. We will come back to this minimal contrast in the discussion in § 4 and § 3.

1.2 The role of the lexical restriction

An alternative way to analyse the mitigation of *wh*-island effects has been explored by proponents of an intervention-based approach, shifting the focus from discourse salience to the morphosyntactic properties of the *wh*-constituents at issue. Following featural Relativized Minimality (fRM, Starke 2001; Rizzi 2004; 1990), the creation of a dependency between two positions X and Y may be disturbed by an element Z whenever it (i) structurally intervenes between X and Y and (ii) shares some relevant features with X, i.e., features that play a crucial role in triggering and determining the trajectory of the dependency ("criterial" features in the sense of Rizzi, 1997; 2004). Further refinements drawing from acquisition studies (Friedmann, Belletti, Rizzi 2009; Grillo 2008 for supporting data from aphasic populations) have shown that the number and the type of features shared by the target of the derivation X and

the intervener Z are directly proportional to the strength of intervention effects. Following this analysis, the ungrammaticality of (2a) is explained by the fact that the object *wh-* in the embedded clause (Y) is raised up to the CP of the matrix clause (X), and raising is triggered by the relevant feature [+Q] that characterizes both the *wh*-item and its surface position. The same feature, however, is also carried by the intervening *who* (Z), so identity of features gives rise to a strong violation of locality:

(2) a. **What* do you wonder *who* bought _ ?
[+Q] [+Q]
X Y Z

As for (2b), the mitigation of intervention is attributed to the presence of a lexical noun phrase specifying the *wh*-constituent, the so-called lexical restriction, which contributes in featural terms by adding a [+NP] to the featural make-up of the extracted *wh-*. Consequently, the features of the intervener represent a subset of the features that trigger the derivation, and this inclusion configuration results in a weaker violation of locality and higher acceptability:

(2) b. ?*Which car* do you wonder *who* bought __?
[+Q, +NP] [+Q]
X Y Z

It is worth noticing that [+NP] *per se* is not able to trigger movement (it is not "at the edge" of the DP phrase), and in principle it should be excluded from the set of relevant features that have a role in the calculus of intervention (+NP is not "criterial" since it is inaccessible at the DP edge). However, proponents of the intervention-based approach provide evidence that lexical restriction has a crucial role in *wh*-movement by looking at Northern Italian dialects (Munaro 1999), where lexically restricted *wh*-items are pronounced in clause-initial positions, while bare *wh*-items surface in clause-final position. This difference is interpreted as the reflex of different landing sites for the two types of *wh-*, and in turn of the relevance of [+NP] to determine *wh*-movement. Hence, the lexical restriction feature should be included in the set of features that enter the calculus of intervention, and in turn responsible for the weaker deviance of (2).b. An idea (Rizzi p.c.) to make the status of the lexical restriction "criterial" is to consider the selectional features associated with the D head: from this perspective, *which* selects a NP, while *who* does not. In this sense a [+NP] feature will be associated to *which* phrases, but not to bare *wh-* like *who*.

1.3 The processing perspective

From the perspective of processing, different degrees of referentiality have been associated with differences in the persistence of the D-linked DP filler in working memory. This approach has often been considered as highly transparent with respect to a gradual prediction in terms of acceptability, then able to "explain" the scale presented in (4).

On the one hand, more referentially accessible DPs (based on a referentiality hierarchy, Ariel 1991) facilitate the filler-gap dependency, since the filler, being "more accessible", can be more easily retrieved in the gap position (Warren and Gibson 2005; 2002; Gibson 1998). On the other, more details (a prepositional restriction and/or a restrictive relative clause) reinforce the memory trace of the filler, again facilitating retrieval (Hofmeister and Sag 2010; Hofmeister 2011).

In both senses (2).b obtains higher acceptability than (2).a because of the stronger referentiality of *which car* as opposed to *what*. Hence D-linking, or its effect on dependency processing, is ultimately held responsible for the observed mitigation of locality violation.

Previous experimental studies systematically tested the well-known paradigm presented in (2), often comparing bare *what* and complex *which NP* from a crosslinguistic perspective confirming the idealized contrast (Sprouse *et al.* 2016; Atkinson *et al.* 2016). Very few studies, however, tried to single out the notions of D-linking/referentiality and lexical restriction to assess which of the two determines a variation in acceptability. Among them, a study by Goodall (2015) tested the predictions of the two competing theories by contrasting the extraction of complex vs. bare *wh-* from different types of structures (a *that*-clause a *wh*-island and a complex noun phrase island). The purpose was to assess whether D-linking is a grammar-internal property with ameliorating effects limited to syntactically deviant structures (as predicted by grammar-driven theories), or an extra-grammatical fact that ameliorates any filler-gap dependency, hence supporting working memory-driven approaches. The results, compatible with an extra-grammatical explanation of D-linking, show that complex *wh*-phrases ameliorate any filler-gap dependency. Crucially the overt partitive structure *which of the NP* was opposed to bare *what*, in the end contrasting a non-strictly minimal pair of determiners.

In a later study, Villata, Rizzi and Franck (2016) tackled the same issue by extracting French bare and complex *wh*-phrases from *wh*-islands and manipulating a further condition, i.e., presence of a short context to trigger a D-linked reading (an identical design consisting of the Italian translation of these paradigms obtained the very same contrasts between conditions, Villata Canal and Franck (2015). No mitigation effect of context was detected (on the contrary, the context was related to a slight degradation of acceptability), thus contrasting Goodall's findings. However, Villata and colleagues tested the traditional opposition between bare *what* and complex *which NP*, which does not seem to be a minimal pair, either, as the two *wh-* should not only be distinguished in terms of D-linking, but they also differ with respect to lexical restriction, that is only found on *which*:

(6) a. Which *problem* do you wonder *who* solved?
[D-linked, +Q, +NP]
b. *What* do you wonder *who* solved?
[+Q]

1.4 What NP *vs* Which NP*: a more minimal D-linking contrast*

We concluded that the two types of *wh-* that are generally compared do not represent an optimal minimal pair, as they differ not only in the presence of a lexical restriction, but also in terms of D-linking, which is naturally induced by *which*, and not by bare interrogatives (Pesetsky 1987). Hence, comparing the extraction of these two constituents does not seem to be a sufficiently fine-grained strategy to isolate the well-known effects on acceptability. Here we considered a more minimal pair of *wh*-phrases: *which NP* and *what NP*. In both DPs, the lexical restriction is kept constant, and the only variation is related to the *wh*-determiner. Here we provide arguments suggesting that the two DPs are structurally different. We will then tentatively assume that only the first is allegedly D-linked, both in Italian and in English. Five arguments indicating a clear structural asymmetry between *which NP* and *what NP* constructions are summarized below.

First, a significant contrast[1] is observed in the perception of appropriateness between *which NP* and *what NP* in asking a question on a specific set of entities, once a precise context introducing the salient reference set is presented, as in (7):

(7) *Context*: Alfred is a math student, and he is struggling to solve one of Hilbert's problems. Berth knows he is spending night and day on Hilbert's problems, and she asks him about the precise problem he is facing now:

#*Che* / *Quale* problema	vuoi risolvere
What / *Which* problem	do you want to solve?

Second, the canonical partitive paraphrases are only available with *which NP*, (8a), and not with *what NP*, (8b):

(8)	a.	Quale	*di questi problemi*	vuoi risolvere?
		Which	*of these problems* do you	want to solve?
	b.	*Che	*di questi problemi*	vuoi risolvere?
		*What	*of these problems* do you	want to solve?

A semi-partitive interpretation (in the sense discussed in § 1.1) can be associated with *what NP*, with a relevant difference in Italian as opposed to English:

(9) Che *(problema) *tra* questi (problemi)…
What (problem) *among* these (problems)…

In both cases, the *among* partitive construction is available. In Italian, however, the "outer" NP must be present, possibly indicating the inability of *che* to license a (pronominal) NP gap restricted by the *among* adjunct.

Third, as suggested by an anonymous reviewer, *which* and *what* seem to occupy different structural positions, as shown by the availability of numerals only with the former *wh-* type, but not with the latter:

(10) Quali *due* problemi (tra questi) devi risolvere?
Which two problems (among these) do you have to solve?
(11) Che **due* problemi (tra questi) devi risolvere?
What *two problems (among these) do you have to solve?

Fourth, a mild agreement preference indicates that (at least in Italian) a straightforward preference for a "kind of" interpretation is favored in the *what NP* condition (12) ((12a) interpreted as "what kind of problems"), while a partitive interpretation is preferred with *which NP* (13) (13b seems mildly more accessible than (13).a, though both readings are available):

(12)	a.	Che problemi	pensi	sia	più facile	(*da) risolvere?
		What problems	do you think	is	easier.sg	(to) solve?
	b.	??Che problemi	pensi	siano	più facili	*(da) risolvere?
		What problems	do you think	are	easier.pl	to solve?

[1] These preliminary data are gathered through an informal inquiry of a number (< 10) of native speakers.

(13)	a.	(?)Quali problemi	pensi	sia	più facile	(*da) risolvere?
		Which.PL problems	do you think	is	easier.sg	(to) solve?
	b.	Quali problemi	pensia	siano	più facili	*(da risolvere?)
		Which.PL problems	do you think	are	easier.pl	to solve?

Last, but not least, cross-linguistic evidence supports this contrast: in a language like Romanian where Maximal Free Relatives (14) and Existential Free Relatives (15) are available, the equivalent of *quale* (*which*), namely *care* leads to ungrammaticality, as opposed to the equivalent of *che* (*what*), namely *ce* (Caponigro and Fălăuş 2021):

(14)	Ana a luat	[**care/ce* [carte/mâncare] a luat-o	şi Maria].
	Ana has taken	*which/what [book/food] has taken-cl.acc.3sg also	Maria

(15)	Maria nu are	[*care / ce [carte/cărţi/mâncare] să (o/le) ia].
	Maria not has	*which/what [book/books/food] SBJV [CL.3SG/CL.3PL] take.3SG

The semantic conflict expressed by the selection of the supremum set of individuals denoted by the relative restriction, in (14), or the absence of any available individual, in (15), is coherent with the analysis proposed by Falco and Zamparelli (2019) and presented in §1.1.

In the acceptability studies introduced in §4, we tested this contrast both in Italian and English, where these *wh*-phrases also differ for agreement morphology: absent on both English *which* and *what*; overt for number in Italian *quale*, but not on *che*. We assessed whether this property may be responsible for some form of variation in the acceptability between the two languages.

An actual minimal pair can be created by keeping one of the two properties constant across the two DPs while manipulating the other. In fact, while both *which* and *what* can take an NP as their complement and thus be lexically restricted, *which* is the only one of the two that also takes a default D-linked interpretation regardless of the conversational context, in virtue of its discourse anaphoricity (Caponigro and Fălăuş 2021).

Hence, a genuine minimal pair to test two competing theories, the first attributing a relevant role to D-linking (§1.1), the second to the presence of a lexical restriction (§1.2), should rather be the following:

(16)	a.	*Which problem* do you wonder *who* solved?
		[D-linked, +NP, +Q]
	b.	*What problem* do you wonder *who* solved?
		[+NP, +Q]

To the best of our knowledge, this contrast has been neglected in the literature, except for Alexopoulou and Keller (2013)'s acceptability judgment test on Greek and English. Based on Anagnostopoulou (1994)'s hierarchy for interrogative DPs, they tested the extraction of *what*, *what NP*, *which NP,* and *which of the NP* from within a *whether* island, but the only significant difference they observed was between *which NP* and bare *what*, while *what NP*, a referentially intermediate condition, was judged neither significantly better than *what*, nor significantly worse than *which NP*.

1.5 Predictions

The contrast in (16) was used to try to disentangle the putative role of D-linking (at least as far as the contrasts discussed in §1.4 are concerned) and lexical restriction in the amelioration of acceptability in ungrammatical extractions from *wh*-islands.

By exploiting the minimal pair with two complex (i.e., lexically restricted) determiners, it is possible to formulate precise predictions with respect to the possible outcomes: if D-linking is the manifestation of specificity, i.e., of a strong referentiality that characterizes highly accessible DPs, then we expect higher acceptability judgments on the D-linked condition than the non-D-linked ones because the latter should occupy a lower position in the same hierarchy. On the other hand, if lexical restriction and the featural Relativized Minimality model are on the right track, we do not expect a significant difference in the acceptability rates attributed to the two determiner types, since both are lexically restricted, i.e., carry the relevant [+NP] feature. More precisely, we first expect to find a main effect of D-linking independently of the intervention condition. Second, if the features distinguishing *which NP* and *what NP* are actually "criterial" in the sense of §1.2, an interaction between the D-linking factor and the extraction condition should be obtained, with much higher acceptability contrasts obtained in the extraction condition for D-linked DPs vs. non-D-liked, as opposed to the much milder contrast obtained in a non-extraction condition.

As far as reading times are concerned, we assume that a perceived difficulty (complexity) would slow down processing: in this sense, if D-linking is a facilitatory factor, we expect a main effect indicating shorter reading times only for this condition. Again, an interaction with the extraction condition would be expected, if and only if D-linking-related features are criterial: higher discrepancy in reading time, favoring D-linked items, is expected in the extraction condition, as opposed to the non-extraction condition.

2. Materials and method

2.1 Stimuli

For both languages, we manipulated two variables (with two levels each) in a 2x2 design: i) intervention (*intervention* level, i.e., long-distance extraction over the bare *wh- who* vs. *no intervention* level, long-distance extraction over a *that*-clause), and ii) the type of determiner introducing the main question (*non-D-linked wh*-item vs. *D-linked wh*-item). Depending on the intervention level, a different bridge predicate was chosen to have the selectional requirements fulfilled: in the *intervention* condition, *wh*-clauses were introduced by *chiedersi* in Italian and by its counterpart *wonder* in English; in the *no intervention* condition we chose Italian *pensare* and English *think* as main verbs. Overall, all extracted objects were singular, inanimate, and, for the Italian stimuli, masculine. An example of the four conditions for English and Italian is reported below:

17) Stimuli:

English	*Intervention*	*Wh- type*
a) What picture do you think that he drew?	no intervention	non-D-linked *wh-*
b) Which picture do you think that he drew?	no intervention	D-linked *wh-*

c) What picture do you wonder who drew?	intervention	non-D-linked *wh-*
d) Which picture do you wonder who drew?	intervention	D-linked *wh-*
Italian		
a) Che disegno pensi che abbia colorato?	no intervention	non-D-linked *wh-*
b) Quale disegno pensi che abbia colorato?	no intervention	D-linked *wh-*
c) Che disegno ti chiedi chi abbia colorato?	intervention	non-D-linked *wh-*
d) Quale disegno ti chiedi chi abbia colorato?	intervention	D-linked *wh-*

For each language, 24 lexically matched paradigms were created, for a total number of 96 stimuli for Italian and 96 stimuli for English. When possible, the Italian and English paradigms were each other's translation; in general, however, the lexical material was chosen based on word frequency in the two languages and keeping word length as homogeneous as possible across paradigms. Additionally, 48 fillers spanning the complete range of values in the acceptability scale were designed. Strongly acceptable fillers included well-formed *wh*-questions and polar questions; strongly unacceptable fillers included strong island violation structures; intermediate fillers, instead, included questions with multiple embeddings or in non-standard varieties of the two languages. Items were collected into four counterbalanced lists, each including 24 experimental stimuli (six per condition) and 48 fillers, for a total number of 72 stimuli for each participant: this way, each participant was exposed to only one stimulus from each lexical paradigm.

Fillers on the two ends of the acceptability scale were also used as inclusion criteria: average performance below 80% in fitting with the predicted range, both for clearly acceptable sentences (from 4 to 7) and for clearly unacceptable ones (from 1 to 3), lead to the experimental subject exclusion.

2.2 Procedure

The stimuli were presented in a web-based acceptability judgment experiment (JsPsych libraries were adopted, De Leeuw 2015). This experimental modality was chosen to encourage and facilitate participation, as the subjects could access the test remotely, just by clicking on a link from a device of their own choice (smartphone, tablet, laptop, or desktop). Participants were asked to judge the acceptability of the stimuli on a 7-point Likert scale, with 1 corresponding to totally unacceptable and 7 to perfectly acceptable, by selecting one of the seven slots corresponding to the values. Each experimental sentence was shown in isolation, screen-centered, one at a time, and on a single line.

Before judging the actual experimental sentences, subjects were presented with instructions on how to carry out the task, and with three sentences that served as examples: these included a perfectly acceptable sentence, a totally unacceptable sentence, and a nearly acceptable one. For each of these sentences, participants were first asked to assign them a value, then, after they scored the item, they were shown the expected acceptability range. This preliminary step was introduced to better explain the task and to encourage full use of the scale.

As for the actual trials, no time constraint on responses was set, and two pauses were planned during the task. One complete session lasted about 20 minutes. Informed consent was collected from all participants. The experiment has been approved by the Ethical Committee of the Department of Psychology at the University of Pavia (protocol 110/22).

2.3 Participants

43 native speakers of Italian (age range=21-59, M=29.77, SD=8.65) and 46 native speakers of English (age range=20-70, M=36.5, SD=14.36) voluntarily took part in the test. All subjects were asked to indicate their language variety (northern (31), central (4), or southern (8) for Italian; American (29), British (17), or Australian (0) for English).

2.4 Data analysis

Four English subjects were excluded from the analysis as they did not meet our inclusion criteria. Answers faster than 500 ms and slower than 60 seconds were excluded (<0.05 datapoints). Data were analyzed by fitting linear mixed-effects models of increasing complexity under the R environment (version 4.2.3) using lme4 library (version 1.1-32) (Bates, Mächler, *et al.* 2015), then comparing the models (ANOVA). Estimated marginal contrasts have been evaluated using the emmeans package (version 1.8.5) (Lenth 2022). A parsimonious random effect approach has been adopted (Bates, Kliegl, *et al.* 2015), in the end always including a random intercept adjustment by subject and by item. We both used as dependent variables acceptability (1-7) and reading time (*rt*, expressed in log-transformed milliseconds). Raw acceptability has also been transformed into z-scores to correct possible scale bias, but since each model equally converged with both dependent variables and the contrasts obtained were identical, here we only present models including raw acceptability as dependent variable, which we believe is intuitively more transparent with respect to judgment intuitions of native speakers.

2.5 Results

A strong main effect of intervention was observed: acceptability rates were significantly higher in the non-intervention condition than in the intervention condition, as expected ($\chi^2(2)=1828.8$, $p<0.0001$). On the contrary, differences in determiner type did not determine any main effect ($\chi^2(1)=1.9109$, $p=0.1669$). Crucially, the use of *che NP* and *quale NP* in the intervention condition did not lead to any significant difference in acceptability (Figure 1.Ita). However, an interaction emerges between determiner type and intervention, driven by the non-intervention condition: whenever the structure to be evaluated consisted of a *wh-* extraction from a complement clause, the lexically-restricted, non-D-linked *wh*-item *che NP* was attributed slightly worse values than the D-linked *quale NP* ($\chi^2(2)=16.346$, $p=0.0003$; non-D-linked - D-linked: *estimate*=-0.3417, *SE*=0.0873, *t*=-3.913, p=0.0006). The interaction between the main factors and reading times did not give rise to any significant effect. We did not observe any effect of language variety spoken ($\chi^2(2)=2.4705$, $p=0.2908$).

The analysis of English data gave very similar results: we observed a strong main effect of intervention ($\chi^2(2)=830.6$, $p<0.0001$). Moreover, no main effect ascribable to the determiner type emerged from the data analysis ($\chi^2(1)=0.994$, $p=0.3188$), that is, the presence of *what NP* or *which NP* in intervention structure did not have significant impacts on the acceptability judgments (Figure 1.Eng). Despite a numerical tendency (favoring *which* over *what*, as in Italian), no interaction emerges in English between determiner type and intervention ($\chi^2(1)=2.3606$, $p=0.1244$). Also in this experiment, no effect of language variety was detected ($\chi^2(2)=0.3748$, $p=0.8291$).

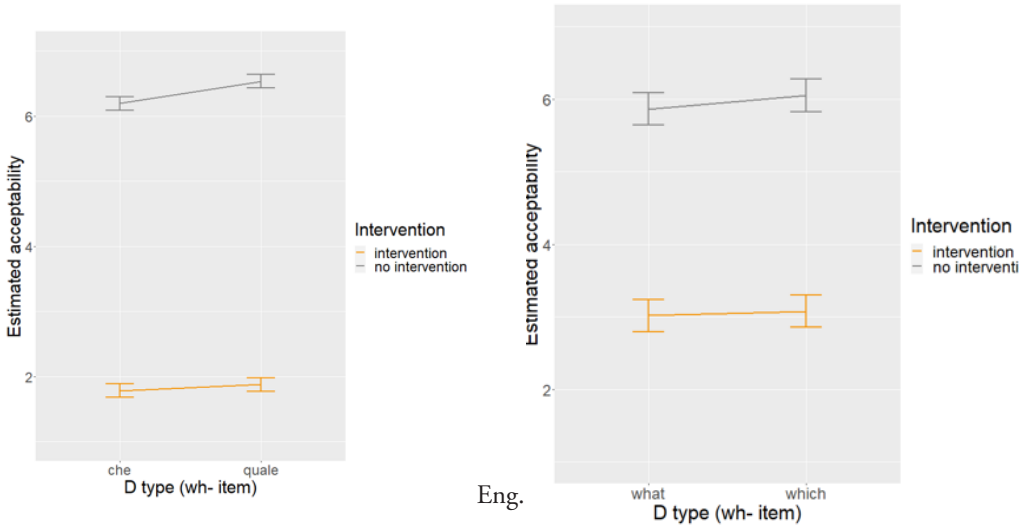


*Figure 1. Predicted acceptability based on the D type (*which/quale NP *vs.* what/che NP*) x intervention type (long distance extraction over a complement clause vs. a* wh- *argument model interaction. Italian data are to the left, English to the right. Error bars indicate Standard Errors.*

In both languages, an extremely low variance both by item and by subject was observed (significantly higher in English than in Italian, as graphically clear from the error bars in Figure 1). No binomial distribution was observed in any condition.

A significant intervention effect is detected looking at reading times ($\chi^2(1)=6.0070$, $p=0.01425$): the intervention condition induces a significant slowdown (of about 7500ms) in reading times (*intervention - no intervention*: *estimate*=755, *SE*=308, *t*=2.454, *p*=0.0143).

3. Discussion

The results obtained do not support the "referentiality" hypothesis while they are compatible with the fRM theory based on the relevance of a lexical restriction (Friedmann, Belletti, Rizzi, 2009): D-linking alone (or, more generally, the features distinguishing *which NP* from *what NP*, as discussed in §1.4) does not ameliorate locality violations (pace Hofmeister and Sag 2010; Hofmeister 2011). Moreover, from the low variance and the absence of any binomial distribution in acceptability, as well as totally comparable variance between the *wh-* type conditions, we should exclude an ambiguous interpretation of the *what/che NP* level between a D-linking and a non-D-linking interpretation, thus confirming that the lexical restriction hypothesis better explains the data collected in this study.

Our experiments cannot address any further the processing perspective (which remains to be tested since the prediction it makes is by and largely compatible with the results here obtained) but clearly indicate some relevant follow-up for this study. As mentioned in §1.1, canonical partitives ("quali di questi libri" / "which of these books") and pseudo-partitives ("quali tra questi libri" / "which among these books") might be another interesting minimal pair, since the former (*of*-PP), but not the latter (*among*-PP) include a partitive PP that should be selected by the preceding NP (Cardinaletti and Giusti 2017; Falco and Zamparelli 2019). According to the selection-based idea (§1.2), which elevates the "lexical restriction" to the status of "criterial feature", only the first item,

and not the second, should induce the relevant facilitation. This contrast cannot be predicted under any plausible interpretation of the processing perspective. Another relevant minimal modification of this contrast, which would erase the "structural" prediction, would be to include a full (outer) NP instead of a null (pronominal) one: "quali libri tra/di questi" / "which books among/of these".

Another critical factor in this experimental design was related to the "colloquial" nature of *che* (*what*) *NP* in Italian, that somehow justifies the significance of the interaction between factor in the Italian experiment: while this has probably nothing to do with D-linking, all the relevant contrasts discussed in §1.4 remain valid. Since we observed neither a main effect of D-linking, nor an interaction between the D-linking factor and the extraction condition that could be interpreted as an amelioration driven by this interpretive property, we conclude that all the structural features discriminating between *which NP* and *what NP* constructions (i.e. specificity, canonical partitivity, functional layer occupied by the *wh*-, reading preference between partitive vs. kind-of interpretation) should not have criterial status.

As suggested by Zamparelli (p.c.), and noticed by an anonymous reviewer, another minimal contrast to test, keeping the partitive construction fixed, would be related to the presupposition of existence: *quali* (*which*) *NP*, but not *quanti* (*how many*) *NP* should allegedly induce a presupposition of existence. Hence, if presuppositionality has a facilitatory effect in terms of extractability, a minimal contrast like "*quali*/*quanti* di questi problemi ti domandi chi abbia risolto?" ("*which*/ *how many* of these problems do you wonder who solved?") should be able to highlight it, resulting in higher acceptability rates for the extraction of *which* DPs, as opposed to extraction of *how many* DPs. These contrasts remain to be explored.

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