A Note on the Factorial Definition of Island Effects

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ABSTRACT

Sprouse's (2007) factorial definition of island effects has been widely used in experimental research on island phenomena. The popularity it enjoys is mainly due to its ability to isolate and quantify island effects by controlling for two important processing factors known to affect the acceptability of island-violating constructions. Despite this and other merits, the factorial design has its limitations: 1) it does not control for other important non-syntactic factors and thus 2) it has little to say about the exact nature of island effects. Researchers employing the factorial design, however, often fail to consider these limitations, resulting in biased interpretations of the results of their experiments. This problem is inevitable unless one takes a balanced view on the source of island effects.

Keywords: experimental syntax, factorial definition of island effects, acceptability judgment, philosophy of linguistics

1. Introduction

Since a factorial definition of island effects was first introduced by Sprouse (2007), it has become one of the most widely used experimental designs for investigating island-related phenomena in various languages, including Brazilian Portuguese, English, Hebrew, Italian, Japanese, Korean, Norwegian, Slovenian, and Spanish (e.g. Almeida, 2014; Fukuda et al. (submitted); Keshev & Meltzer-Asscher, 2019; Kim & Goodall, 2016; Ko et al., 2019; Kush et al., 2018; Kush et al., 2019; Lee, 2018; Pañeda et al., 2020; Sprouse et al., 2016; Sprouse, 2007; Stepanov et al., 2018). The popularity the factorial design (henceforth, FD) enjoys is due to the fact that it helps to better understand island-related phenomena, which is possible thanks to its ability to *isolate an island effect and measure its exact size*.

In this squib, however, rather than discussing FD's strengths, the focus will be on calling attention to limitations of FD and to bias that arises from failing to take into account those limitations. After explaining the basics of FD in Section 2, the

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limitations of FD and the bias will be introduced in Sections 3 and 4, respectively. The limitations are that FD leaves important non-syntactic factors uncontrolled, and (as a result) cannot provide a clue to the exact nature of island effects. Researchers failing to consider these limitations show a biased tendency to uncritically take an island effect found by FD-based experiments to be syntactic in nature. Section 5 concludes the squib with an emphasis of the importance of taking a balanced view on the nature of island effects.

2. Basics of FD

According to Sprouse (2018), acceptability of a linguistic expression is determined by four factors in an experimental setting.

(1) acceptability = grammatical factors + processing factors[1] + task factors + noise

Among these, it is relatively easy to control task factors and noise with the standard experimental procedure. What is important is to properly control experimental conditions, that is, grammatical and processing factors, in a way that minimizes confounding factors.

Minimizing confounds can be achieved by making a treatment condition and a control condition form a minimal pair so that the two are identical except for one aspect, namely the value of an independent factor. For instance, (2a) and (2b) have the same syntactic structure with the same number of words, and even the words themselves are also identical except for the verbs.

(2) a. The students is happy.
    b. The students are happy.

Thus, the examples in (2) would make an ideal minimal pair for examining the effect of agreement violation.

A problem occurs when one tries to create a minimal pair in which two expressions differ from each other in terms of only one respect, namely whether

1) According to Sprouse (2018), processing factors include memory, parsing, world knowledge, and thought. So his processing factors include what are commonly known as discourse/pragmatic factors.

or not island violation occurs. For instance, Sprouse (2018) points out that examples like (3a) and (3b) do not make an ideal minimal pair, since the two sentences differ from each other not only with respect to whether the *wh*-island is violated, but also with regard to the type of the embedded clauses: *whether*-clause vs. *that*-clause.

(3) a. *What$_i$ do you wonder [whether Paul read e$_i$]?
    b. What$_i$ do you think [that Paul read e$_i$]?

Different types of embedded clauses, according to Sprouse, could put different amounts of cognitive burden on the parser, which in turn would ultimately affect the acceptability of sentences containing embedding clauses.[2)]

What if the type of embedded clause is controlled as in (4), where (4a) and (4b) both have *whether*-clauses?

(4) a. *What$_i$ do you wonder [whether Bob ate e$_i$]?
    b. Who$_i$ e$_i$ wonders [whether Bob ate a candy]?

Here, the biggest problem is that the type of dependency is different; that is, whereas the dependency, or the distance between a filler and a gap, is long in (4a) (by the gap being located in the embedded clause), it is short in (4b) (by the gap being located in the matrix clause), which is known to cause difference in processing difficulty (e.g. Gibson, 1998, 2000; Lewis & Vasishth, 2005). In addition, the words in each sentence are also different. For instance, (4b) has *candy* in it while (4a) does not.

In order to solve this problem, Sprouse (2007) came up with a clever idea based on *crossed factorial design* and *subtraction logic*. The design he created has two independent factors, STRUCTURE and DEPENDENCY-LENGTH, each of which has two levels: *island* and *non-island* for STRUCTURE, and *long* (i.e. extraction out of an embedded clause) and *short* (i.e. extraction out of a matrix clause) for DEPENDENCY-LENGTH. An example of this design is shown in (5) below.

2) Although not pointed out by Sprouse (2018), examples like (3a) and (3b) are also different from each other with respect to their matrix verb, which might act as another confounding factor.

(5) A factorial design for measuring island effects:	STRUCTURE	DEPENDENCY -LENGTH
a. Who$_i$ e$_i$ thinks that Tom hit it?	non-island	short
b. What$_i$ do you think that Tom hit e$_i$?	non-island	long
c. Who$_i$ e$_i$ wonders whether Tom hit it?	island	short
d.*What$_i$ do you wonder whether Tom hit e$_i$?	island	long

By subtracting the acceptability of (5b) from that of (5d) we get the effect of STRUCTURE and island violation, as shown in (6).

(6) Acceptability$_{(5d)}$ = violation + long + island
-Acceptability$_{(5b)}$ = + long + non-island

Acceptability$_{(5d)-(5b)}$ = violation + (island-non-island)

And by subtracting the acceptability of (5a) from that of (5c), we get the effect of STRUCTURE, as shown in (7).

(7) Acceptability$_{(5c)}$ = short + island
-Acceptability$_{(5a)}$ = short + non-island

Acceptability$_{(5c)-(5a)}$ = (island-non-island)

Finally, we can pick out the effect of island violation by subtracting the difference in (7) from the difference in (6), which is called differences-in-differences score (henceforth, DD score) (Maxwell and Delaney, 2003), as shown in (8).

(8) Acceptability$_{(5d)-(5b)}$ = violation + (island − non-island)
-Acceptability$_{(5c)-(5a)}$ = (island − non-island)

Acceptability$_{DD}$ = violation

According to Sprouse (2007), if the difference in acceptability between (5b) and (5d) is bigger than that between (5a) and (5c), that difference, or the super-additive effect, is the island effect, and its size is the size of the island effect. In other words, if the DD score is positive and its size is significantly big enough, it can be

concluded that (5d) shows a real island effect, which cannot be attributed to the sum of the processing costs caused by structure and DEPENDENCY-LENGTH.

It is important to note that before FD was introduced, mere (un)acceptability of an island-violating expression had been widely used as the crucial criterion for determining whether it shows an island effect or not. However, now that FD provides a way to objectively define an island effect and measure its exact size, we have a more reliable criterion; that is, an island effect exists only if there is a statistically significant super-additivity, regardless of the absolute acceptability of the expression at issue.

This new way of defining an island effect allowed us to discover many interesting phenomena which are crucial for a deeper understanding of the nature of island effects. Among them two phenomena are of special interest in that they clearly show the problem of linking mere (un)acceptability to (in)existence of island effects: 1) an unacceptable island-violating expression showing no island effect, and 2) an acceptable island-violating expression showing an island effect. First, Sprouse et al. (2016) showed that the alleged adjunct-island effects in English relative clause dependencies exhibited very low acceptability ratings but no super-additive effect, that is, no decrease in acceptability beyond that predicted based on STRUCTURE and DEPENDENCY-LENGTH. Ko et al. (2019) also concluded that the low acceptability of the Korean scrambling constructions in their experiment could not be evidence of the existence of island effect, based on lack of significant super-additive effect.

In contrast, several experimental studies employing FD have shown that some island-violating constructions manifest significant super-additive effects, that is, "real" island effects, even though their acceptability is so high that they cannot be treated to be unacceptable; rather, participants' acceptability judgments on those constructions are usually in the range of (marginally) acceptable. This phenomenon, which is also called *subliminal* island effect, was discovered in Brazilian Portuguese (Almeida, 2014), Norwegian (Kush et al., 2018), and Hebrew (Keshev & Meltzer-Asscher, 2019). The two types of new findings would not have been possible if FD had not been developed.

3. Limitations of FD

Despite all the merits and new findings, FD has two important limitations that researchers often fail to consider when they interpret their experimental results.

First and foremost, FD has little to say about what the exact nature of island effects really is, that is, whether they are syntactic, processing, or semantic/pragmatic in nature. In other words, it is impossible to pinpoint the exact source of the super-additivity produced by FD. This limitation arises from its another limitation that it is only the length of dependency (DEPENDENCY-LENGTH) and the island structure (STRUCTURE) that are properly controlled non-syntactic factors under FD, which means that other potential non-syntactic factors are left uncontrolled.[3] In fact, the limitations are sometimes explicitly acknowledged by Sprouse himself and others.

> If ... we observe the super-additivity ..., then an additional mechanism (above and beyond the processing cost of long-distance dependencies and island structures) is necessary to explain the effect. This additional mechanism could either be a grammatical constraint, *or it could be a mechanism that creates an interaction between the processing of long-distance dependency and island structures (e.g., the limited pool of working memory resources postulated by Kluender and Kutas 1993)* [emphasis added]. (Sprouse et al., 2016, p. 315).

> If the lines are not parallel [that is, if there is a super-additive effect], there is evidence that something is affecting acceptability above and beyond our two factors. This could be a violation [of the syntactic island] (*or it could be something else, like a processing effect that arises from the interaction of the two factors* [emphasis added]) (Sprouse, 2018, p. 23).

> A disproportionate decrease in ratings for the island structure would suggest that the acceptability of this structure is affected not only by the processing factors of length and complexity, but by an additional aspect, namely a violation of some (grammatical or *extra-grammatical* [emphasis added]) island constraint. (Keshev & Meltzer-Asscher, 2019, p. 624)

Furthermore, Keshev & Meltzer-Asscher (2019) even provide empirical evidence for the limitations of FD. Conducting several FD-based experiments, they convincingly

3) In fact, FD "can control an unlimited number of potential confounds with respect to the interaction term, as long as the potential confounds are distributed across the subtractions in the correct way" (Kush, et al., 2018, p. 749). Although this is another strength of FD, it is important to note that the non-syntactic factors that are discussed in this squib cannot be controlled this way.

argued that the source of the subliminal island effects in Hebrew *wh*-island-violating constructions is the interaction of the two processing factors, STRUCTURE and DEPENDENCY-LENGTH, but not the syntactic constraint (i.e. *wh*-island). This claim was supported by the results of their other experiments showing that 1) the super- additivity caused by the same processing factors was also observed in binding structures, where no island-violation occurs, and 2) the super-additivity did not emerge in Hebrew *wh*-islands when the effect of the processing factors was minimized. All these results lead them to ultimately conclude that "processing costs underlie the apparent *wh*-isalnd effect in Hebrew … and that the super-additivity paradigm should be fine-tuned in order to avoid these confounds" (Keshev & Meltzer-Asscher, 2019, p. 621).

Note that all the non-syntactic factors that are discussed above with regard to the limitations of FD are processing ones; however, another type of non-syntactic factors, that is, pragmatic factors also cannot be properly controlled by FD. Interestingly, however, pragmatic factors are rarely discussed by researchers employing FD for their experimental work, the reason for which will be discussed in the next section.

4. Bias

Despite the apparent fact that one cannot understand the real nature of island effects just based on FD alone, it is not uncommon to find a strong tendency towards one-sided interpretations of island effects defined by FD-based super-additivity. To be more specific, a number of experimental linguists employing FD show a bias in favor of the syntactic nature of the island effects. This bias is basically manifested in two ways. First, FD-based experimental results are often interpreted and discussed only within the framework of syntactic approaches to island effects (e.g. Fukuda et al., 2021; Kim & Goodall, 2016; Kush et al., 2018, 2019; Lu et al., 2020), which would be meaningful only if the island effects found in their experiments turn out to be syntactic in nature. For instance, Kush et al. (2018) use the results of their experiments to evaluate the validity of different syntactic analyses of island effects (e.g. cycle-based analyses, (featural) Relativized Minimality, D-linking). They justify their treatment of the island effects under an unjustified assumption that "grammatical explanations are a [more] profitable avenue [than complex processing explanations] to pursue at this time" (Kush et al.,

2018, p. 767). This assumption is made more explicit in their later work, in which they claim that "[a]lthough there is uncertainty about how best to interpret these results, we prefer to stake the stronger and more conservative claim that CNPs are syntactic islands in Norwegian until evidence is provided to the contrary" (Kush et al., 2019, p. 412). Again, it is not clear why Kush et al.'s syntactic account is "stronger and more conservative" than non-syntactic accounts, at least for those who are not oriented towards syntactic accounts of island effects at first.

Apart from giving priority to syntactic analyses (while admitting the possibility of non-syntactic nature of island effects), some researchers go even further and show a strong tendency to *directly* relate a FD-based super-additive effect to the existence of a syntactic island at issue. The following quotations are from conclusions of experimental works based on FD:

> The experiment revealed that only complex NPs count as an island in Korean long-distance scrambling, but the effect of whether-islands and adjunct islands was turned out to be imaginary. ⋯ Given that the structural complexity of complex NPs did not cause an independent processing difficulty, however, *it is highly likely that the island effect is induced by a grammatical constraint—the Complex NP Constraint* [emphasis added]. (Jung et al., 2017, p. 18)

> [T]he GLM analyses ... show that the differences are statistically significant. This implies that Korean may have island phenomena, *supporting the previous claims that Korean has island constraints* [emphasis added]. (Lee, 2018, p. 505)

The widespread tendency to directly link FD-based island effects to syntactic constraints is also pointed out by Keshev & Meltzer-Asscher (2019, p. 649), who emphasize that their experimental results "challenge the notion that super-additivity is an indicator for ungrammaticality of *wh*-islands".

What makes researchers ignore the limitations of FD and bias themselves towards syntactic analyses? At least two reasons exist: 1) underestimation of functional (i.e. processing and pragmatic) factors and 2) overestimation of syntactic constraints. First, those who are biased in favor of the syntactic nature of island effects do not take into account the role of functional factors other than STRUCTURE and DEPENDENCY-LENGTH in explaining the super-additivity found in their experiments. This is mainly due to the wrong assumption that STRUCTURE and DEPENDENCY-LENGTH are the only relevant and important non-syntactic factors.

In fact, this assumption underlies the motivation for developing FD.

> The idea behind the factorial design is to quantify these extra-grammatical components such that the effect of the grammatical constraint can be isolated (or, if one is agnostic about the source of island effects, the goal is to isolate the acceptability effect that cannot be accounted for by known effects). (Sprouse et al., 2016, p. 313)

> [FD] was originally developed as a way to formalize the definition of island effects as part of an investigation of theories that seek to reduce island effects to an epiphenomenal consequence of processing complexity rather than the consequence of grammatical constraints. (Sprouse et al., 2016, p. 315)

If one believes that FD really meets its motivation for isolating the effect of the grammatical constraint, it is not surprising to expect her to show the bias when interpreting the results of her experiment. It is important to note, however, that FD does not really satisfy the motivation, which is admitted by Sprouse himself and others as shown in the previous section.

Unlike processing factors, which have been, albeit insufficiently, considered, by FD developers and users, as possible confounds that need to be properly controlled, pragmatic factors are almost never paid any attention. One of the reasons why they are ignored is that they are assumed to be not explicit enough to be empirically investigated. For instance, despite admitting that discourse context is a possible confound for isolating an island effect, Kush et al. (2018, p. 775) give up pursuing the possibility further because they believe that "constructing such contexts is not a trivial task because the discourse constraints that are assumed to operate on these extractions are not well understood".

Even when they do deal with pragmatic factors in their later work (Kush et al., 2019), what they test is just the effect of whether the referent denoted by an extracted element is introduced in prior context, which has never been claimed to be related to island effects with solid grounds. Rather, there are pragmatic factors that have been empirically shown to be directly related to island effects, such as backgroundedness (Abeillé et al., 2020; Ambrige & Goldberg, 2008; Goldberg, 2006, 2013), frame (Chaves & King, 2019), and coherence (Kim, 2016, 2017; Kim & Ji, 2020). Note that the role of these pragmatic factors could not have been tested empirically, that is, in experimental settings, if they had not been well understood

or explicit enough as critics say. Thus, it is not fair to simply conclude or assume that an island effect found in FD-based experiments is a sign for the syntactic nature of island effects without investigating the effect of the previously proposed pragmatic factors.

Underestimation of functional factors is also evidenced by the exclusion of the possibility of linking the super-additivity to the two processing factors (i.e. STRUCTURE and DEPENDENCY-LENGTH). As discussed above, Keshev & Meltzer-Asscher (2019) convincingly claimed that the source of the super-additivity found in their experiment is the interaction of STRUCTURE and DEPENDENCY-LENGTH. Furthermore, according to Hofmeister et al. (2013, p. 45). "such "superadditivity" effects ⋯ are not uncommon in studies of processing difficulty, attention, and multi-tasking: processing costs combine superadditively due to either resource limitations or processing bottlenecks". Thus, it is not unreasonable to pursue the possibility of attributing the super-additivity found in FD-based experiments to the combination of STRUCTURE and DEPENDENCY-LENGTH, and it is a shame that those who are biased towards the syntactic nature of island effects just assume that the interaction of the two would simply yield linear additivity.

Lastly, let us turn to the issue of overestimation of syntactic constraints. Despite decades of efforts to provide a principled and comprehensive syntactic account of island effects, no single account has been successful, with recent attempts under the framework of Minimalist Program faring not much better than the Ross's (1967) original proposals (cf. Hofmeister et al., 2013; Progovac, 2009). The biggest problem of the syntactic analyses proposed so far (e.g. subjacency, Condition on Extraction Domains (CED)) is the fact that all of them have failed to explain away numerous counterexamples provided in the literature. Consequently, experimental linguists who claim that island effects are at least partly syntactic in nature actually do so without specifying what that syntactic aspect really is, and, in practice, still rely on the notions of island constraints as defined by Ross more than fifty years ago. Given that every syntactic account does not really stand up to scrutiny, it makes little sense to try to determine which syntactic account is more consistent with the results of FD-based experiments, or to simply conclude that the island effects defined by FD-based super-additivity has grammatical foundation.[4)]

4) One reviewer questioned the academic value of this paper mainly for two reasons: 1) the limitations of FD are already acknowledged by Sprouse and his colleagues, and 2) I do not provide an experimental design that can overcome the limitations of FD and (potentially) show the importance of non-syntactic factors on FD-based island effects. First, I would argue that the academic value of this paper comes from the main purpose of this paper, which is to point out the mistake of (or bias

5. Conclusion

Although FD provides a way to objectively define and measure island effects, one must remember that it has little to say about the nature of island effects due to the fact that it cannot perfectly control non-syntactic factors. It is noteworthy that those who use FD often fail to recognize these limitations and tend to be biased towards the syntactic interpretations of island effects. This bias is mainly due to underestimation of non-syntactic factors and overestimation of syntactic accounts of island effects. It has to be emphasized that this bias does not help to better understand the real nature of island effects and that one should take a balanced view on the source of island effects and try to employ various experimental designs that can test not only the role of syntactic factors but also that of non-syntactic ones.

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towards) tending to attribute the FD-based island effects to be syntactic in nature, not from pointing out the limitations of FD itself. Second, proposing a new experimental design or research that emphasizes the importance of non-syntactic factors is beyond the scope of this paper. The purpose of this paper, again, is to call attention to the problem of misinterpreting FD-based experimental results, but not to find out specific non-syntactic factors that play a role in explaining FD-based super-additivity.

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