Prosodic Prominence and Intervention Effects: An Experimental Study

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[redacted]

Abstract

Intervention effects are standardly analyzed as syntactic or semantic phenomena where grammatical restrictions on the well-formedness of *wh*-questions hold (Kim, 2005; Beck, 2006; Li and Law, 2016). However, empirical observations suggest otherwise; grammaticality judgments are subtle and divergent. This paper presents an experimental study that provides evidence that sentences associated with intervention effects are far from strictly ungrammatical. The results are in line with previous findings (Kitagawa et al., 2013) which support the pragmatic approach (Tomioka, 2007; Hamlaoui, 2010). An effective experiment design is also proposed that takes into account the ambiguity of *wh*-phrases in Korean (Yun, 2019), and allows us to test in a precise manner which prosodic cue bears influence.

1 Introduction

It is widely assumed among linguists that the violation of syntactic/semantic rule or constraint leads to strictly ungrammatical, irredeemable linguistic expressions. For example, native speakers of General American English judge (1a) and (1b) to be totally unacceptable.

(1) a. *Who did John wonder who met?
b. *I had any sleep yesterday.

Simplifying things a bit, the source of ungrammaticality is clear. (1a) instantiates movement out of a *wh*-island, and in (1b) the negative polarity item (NPI) *any* is not licensed. In these cases, ungrammaticality is stubborn; it is impossible to make the sentence better by changing its prosodic realization. This suggests that the rule or constraint on islands and NPI licensing return binary results: 1 (grammatical) if obeyed, 0 (ungrammatical) if violated.

On the other hand, there seem to be cases where prosody does affect the acceptability of a sentence. Schütze (2001), for example, observes that case-stacked sentences in Korean require a specific prosody to sound felicitous. That is, an intonation phrase boundary is necessary after the subject in (2c) while this requirement does not hold in (2a) or (2b).

(2) a. Nay-ka paym-i mwusepta.[1]
I-NOM snake-NOM fearful[2]
b. Na-eykey paym-i mwusepta.
I-DAT snake-NOM fearful
c. Na-eykey-ka paym-i mwusepta.
I-DAT-NOM snake-NOM fearful
'I am afraid of snakes.' (*case stacked*: DAT-NOM)

In this paper, I investigate the effect of prosody on intervention effects, a focus-related phenomenon standardly analyzed as syntactic or semantic ill-formedness. If it turns out to be the case that prosody does play a significant role, this will call for an alternative analysis of the effect. But first, to better understand what intervention effect is, see the following examples:

(3) a. ?*__Amwuto__ *mwues*-ul mek-ci anh-ass-ni?
anyone what-ACC eat-NMLZ NEG-PST-Q?
'What did no one eat?'
b. ?*__Nwukwuna__ *mwues*-ul mek-ess-ni?
everyone what-ACC eat-PST-Q?
'What did everyone eat?'
c. ?*Minwu-__pakkey__ *mwues*-ul mek-ci anh-ass-ni?
Minwu-but what-ACC eat-NMLZ NEG-PST-Q?
'What didn't anyone but Minu eat?' (= 'What did only Minwu eat?")

What these examples have in common is a *wh*-word *mwues* 'what' preceded by an NPI **amwuto** 'anyone', **pakkey** 'but', or a quantifier **nwukwuna** 'everyone'. These expressions are called "interveners" because the sentences in (3) seem to become grammatical when the *wh*-word is scrambled over.

[1]All glosses in this paper follow the Yale Romanization of Korean.

[2]The following abbreviations are used in this paper: ACC = accusative case, ASP = aspect, DAT = dative case, DECL = declarative, GEN = genitive case, NEG = negation, NOM = nominative case, NMLZ = nominalizer, PL = plural, PST = past tense, Q = question particle, TOP = topic marker.

(4) a. *Mwues*-ul **amwuto** mek-ci anh-ass-ni?
what-ACC anyone eat-NMLZ NEG-PST-Q
'What did no one eat?'
b. *Mwues*-ul **nwukwuna** mek-ess-ni?
what-ACC everyone eat-PST-Q
'What did everyone eat?'
c. *Mwues*-ul minwu-**pakkey** mek-ci anh-ass-ni?
what-ACC Minwu-but eat-NMLZ NEG-PST-Q
'What didn't anyone but Minu eat?' (= 'What did only Minwu eat?')

The contrast between (3) and (4) has led researchers to suggest that intervention effect arises when an intervener c-commands an interrogative in-situ *wh*-phrase, as schematized in (5).

(5) Classic configuration of intervention effects
?*[Q . . . [**intervener** [YP . . . *wh*-phrase . . .]]][3]

In this paper, I consider whether the acceptability of sentences associated with intervention effects can be improved, not only by syntactic operations such as scrambling, but also by prosodic means. The starting intuition is as follows: Even in those cases where the *wh*-phrase is preceded by an intervener, the sentence seems to sound slightly better if the *wh*-phrase is made prosodically more prominent, e.g. by increased pitch and/or intensity. This is demonstrated in the following example, with "prosodic prominence" marked by underline.

(6) a. ?***Amwuto** *mwues*-ul mek-ci anh-ass-ni?
anyone what-ACC eat-NMLZ NEG-PST-Q
'What did no one eat?'
b. ?**Amwuto** *mwues*-ul mek-ci anh-ass-ni?
anyone what-ACC eat-NMLZ NEG-PST-Q
'What did no one eat?'

This paper presents an experimental study on the prosodic effects on intervention effects in Korean. The empirical aim of the experiment is twofold: First, it aims to show that sentences associated with intervention effects are far from strictly ungrammatical. Second, it aims to demonstrate that prosody does affect the acceptability of such sentences. The results of the experiment, although not entirely

[3]Note that the Q operator in this schema is found in the leftmost of the sentence, whereas the glosses suggest otherwise for *-ni* in Korean. The choice of head directionality here doesn't matter as long as the intervener "intervenes" between the Q operator and the *wh*-phrase, blocking the two from establishing a syntactic relationship. I remain agnostic about whether the head directionality is to be understood parametrically or under the antisymmetry theory (Kayne, 1994).

conclusive, suggest that intervention effect is not a grammatical restriction but a pragmatic, information structure-related phenomenon, as argued by Tomioka (2007), Hamlaoui (2010), Kitagawa et al. (2013), etc.

The rest of the paper is structured as follows: Section 2 provides some further background on the empirical facts and the theoretical characterization of the intervention effect. Section 3 illustrates the experiment design, including the issue of ambiguity that arises in interpreting *wh*-questions in Korean, which needs to be meticulously controlled for in the experiment. Section 4 presents the results and analysis, and section 5 concludes.

2 Previous Literature

Let us recollect the empirical observations on intervention effects discussed so far. First, the effect emerges when an NPI or a quantifier c-commands an in-situ *wh*-phrase. Second, the effect disappears when the *wh*-phrase is scrambled across the intervener. These findings point towards an analysis where intervention effect can be understood as a ban on LF movement of *wh*-in-situ. Beck (1996) and Beck and Kim (1997) propose the Minimal Quantified Structure Constraint (MQSC) which basically says that an intervening quantifier blocks LF-movement of *wh*-in-situ.

In a follow-up study, however, Kim shows that the MQSC is too strong a constraint in the sense that not every quantifier seems to show the effect in Korean (Kim, 2002).

(7) a. **Taypwupwun-uy** haksayng-tul-i *nwukwu*-lul hoycang-ulo
most-GEN student-PL-NOM who-ACC president-as
chwuchenhay-ss-ni?
recommend-PST-Q
'Who did most students recommend as president?'

b. Minswu-nun **hangsang/cacwu** *nwukwu*-lul phathi-ey
Minswu-TOP always/often who-ACC party-to
teyliko ka-ss-ni?
take-PST-Q
'Who did Minsu always/often take to the party?'

Kim then solidifies the argument that intervention effects are focus-related phenomena, based on a morphological analysis of Korean and Hindi NPIs. Korean NPIs like *amwuto* 'anyone' are morphologically made up of an indefinite expression and a focus particle such as *to* or *na*. Interestingly, quantifiers that induce intervention effects, such as *nwukwuna*, also seem to share the same morphological structure. This suggests that, to be precise, the natural class of "interveners" are focus-related linguistic expressions.

Kim (2005) and Beck (2006) further develops an account of intervention effects by appealing to the semantic notion of focus. They argue that *wh*-phrases are like focused expressions in denoting a set of alternatives as its focus semantic value, à la Rooth (1992). The only difference is that *wh*-phrases lack an ordinary semantic value, from which it follows that they should be associated with a Q operator whose job is to elevate the focus semantic value of its complement to its ordinary semantic value. The problem arises when a focus-sensitive operator "intervenes" in the course of semantic composition.

Although this reductionist approach has been highly influential in the literature, a couple of issues have been pointed out. Li and Law (2016) shows that Kim and Beck's proposal is challenged by 'F-WH association', a phenomenon in which focus-sensitive operators associate with *wh*-phrases themselves. If focus-sensitive operators were genuine interveners between Q and *wh*-phrases, none of the sentences in (8) should be well-formed.

(8) a. Libai **zhi** chuxi-le *shenme huodong*?[4]
Libai only attend-Asp what activity
'What was the activity x such that Libai only attended x?'

b. **Zhiyou** *shei* chuxi-le wanyan?
only who attend-Asp dinner
'Who was the person x such that only x attended the dinner?'

Based on this observation, Li and Law (2016) instead claims that a *wh*-phrase introduces alternatives into its ordinary semantic value, and attributes intervention effects to the interaction of alternatives in different dimensions. Their proposal is called a quantificational domain approach, since intervention effects are ultimately reduced to the requirement that focus-sensitive operators be fed a quantificational domain of the right type.

Although divergent in the exact formulation of the effect, the studies discussed so far can be classified as the "strong" approach to intervention effect. This is because they predict the effect to be rigid. Under the syntactic approach, the effect is a result of violating a constraint on LF-movement, which should make

[4]These examples are Mandarin sentences provided by Li and Law (2016). However, F-WH association is also found in a variety of languages (perhaps unsurprisingly, because *wh*-questions are known to often demand 'exhaustive' answers), including Korean:

(i) Minwu-ka *mwe*-**man** mek-ess-ni?
Minwu-Nom what-only eat-Pst-Q
'What is the thing x such that Minwu ate only x?'

An interesting fact about (i) is that the reduced form of *mwues* 'what', *mwe*, is necessary (or strongly preferred, to say the least). Although an interesting phenomenon on its own, I don't have an answer yet to why this has to be the case, and would like to leave it for future research.

the sentence as ungrammatical as (1a) (overt movement out of *wh*-island). Under the semantic approach, the effect is effectively a failure in composition.

Tomioka's (2007) pragmatic approach to intervention effects offers an alternative explanation. Following Krifka (2001), Tomioka assumes that *wh*-questions are divided up in a way similar to the focus-background partition: the *wh*-phrase is information-structurally focused while the rest of the sentence belongs to the background against which the question is asked. Intervention effects are derived from less than perfect correspondence between syntactic structure and information structure. Hamlaoui (2010) adds to this analysis the observation that cross-linguistically the common property shared by "interveners" is anti-givenness.

The starting intuition for the "weak" approach to intervention effects such as Tomioka (2007) and Hamlaoui (2010) is that intervention effects do not seem like that strict of a grammatical restriction after all. Grammatical judgments on intervention effects are notoriously subtle, and the variability among native speakers is vast (Tomioka, 2007). A worthwhile research objective in this respect would be to first establish empirical data in a controlled experimental setting.

Kitagawa et al. (2013) investigates the effect of prosody on intervention effects in Japanese. Although it reports experimental findings that support Tomioka's analysis, it crucially relies on the Implicit Prosody Hypothesis (Fodor, 1998). Their experiment is designed in a way to compare acceptability ratings of sentences such as (9) and (10) when presented only visually (without prosody) versus aurally (with *wh*-focus prosody).[5]

(9) a. Ma'riko-**si**(')**ka** *dare*-o sasow-ana-katta-no?
Mariko-but who-ACC invite-NEG-PST-Q

b. *Dare*-o Ma'riko-**si**(')**ka** sasow-ana-katta-no?
who-ACC Mariko-but invite-NEG-PST-Q
'Who didn't anyone but Minako invite?' (='Who did only Minako invite?')

(10) a. **Daremo** *dare*-o sasow-ana-katta-no?
anyone who-ACC invite-NEG-PST-Q

b. *Dare*-o **daremo** sasow-ana-katta-no?
who-ACC anyone invite-NEG-PST-Q
'Who did no one invite?'

[5]In addition to NPI interveners such as *sika* 'but' and *daremo* 'anyone', Kitagawa et al.'s experiment also included stimuli with *dake* 'only' as a potential intervener. However, the result indicated that *dake* simply does not show intervention effects the way NPI interveners do. *dake* has been described as a weak intervener in the literature (Tomioka, 2009), but as Kitagawa et al. (2013) argues, even that terminilogy seems inaccurate because the signature characteristic of intervention effects, improvement with scrambling, is not observed. However, it is still interesting to see that the overall acceptability of *wh*-questions with *dake* was in the marginal range.

The result of the experiment showed that the addition of prosody improved the acceptability rating of these sentences. Kitagawa et al. (2013) argues that the contrast arises because language users tend to assign focus prosody to accented interveners as a default strategy when they process sentences via silent reading. However, since their experiment was not designed in a way to keep everything else constant and minimally control certain prosodic cues (e.g. pitch, phrasing, etc.), it is difficult to conclude if prosody does actually play a crucial role in intervention effects. It could arguably be the case that the addition of prosody simply facilitated participants' processing of seemingly complex sentences.

3 Experiment

An experiment was conducted to examine the effect of prosody on intervention effects in Korean. Participants were given *wh*-questions with NPI interveners *amwuto* 'anyone' and *pakkey* 'but' and were asked to rate their naturalness. The sentence were always presented in audio form; based on recordings from a native Korean speaker, an audio manipulation was conducted to create the stimuli. This experiment design allows us to keep under scrutiny (i) if prosody influences intervention effects and (ii) which prosodic cue, if present, plays a role. I hypothesize that the pitch level on the *wh*-phrase is strongly related to its prominence within the sentence, and thus will play a role in intervention effects. This hypothesis is in line with the pragmatic approach, according to which intervention effects are deeply connected to the information structure of *wh*-questions.

3.1 Method

3.1.1 Participants

9 native speakers of Korean were recruited as participants. 5 of them were male and 4 female. The age range was between 23 and 51. None of them had the experience of living abroad for more than one year. I express my gratitude for their volunteering their time (about 15-20 minutes) without payment.

3.1.2 Stimuli

One male native speaker of Korean was recruited for the audio recording of the stimuli. Target stimuli were created by a total combination of the following factors:

(11) a. *wh*-phrase (1): *mwel* 'what-ACC'[6]
b. NPI interveners (2): *amwuto* 'anyone', *pakkey* 'but'
c. predicate (4): *mek* 'eat', *ilk* 'read', *po* 'watch', *sa* 'buy'
d. word order (2): intervener-*wh* order, *wh*-intervener order

However, a confounding factor was found in the makeup of the stimuli. That is, Korean *wh*-phrases are ambiguous between an interrogative and an indefinite reading, which is disambiguated by prosody (Yun, 2019; Hengeveld et al., 2023). To illustrate, the following sentence is ambiguous between two readings, as shown by the different type of responses they elicit.

(12) a. Yenwu-ka mwel mek-ess-ni?
Yenwu-NOM what-ACC eat-PST-Q
'What did Yenwu eat?' (interrogative)
b. Yenwu-ka lamyen-ul mek-ess-e.[7]
Yenwu-NOM ramyun-ACC eat-PST-DECL
'Yenwu ate ramyun.'

(13) a. Yenwu-ka mwel mek-ess-ni?
Yenwu-NOM something-ACC eat-PST-Q
'Did Yenwu eat something?' (indefinite)
b. Ung, Yenwu-ka mwel mek-ess-e.
yes, Yenwu-NOM something-ACC eat-PST-DECL
'Yes, Yenwu ate something.'

Yun (2019) presents an experiment investigating the relative contribution of two different prosodic properties to the disambiguation of Korean *wh*-phrases. The experiment shows that it is prosodic phrasing after the *wh*-phrase that determines the interpretation. That is, post-*wh* dephrasing was necessary for the *wh*-phrase to be interpreted as an interrogative. Prosodic prominence (*wh*-pitch), however, did not contribute to such a distinction; rather, it increased the possibility of a wide scope reading.

[6]Native Korean speakers prefer to use *mwel*, a reduced form of *mwues-ul* 'what-ACC', in colloquial speech. In fact, *mwues-ul* is mostly used in written contexts and is considered to sound unnatural when used in speech. The choice of *mwel* over *mwues-ul* was intended to avoid other potential factors that may contribute to perceived unnaturalness in the experiment, as they may obscure the interpretation of the results. For the same reason, short-form negation *an* was used instead of long-form negation *anh* in the stimuli.

[7]Sentence ending *e* in Korean does not, in fact, decide clause type. It can be used in declarative, interrogative, even exhortative and imperative sentences, given the right prosody and context. However, for ease of exposition, I gloss it here as a declarative marker. For a detailed theoretical discussion on the meaning of *e*, see An (2020).

Taking this into consideration, the recruited speaker was asked to read the target stimuli twice, once under the interrogative meaning and once under the indefinite reading. A simple comparison between the two readings showed that the interrogative reading had higher pitch on the *wh*-phrase and lower sentence-final tone. This is shown in the visual representation of one of the stimuli recording pairs (see figure 1).

In addition to the 32 target stimuli recordings (16 target stimuli sentences * 2 readings), the recruited speaker was also asked to read grammatical and ungrammatical filler sentences. These sentences were similar in form to the target sentences. The grammatical fillers included 8 *wh*-interrogative sentences, 8 *wh*-indefinite sentences, 8 NPI sentences, and 8 plain sentences. The ungramamtical fillers included 8 NPI sentences (non-NPI-licensing environments[8]) and 8 plain sentences (case mismatch).

(14) Grammatical Fillers

a. Yenwu-ka mwel mek-ess-ni?
Yenwu-NOM what-ACC eat-PST-Q
'What did Yenwu eat?' (*wh*-interrogative)

b. Minwu-ka mwel mek-ess-ni?
Minwu-NOM what-ACC eat-PST-Q
'Did Minwu eat something?' (*wh*-indefinite)

c. Amwuto lamyen-ul an mek-ess-ni?
anyone ramyun-ACC NEG eat-PST-Q
'Did no one eat ramyun?' (NPI)

d. Minwu-ka lamyen-ul mek-ess-ni?
Minwu-NOM ramyun-ACC eat-PST-Q
'Did Minwu eat ramyun?' (plain)

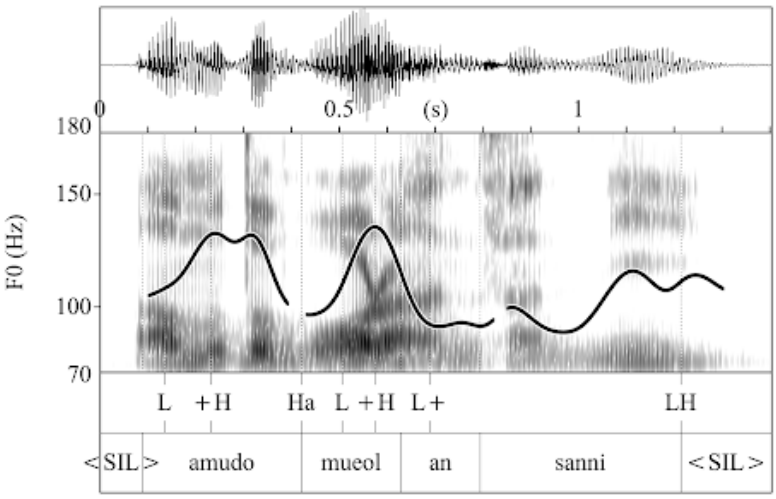
(15) Ungrammatical Fillers

a. *Amwuto twupwu-lul sa-ss-ni?
anyone tofu-ACC buy-PST-Q (NPI)

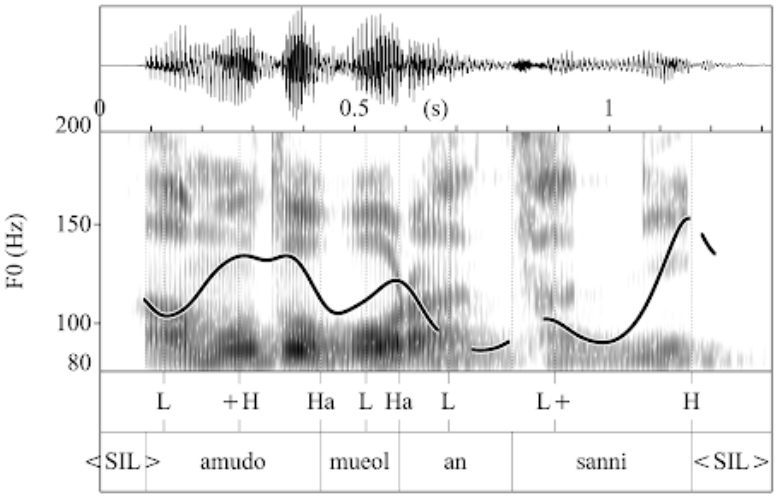
b. *Yena-ka twupwu-ka sa-ss-ni?
Yena-NOM tofu-NOM buy-PST-Q (plain)

[8]Korean NPIs are known to have different licensing conditions from English NPIs such as *any*. The empirical facts suggest that Korean NPIs are licensed by clausemate negation (Choe, 1988). They differ from English NPIs in that they are not allowed in non-negative questions (15a) but allowed in subject positions when there is negation in the same clause (i).

(i) Amwuto twupwu-lul an sa-ss-e.
anyone tofu-ACC NEG buy-PST-Q
'Anyone didn't buy tofu.' (='No one bought tofu.')



(a) interrogative reading



(b) indefinite reading

Figure 1: Pitch tracks of one of the target stimuli recording pairs, *Amwuto mwel an sa-ss-ni?* 'What did no one buy?'/'Is there something that no one bought?' The annotation follows the K-ToBI convention (Jun, 2000). The interrogative reading shows higher *wh*-pitch and lower sentence-final pitch. Post-*wh* dephrasing is faintly observed, perhaps due to a small number of syllables following the *wh*-phrase.

Back to target stimuli again, the recordings under the indefinite reading of *wh*-phrases were chosen as the base and manipulated with Praat. This is because the interrogative reading of *wh*-phrases are judged to be unnatural in the first place, due to intervention effects, and thus might include other acoustic cues (stutter, hesitation, etc.) that might reflect the speaker's confusion. Therefore, the recordings under the interrogative reading was only used as a reference for audio manipulation, which is why they will be referred to as 'reference recordings' henceforth.

The audio manipulation was guided by the following steps: First, pitch contours were stylized to points that represented AP tonal targets, both for target and reference recordings. Pitch points of *wh*-phrase and sentence ending were identified. Second, *wh*-pitch of the target sentence was raised to the same level of the reference sentence. There was no instance in which the *wh*-pitch of the target was higher than the reference. Third, sentence-final pitch of the target sentence was lowered to the same level of the reference sentence. There was no instance in which the sentence-final pitch of the target was lower than the reference. Lastly, *wh*-pitch raising and sentence-final pitch lowering was done at the same time to create a manipulation that sounds similar to the reference recording.

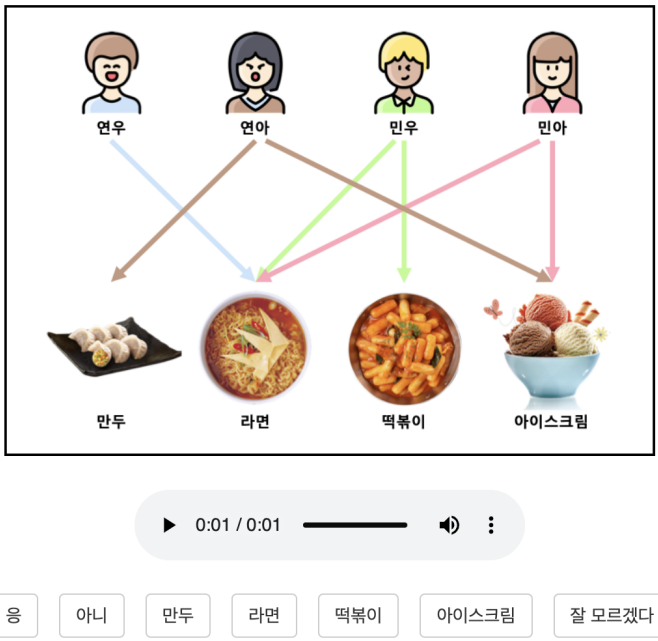
64 target stimuli were further distributed into 4 different test-sets, 16 each. Prosodic conditions, as well as intervener, predicate type and word order, were counterbalanced. At the beginning of the experiment, each participant was randomly assigned one of these test-sets. 3 of the participants were assigned to test-set 2, 4 of them to test-set 3, and 1 for test-sets 1 and 4, each.

3.1.3 Procedure

The experiment consisted of a total of 64 trials. For each trial, the participants were first asked to listen to a question and rate how natural it sounds and further asked to respond to the question with regard to the image presented on the screen. The images were created to introduce a context in which four different individuals have randomly assigned relationship with four different items, depending on the predicate type.

The interpretation & response task was added to the experiment because, as previously mentioned, the target stimuli are potentially ambiguous between two readings. Hence, the choice of possible answers included two polar particles, four item responses, and a panic button: "I don't know". If the participant interpreted the target stimuli as a polar interrogative (under an indefinite reading of the *wh*-phrase), a possible answer would be either *Yes* or *No*. If the participant interpreted the target stimuli as a *wh*-interrogative, a possible answer would be one of the four items.[9]The participants were informed that clicking "I don't know" is always an available option whenever they feel the sentence in uninter-

(a) Task 1: Naturalness Rating



(b) Task 2: Interpretation & Response

Figure 2: Screenshot of a sample trial. In the naturalness rating task, the participants were asked, "How natural was the sentence you just heard?" In the interpretation & response task, the participants were asked, "With respect to the above image, what is the most appropriate answer to the question?" For example, if the audio stimuli played in this trial is *Yenwu-ka mwel mek-ess-ni?* 'What did Yenwu eat?', the correct answer would be ramyun.

pretable. The order of the seven choice of responses were fixed throughout the experiment, to avoid further processing load and complexity.

Given the somewhat demanding and complex structure of the experiment, it was divided into three different sections to help the participants get a grasp on the procedures. In the practice trials, participants were informed of the basic structure of the experiment. They were presented with four grammatical fillers: two *wh*-interrogative types and two plain types. In the train trials, participants were informed of the fact that *wh*-words in Korean are ambiguous. They were then presented with 12 grammatical fillers including all four types in random order. This stage was introduced to ensure that the participants were "trained" to disambiguate Korean *wh*-phrases based on the prosodic structure of the sentence. In the test trials, a mixture of 16 grammatical fillers, 16 ungrammatical fillers, and 16 target stimuli (which belongs to one of the four test-sets) was presented in random order. The experiment was followed by a short demographic survey.

3.2 Predictions

Regarding the interpretation of target stimuli, the following predictions can be made:

(16) Predictions: Interpretation

a. *wh*-pitch will not contribute to the disambiguation of target sentences.

b. Sentence-final pitch will be the crucial factor to disambiguating the target sentences. Specifically, sentences with higher final pitch will be associated with an indefinite reading, whereas sentences with lower final pitch will be associated with an interrogative reading.

Predictions on the naturalness ratings of the stimuli and intervention effects are the following:

[9]It was made sure in the experiment that there were no trials in which it is impossible for the participant to choose a legitimate answer to the *wh*-question. For example, the question 'What did Yenwu eat?' was always presented with an image where Yenwu ate at least one object. However, this should have been much carefully controlled for, because it is equally difficult to provide a good enough answer if Yenwu chose multiple objects to eat. For a more detailed discussion, see section 3.3.

(17) Predictions: Naturalness

a. Naturalness rating for target stimuli will lie in between that of ungrammatical and grammatical fillers. That is, sentences standardly associated with intervention effects are "not that bad".
b. When target stimuli are interpreted as polar interrogatives under the indefinite reading of the *wh*-phrase, no intervention effect is found.
c. When target stimuli are interpreted as *wh*-interrogatives, intervention effect is found. Word order is proven to alleviate the effect; *wh*-intervener order is significantly more natural than intervener-*wh* order.
d. For *wh*-interrogatives, prosody also influences intervention effect. Specifically, higher *wh*-pitch contributes to higher naturalness ratings, regardless of the word order.

3.3 Results and Analysis

Let us first focus on the disambiguation of *wh*-phrases. Target sentences were interpreted as polar questions 78.5% of the time (113) and *wh*-questions 13.2% of the time (19). Participants used the panic button ("I don't know") 8.3% of the time (12). The discrepancy between the two possible readings is surprising, and I believe two possible explanations are available.

First, the target stimuli are created via audio manipulation from a base recording under an indefinite reading. There might have been remaining acoustic factors that biased the participants towards an indefinite reading, e.g. post-*wh* dephrasing, which was not really controlled for in this experiment.

Second, there could have been a flaw in the experiment design that created bias among the participants. There were several instances throughout the experiment where the participants were shown an image in which an individual is depicted to have relationship with multiple items. If it was unclear from the audio recording whether the question is to be interpreted as a polar interrogative or a *wh*-interrogative, the previously described context could have facilitated a polar interrogative interpretation. This is because *wh*-questions are often interpreted to demand an exhaustive answer, and the fact that it is impossible to provide a good enough answer towards the *wh*-question could have led the participants to lean towards another possible reading.

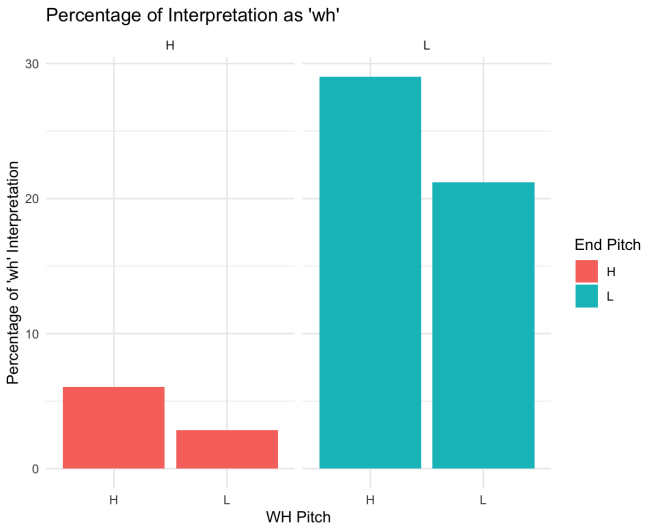


Figure 3: Percentage of *wh*-interrogative interpretation for each prosodic condition

Figure 3 shows the relationship between prosody (*wh*-pitch and sentence-final pitch) and the interpretation of *wh*-phrases. As expected, sentence-final pitch was found to elicit higher *wh*-interrogative interpretations, while *wh*-pitch had no significant effects. This corroborates our predictions (16) and the previous findings of Yun (2019). A logistic mixed-effects model was employed in R (*lme4* package) with interpretation — polar interrogative or *wh*-interrogative — as the dependent variable, *wh*-pitch and sentence-final pitch as independent variables (predictors), including the interaction between the two. Random intercepts were posited for participants. The model confirms that sentence-final pitch predicted interpretation (p ¡ .05), while there was no main effect of wh-pitch ($p = .517$). No significant effect of interaction ($p = .806$) was observed.

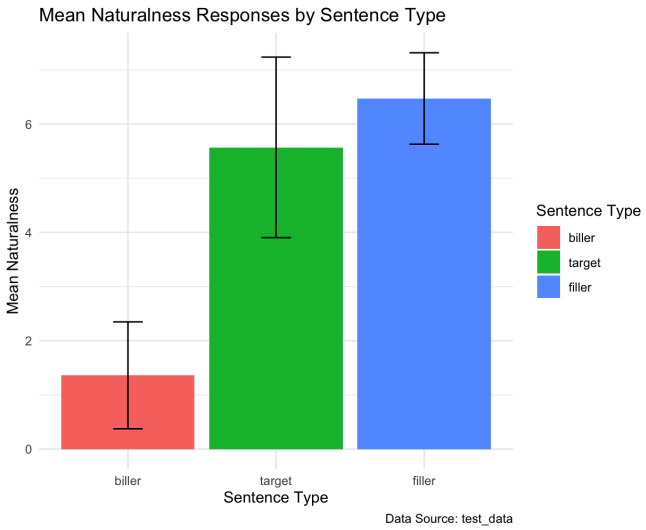


Figure 4: Mean naturalness ratings by stimuli type: biller (ungrammatical fillers), target, and filler (grammatical fillers)

Let us now move on to the naturalness ratings. The mean naturalness rating of target sentences was 5.57 ($SE = 0.14$), lying in between ungrammatical fillers (1.36, $SE = 0.08$) and grammatical fillers (6.47, $SE = 0.07$). The fact that target sentences were only marginally worse than grammatical fillers confirms our prediction that sentences standardly associated with intervention effects are "not that bad".

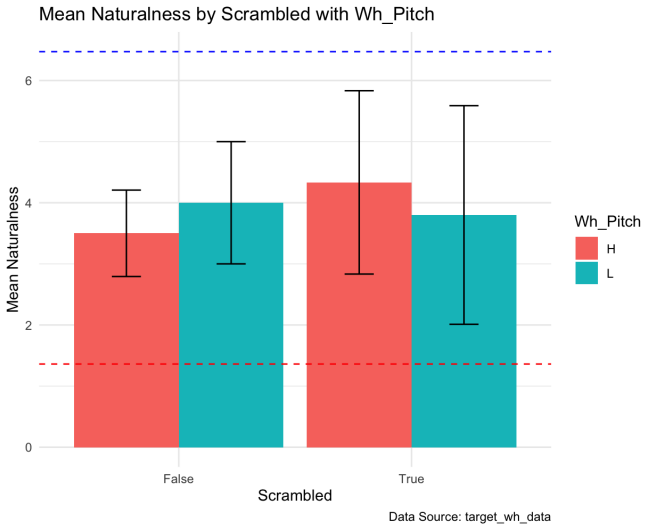


Figure 5: Mean naturalness ratings of *wh*-interrogatives by word order and *wh*-pitch

Narrowing down to cases where the target stimuli were interpreted as *wh*-interrogatives, our prediction was to find improvement in naturalness ratings (i) when the *wh*-phrase is scrambled over the intervener, and (ii) when the *wh*-phrase is prosodically made more prominent. However, both of these predictions were not borne out, as shown by figure 5. An ordinal mixed-effects model was fitted, with word order, *wh*-pitch, and sentence-final pitch as predictors and participants as random intercepts. No significant effect of scrambling ($p = .690$) or *wh*-pitch ($p = .121$) was reported.

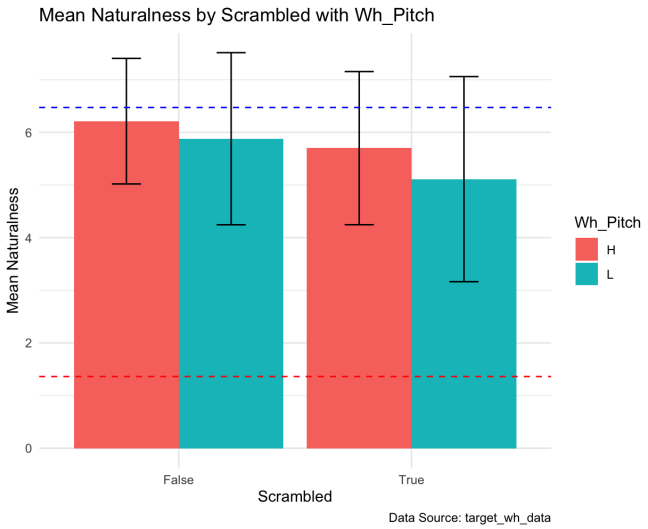


Figure 6: Mean naturalness ratings of polar interrogatives by word order and *wh*-pitch

Finally, in cases where the target stimuli were interpreted as polar interrogatives (under the indefinite reading of *wh*-phrases), an unexpected pattern was found. There seems to slight improvement in naturalness (i) when the *wh*-phrase is not scrambled across the NPI, and (ii) when the *wh*-phrase is made prosodically more prominent. This is particularly surprising, given the fact that intervention effects are expected to apply only to *wh*-questions, and a vast amount of previous literature predicts a polar interrogative with indefinite expressions to be "perfectly grammatical". Again, an ordinal mixed-effects model was fitted, with word order, *wh*-pitch, and sentence-final pitch as predictors and participants as random intercepts. Although the effect of *wh*-pitch was reported to be statistically insignificant, a significant effect of scrambling (p ¡ .01) was found (but in a negative direction).

4 Conclusion

The results of the experiment, although somewhat inconclusive, suggest that intervention effects should be understood from a new perspective. The effect is far from a strict, grammatical restriction on well-formedness of sentences, as previous literature predicts. Instead, the experimental findings of this paper point towards a pragmatic analysis (Tomioka, 2007; Hamlaoui, 2010), where prosody and context are expected to play a role. Although the experiment presented in this paper does not itself pinpoint what prosodic cue can exactly improve *wh*-questions with interveners, a good theoretical standpoint would be that something related to prominence and information structure will do the job. This is why, I believe, this experiment will lead to promising results when fleshed out in a larger scale with careful design that fixes some of the issues here.

A Link to experiment

`https://snuling.com/experiments/scleev/experiment.html`

B Link to audio & visual stimuli

`https://github.com/sukchan-0811/expling2024`

References

An, D.-H. (2020). Three ways to see in korean: Sentence final endings, clause structure, and the subjunctive circumstantial evidence construction. *Linguistic Research*, 37(3):477–498.

Beck, S. (1996). Quantified structures as barriers for lf movement. *Natural language semantics*, 4(1):1–56.

Beck, S. (2006). Intervention effects follow from focus interpretation. *Natural Language Semantics*, 14(1):1–56.

Beck, S. and Kim, S.-S. (1997). On wh-and operator scope in korean. *Journal of East Asian Linguistics*, 6(4):339–384.

Choe, H. S. (1988). Restructuring parameters and complex predicates: A transformational approach. *RLE Progress report*, (131):304–306.

Eckardt, R. (2007). Inherent focus on wh-phrases. In *Proceedings of Sinn und Bedeutung*, volume 11, pages 209–228.

Fodor, J. D. (1998). Learning to parse? *Journal of psycholinguistic research*, 27:285–319.

Haida, A. (2007). The indefiniteness and focusing of wh-words (online veröffentlichte diss.[anm. myp]). *Berlin, Institut für Deutsche Sprache und Linguistik, Humboldt Universität zu Berlin.[Zugriff 10.01. 2010: http://amor. cms. hu-berlin. de/˜ haidaand/]*.

Hamlaoui, F. (2010). Anti-givenness, prosodic structure and "intervention effects". *The Linguistic Review*, 27(3):347–364.

Hengeveld, K., Iatridou, S., and Roelofsen, F. (2023). Quexistentials and focus. *Linguistic inquiry*, 54(3):571–624.

Jun, S.-A. (2000). K-tobi (korean tobi) labelling conventions. *Ms., University of California, Los Angeles, Department of Linguistics. Available online at http://www. linguistics. ucla. edu/people/jun/ktobi/k-tobi. html (accessed 4 December 2015)*.

Kayne, R. S. (1994). *The antisymmetry of syntax*, volume 25. MIT press.

Kim, S.-S. (2002). Intervention effects are focus effects. *Japanese/Korean Linguistics*, 10(1):615–628.

Kim, S.-S. (2005). Focus intervention effects in questions. *Theoretical East Asian Languages*, 3.

Kitagawa, Y., Tamaoka, K., and Tomioka, S. (2013). Prosodic matters in intervention effects in japanese: An experimental study. *Lingua*, 124:41–63.

Kotek, H. (2017). Intervention effects arise from scope-taking across alternatives. In *NELS 47: Proceedings of the 47th Annual Meeting of the North East Linguistic Society*, pages 153–166. University of Massachusetts, Graduate Linguistics Students Association Amherst.

Kratzer, A. and Selkirk, E. (2020). Deconstructing information structure. *Glossa: a journal of general linguistics*, 5(1).

Krifka, M. (2001). For a structured meaning account of questions and answers. *Audiatur vox sapientia. A festschrift for Arnim von Stechow*, 52(2055):287–319.

Li, H. and Law, J. H.-K. (2016). Alternatives in different dimensions: a case study of focus intervention. *Linguistics and philosophy*, 39:201–245.

Richards, N. (2010). *Uttering trees*, volume 56. MIT Press.

Rooth, M. (1992). A theory of focus interpretation. *Natural language semantics*, 1(1):75–116.

Schütze, C. T. (2001). On korean case stacking: The varied functions of the particles ka and lul. *The Linguistic Review*, 18.

Tomioka, S. (2007). Pragmatics of lf intervention effects: Japanese and korean wh-interrogatives. *Journal of pragmatics*, 39(9):1570–1590.

Tomioka, S. (2009). Why questions, presuppositions, and intervention effects. *Journal of East Asian Linguistics*, 18:253–271.

Truckenbrodt, H. (2013). An analysis of prosodic f-effects in interrogatives: Prosody, syntax and semantics. *Lingua*, 124:131–175.

Yun, J. (2019). Meaning and prosody of wh-indeterminates in korean. *Linguistic Inquiry*, 50(3):630–647.