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ABSTRACT

We used a forced choice visual world paradigm to examine when listeners integrate case when processing Korean, in native speakers and two groups of adult L2 learners. The L2 learners varied as concerns the typological proximity between their L1 (French or Kazakh) and Korean. Processing was compared for canonical (SOV) and scrambled (OSV) word order. Nominal case marking was either accusative (NOM-ACC) or dative (NOM-DAT). Native Koreans showed anticipatory looks to the correct image, regardless of word order or case. Neither L2 group showed anticipatory looks to the correct image prior to the final auditory verb. Both L2 groups demonstrated superior performance for the dative. However, the Kazakh group showed better capacities to correctly interpret utterances based on case than the French. Our results provide evidence of the incremental nature of processing in Korean for native speakers and, for L2 learners, the effect of L1-L2 overlap and specific case marking.

Introduction

To understand human language, one must generate hypotheses about the respective roles of incoming words in an utterance or sentence, which may or may not be verified and sometimes lead to either misinterpretation or revision (Clifton & Staub, 2008; MacDonald, Pearlmutter & Seidenberg, 1994; Sturt, Scheepers & Pickering, 2002). Human language is indeed riddled with ambiguity and even the seemingly simplest utterance may hold more than one meaning depending on the syntactic structure that is projected (Fine, Jaeger, Farmer & Qian, 2013), the specific interpretation of polysemous words (Foraker & Murphy, 2012) and the speaker's intent (Piantadosi, Tily & Gibson, 2011), to name but a few factors. In the present paper, we will focus on the listener's capacity to immediately process the overt marking of the grammatical roles of nouns, i.e. case, to interpret utterances in Korean, which indeed can present numerous ambiguities (Koh, 1997; Lee, 1999) as has been equally demonstrated for Japanese (Miyamoto, 2002), a language that is typologically very similar to Korean in terms of case marking, particles and word order. We will examine this question both in native speakers and in two groups of adult learners.

Eye movement data from studies of online processing by native speakers of overt case languages such as Korean (Koh, 1997; Lee, 1999), Japanese (Kamide Altmann & Haywood, 2003; Mitsugi & MacWhinney, 2010; 2016) and German (Henry, Hopp & Jackson, 2017; Kamide, Scheepers & Altmann, 2003) suggest that they immediately use case to compute sentence structure (Koh, 1997; Mitsugi & MacWhinney, 2010) and to anticipate upcoming arguments (Henry et al., 2017; Kamide, Altmann et al., 2003; Kamide, Scheepers et al., 2003; Mitsugi & MacWhinney, 2016). The capacity for non-native speakers, more specifically adult learners, to exploit grammatical information to predict upcoming elements is less clear (Henry et al., 2017; Mitsugi & MacWhinney, 2016). Moreover, the influence of the learner's native

language on second language representation and processing continues to fuel debate (Clahsen & Felser, 2006; Herschensohn, 2001 Hopp, 2010; Lardiere, 2009; Schwartz & Sprouse, 2017). The present study examined how both native Koreans and adult L2 learners of Korean from two typologically distinct languages—French and Kazakh--process case particles in spoken Korean sentences via the recording of eye movements. To determine whether the two populations of L2 learners reliably used case over word order to interpret the utterances, we used both canonical and scrambled word order. As will be outlined below, the parametric differences across the L2 learners' two languages provides for a rich test bed of current linguistic theories of second language attainment.

We will begin with a brief sketch of the three languages in question—Korean, French and Kazakh—with an emphasis on Korean, as concerns case marking and canonical word order for monotransitive accusative structures (e.g 선생님이 학생을 본다 *"The teacher-Nom the student-Acc sees-Pres Ind"*) and dative structures with either one or two arguments (e.g. 의사가 간호사에게 인사한다*"The doctor-Nom the nurse-Dat says hello to-Pres Ind"* and 의사가 환자에게 종이를 전달한다 *"The doctor-Nom the patient-Dat the paper-Acc hands to-PresInd"*). We will discuss how dative case may differ from the nominative and accusative in Korean, notably as concerns ellipsis, and how such may affect the acquisition of different case markers in L2 learners. While our main interest is in the online computation of case, we will also discuss scrambling in Korean both because it is a prominent feature of Korean and due to our use of scrambled structures to test for the correct use of case over simple linear word order during auditory processing. Finally, prior to the introduction of the study at hand we will present empirical data from studies on the L1 acquisition of case in Korean (and Japanese) followed by that of the L2 acquisition in adult learners.

An overview of Korean, Kazakh and French case and word order

Korean is a left-branching head final language that has canonical SOV word order (Sohn, 1999). It is an agglutinative language, with clear demarcation between nouns and their suffixes, notably case, used to convey grammatical and/or semantic information about the roles of the nouns in a sentence. Indeed, what Korean lacks in verbal inflectional morphology (which marks neither number nor person but various registers) it makes up for in rich case marking. Numerous papers have addressed the issue of case in Korean (Kwon & Zribi-Hertz, 2008; Lee, E., 2007; Lee, H., 2007, 2011; Schütze, 2001). We will limit our discussion to that of the nominative, dative and accusative, the latter of which were manipulated in the current study. We shall address the question, first, of the status of dative in relation to both nominative and accusative.

As we will see, the dative case is distinct in several respects from the accusative, as well as nominative case. Korean marks the dative via the suffix "ey/eykey" (에 에게), which varies depending upon the animacy of the noun it attaches to. This in itself demonstrates a difference between dative versus nominative and accusative, which vary in surface form according to phonological constraints rather than semantic ones. Nouns with a CV syllable structure (e.g.,차, *cha*,'car') take particles with an initial consonant (가*"ka"* and 를 *"lul"),* whereas nouns with CVC structure (e.g., 꽃, *kkoch*, "flower') take vowel-initial particles (이 *"i"* and 을 *"ul"),* for nominative and accusative, respectively. The dative is used to mark Recipient, but also Time, Source and Location, although the respective constraints differ (cf. Lee, 1999). Below are examples of the dative when used to denote the Recipient, for animate (1a) and inanimate (1b) nouns, demonstrating the animate and inanimate dative markers.

(1) a. 아이가 여자에게 우산을 준다
Ai-ka yeoja-eykey wusan-ul jun-ta

Child-Nom woman-Dat umbrella-Acc gives-Pres-Ind

"The child gives an umbrella to the woman."

(1) b 아이가 꽃에 물을 준다
Ai-ka kkoch-ey mwul-ul jun-ta

Child-Nom flower-Dat water-Acc gives-Pres-Ind

"The child gives water to the flower(s)."

Korean also has double accusative object constructions for the dative, as is true of English, illustrated in 2a and 2b for English and 3a and 3b for Korean. However, while English allows for the dative/double accusative alternation freely, in Korean the dative structure like 3a is preferred over the double accusative in 3b. Note that while the order of nouns is fixed in English, it is flexible in Korean (as will be discussed below). In Korean, the dative can also be stacked with the accusative, as illustrated in 3c.

2a. The teacher gives a book to the student

2b. The teacher gives the student a book.

3a. 선생님이 학생에게 책을 준다
Seonsaengnim-i haksaeng-eykey chaek-ul jun-ta

Teacher-Nom student-Dat book-Acc give-Pres-Ind

"The teacher gives a book to the student."

3b. 선생님이 학생을 책을 준다
Seonsaengnim-i haksaeng-ul chaek-ul jun-ta
Teacher-Nom student-Acc book-Acc give-Pres-Ind

"The teacher gives the student a book."

3c. 선생님이 학생에게를 책을 준다

Seonsaengnim-i haksaeng-eykey-lul chaek-ul jun-ta

Teacher-Nom student-Dat-Acc book-Acc give-Pres-Ind

“The teacher gives the student a book.”

It is outside the scope of the present paper whether the dative/double object variation also connotes semantic differences (cf. Ryu, 2013, for a discussion of sequences of NPs marked with identical case, for the dative, accusative and nominative). Lee (1997) cites work by Ushibara (1991) concerning the syntactic behavior of dative relative to other case markers in Korean to argue that dative is a postposition rather than case proper. Of importance for the present purposes, dative may be alternatively expressed as dative or, in double object constructions, as accusative, and can be stacked, as illustrated above, but is rarely if ever dropped. This contrasts with nominative and accusative case, for which case ellipsis is relatively frequent, if indeed determined by discourse, syntactic and perhaps semantic constraints (Lee, H., 2007, 2011; Sohn, 1999). We shall return to the question of case omission below, in the discussion of L1 and L2 acquisition of Korean case.

Kazakh is a Turkik language that shares some important grammatical features with Japonic and Koreanic languages. It is left-branching, head final, agglutinative and the canonical word order is SOV (Kirchner, 1998). It uses case to mark the grammatical functions of nouns, and includes nominative, accusative, dative, genitive, locative and ablative cases. For the present purposes, we will concentrate on nominative, accusative and dative. The (singular) nominative case is unmarked. Both accusative and dative suffixes (and indeed all other case suffixes) are subject to vowel and consonant harmony. Akin to Korean, various permutations on the canonical word order are allowed due to case (Kornfilt, 2003), as illustrated in examples 4a through 4d for structures with Nom-Acc. An important difference between Korean and Kazakh, which will be discussed below, is that Kazakh allows for variant

surface orders in which the predicate (V) is scrambled above its nominal arguments (Hoffmann, 1992). Given the presence of overt case marking and the canonical SOV word order in Kazakh, these learners should come to Korean equipped with grammatical knowledge that allows them to readily acquire the basic structure of this language (Herschensohn, 2002; Schwartz, 1998; Schwartz & Sprouse, 2017)

4a. ұл қызды көреді
ul qızdı köredi
Boy_0 girl_ACC see-Pres-Ind
"The boy sees the girl"
4b. қызды ұл көреді
Qızdı ul köredi
girl_ACC boy_0 see-Pres-Ind
"The boy sees the girl"
4c. қыз ұлды көреді
qız uldı köredi
girl_0 boy_ACC see-Pres-Ind
"The girl sees the boy"
4d. ұлды қыз көреді
uldı qız köredi
boy_ACC girl_0 see-Pres-Ind
"The girl sees the boy"

French contrasts with Korean (and Kazakh) in numerous respects. It is a head initial language, with canonical SVO word order, and has a moderately rich inflectional morphology. In modern French, nouns have a basic form derived from the Latin accusative singular. Hence, French does not have a morpheme that indicates case for full noun phrases that are direct objects (see 5a), but does mark dative case by the preposition *à* 'to' (see 6a). In contrast, accusative and dative pronouns are preverbal clitics whose phonological, morphological and semantic environments constrain their form. While SVO is canonical for sentences with full

noun phrases, SOV is the required order for clitic pronouns, as illustrated in 5a and 5b for transitive accusative structures and in 6a and 6b for dative structures. Indeed, when a full noun is not used, the obligatory object in French is a clitic pronoun, which demonstrates various properties that distinguish it from both full nouns and strong pronouns: it may not remain in situ (it must cliticize to the verb), is marked for case (nominative, accusative, dative) and may refer to either animate or inanimate referents (cf. Herschensohn, 2004; Sneed, Herschensohn & Frenck-Mestre, 2015). French also exhibits SOV surface order for clitic left dislocated NPs, as illustrated in 7. As such, native French speakers should not have difficulty per se with SOV word order.

5a. Jean voit le chien.

“John sees the dog.”

5b. Jean le voit.

John it sees “John sees it.”

6a. Jean écrit à Marie.

“John writes to Mary”

6b. Jean lui écrit.

John her writes -> “John writes to her”

7. a. Cet hommei$_j$ je l$_j$’aime.

That man -> I him love “That man, I love him.”

To summarize, Kazakh is typologically similar to Korean in case marking, scrambling and basic SOV word order while French shares aspects of those characteristics in the pronominal system. All three languages distinguish accusative from dative objects in terms of case marking, a phenomenon we return to below.

Scrambling in Korean

The three languages in question (Korean, French and Kazakh) also differ as concerns the possible permutations of arguments. Due to the presence of case marking, both Korean and Kazakh allow for relatively free ordering of subject and object arguments, in like manner to Japanese, Turkish, German, etcetera and in contrast to languages that do not have "free word order" due to a lack of overt nominal morphology, e.g. French, English, etcetera. While the typical sequence of nouns in Korean is SOV, provided that the verb remain in final position, nominal position may vary, as illustrated below in 8a – 8f .

8a. 요리사가 남자에게 술을 판다

Yorisa-ka namja-ekey swul-ul pan-ta
chef-Nom man-Dat alcohol-Acc sells-Pres-Ind

8b. 남자에게 요리사가 술을 판다

man-Dat chef-Nom alcohol-Acc sells-Pres-Ind

8c. 술을 남자에게 요리사가 판다

alcohol-Acc man-Dat chef-Nom sells-Pres-Ind

8d. 요리사가 술을 남자에게 판다

chef-Nom alcohol-Acc man-Dat sells-Pres-Ind

8e. 남자에게 술을 요리사가 판다

man-Dat alcohol-Acc chef-Nom sells-Pres-Ind

8f. 술을 요리사가 남자에게 판다

alcohol-Acc chef-Nom man-Dat sells-Pres-Ind

"The chef sells alcohol to the man"

While all of the above permutations of arguments are permissible in Korean (and

typologically similar Japanese), they are not without constraint. Lee (2007) provides a detailed description of "scrambling" in Korean, which he argues is not entirely free but governed by various syntactic and semantic constraints. Interestingly, these constraints are not linguistically universal, as illustrated by Lee's (2007) comparison of Korean and Turkish, which is particularly relevant to the current study. As stated above, in Korean the verb must remain in final position whereas in Turkish it may rise above nominal arguments. In addition, not all word orders are equally likely to occur nor, depending upon the theoretical stance or experimental study in question, processed without cost. As concerns usage frequency, corpus based studies in Japanese have shown that scrambled sentences are far and away less frequent than canonical word order (Kuno, 1973 (cited by Yamashita, 1997); Yamashita, 2002). Yamashita (2002) used a variety of written materials with various registers to examine the occurrence of scrambled sentences in Japanese. In text, short distance (within clause) scrambling was found to be the most frequent of scrambled structures, but nonetheless rare (less than 1%). As stated by Yamashita (2002) comparisons with spoken materials are yet to be made.

In relation to the question of computational costs, in the framework of the minimalist program (Chomsky 1995) following government and binding theory (Chomsky, 1981), scrambled (OSV) structures are derived from configurational (base) structures in which the subject NP is positioned higher in the syntactic tree than other NPs (cf. Koizumi & Tamakoa, 2010 for an in depth discussion of the competing analyses in concern to movement of the object in relation to the subject and the derivational cost of OSV compared to SOV order). Hence, scrambled structures involve movement and a chain that is formed between the scrambled argument and its trace. Experimental evidence for this was provided by Miyamoto and Takahashi (2004) in a probe recognition task, showing facilitated recognition of probes in scrambled as compared to canonical structures due to the assumed reactivation of the trace

(but see Shibata, Suzuki, Kim, Gyoba & Koizumi, 2005). Scrambled structures are generally considered to be syntactically more complex (Imamura, Sato & Koizumi, 2016; Koizumi & Tamakoa, 2010; Yamashita, 19997) and hence predicted to incur greater processing cost in comparison to canonical structures. The fact that scrambled structures are far and away less frequently encountered than canonical ones should also contribute to greater processing difficulty. Several experimental studies of Japanese have addressed this question, showing somewhat mixed results. When holistic measures of sentence processing are considered, whereby participants make speeded acceptability judgments, the results show that participants take longer to accept syntactically correct scrambled than canonical sentences (Imamura, Sato & Koizumi, 2016; Koizumi & Tamakoa, 2004; 2010; Miyamoto & Takahashi, 2002). When self paced reading times are examined, the effects of scrambling on processing time are less apparent, sometimes being only marginal (Shibata et al., 2005) or absent (Mitsugi & MacWhinney, 2010; Yamashita, 1997). However, as discussed by Miyamoto and Takahashi (2004), scrambled word order may not be immediately apparent, due to ambiguity, such that there is not an immediate projection of a gap or need of restructuring (cf. Ahn, 2015, for a further discussion of ambiguity and the constraints on scrambled structures in Korean). Moreover, for short distance (within clause) scrambling, the restructuring may be resolved too quickly to be picked up in self paced reading (cf. Shibata et al., 2005 for a discussion).

In the present study, we presented participants with both canonical and scrambled structures in the aim of examining the online use of case, rather than to test for the effect of structural complexity per se. Moreover, we purposefully used within clause OSV scrambling to reduce processing load, compared to long distance scrambling. The materials were such that we could compare processing, as concerns both accuracy, at the end of utterance, and speed as determined by the point in the utterance at which listeners showed a statistical preference for correct interpretation, i.e. when they directed their gaze to the image that

correctly depicted the auditory sentence. Before describing our study, we outline previous research on the acquisition of case in Korean.

The acquisition of case in Korean

The acquisition of case particles in Korean has been argued to be relatively late, even under monolingual conditions. Studies on child acquisition of Korean case have shown that up until age 4, children by and large do not use case when interpreting auditory input but impose canonical SOV structure (Kim, O'Grady & Cho, 1995). This is true even when case particles are present and indicate OSV word order (Chung, 1994; Kim et al., 1995). When the children were asked to act out an OSV utterance, they produced an SOV sequence due to using canonical word order over case to attribute grammatical roles. This comprehension evidence contrasts with production, where monolingual Korean children produce both nominative and accusative case by age 2.8, with nominative case being the first to emerge, and as early as age 1.11 (Kim, 1997). The lack of evidence of an early effect of case marking in comprehension may be related, however, to the design used to probe for it. Indeed, preceding OSV utterances by a prior discourse context, which introduced the object argument and thus licensed it as the focus of the subsequent utterance, significantly improved Korean 4 year olds' interpretation of these utterances (Kim et al., 1995). The same effect of discourse was found for 3 and 4 year old Japanese children by Otsu (1994) who argued that isolated scrambled sentences violate discourse principles, thus leading to a breakdown in comprehension in young children. Subsequent work with Japanese 2 to 6 year olds has also suggested that as early as age 3 they may reliably use case marking to understand spoken sentences (Murasugi & Kawamura, 2004), although it should be noted that the study examined a very small number of participants and only numerical differences were reported. Hence, it remains an open question whether the use of case particles during comprehension

lags behind production in monolingual children of agglutinative languages.

The mastery of case particles in Korean is likely to be subject to protracted difficulty in L2 acquisition. Despite its universal nature, correctly interpreting and producing case has been shown to be a source of difficulty for L2 learners (Brown & Iwasaki, 2013; Ahn & Herschensohn, 2013; Hopp, 2010, 2015) as well as "heritage speakers" i.e. speakers who are raised in a different linguistic community from that of their care takers who are native speakers of another language (Kim, O'Grady and Schwartz, in press). Moreover, although the question of whether convergence on the target grammar depends upon the particular L1-L2 pairing remains open to debate, recent work has suggested that adult learners of Korean whose L1 does not have case marking on full NPs are at a disadvantage compared to those whose L1 does (Ahn 2015; Brown & Iwasaki, 2013). Indeed, in a longitudinal case study of 3 Japanese L1 speakers and 3 English L1 speakers, Brown and Iwasaki (2013) showed different trajectories and success rate as concerns the acquisition of case particles in Korean. The L1 Japanese speakers showed clear reliance on their L1 case marking system which, however, also led these learners to ignore certain aspects specific to the (L2) Korean system and commit more errors than their L1 English counterparts in these instances. In like manner, the cross-linguistic comparison of L1 Russian, Dutch and English learners of L2 German showed that for advanced learners, the capacity to compute grammatical relations from case was dependent upon the overlap of the learners' L1 and L2, at least under conditions where processing was time constrained (Hopp, 2010). Note, for "end-state" learners, i.e. those who have acquired near-native status, the convergence of the L1 and L2 did not play a significant role; these learners showed online use of case to understand sentences in like fashion to native L1 German speakers (Hopp, 2010). The present study was designed to address these issues, i.e. whether L2 learners of Korean are able to use case-marking under conditions where they must compute grammatical relations under time pressure, and whether the presence of case in

their L1 will impact this ability.

Another issue in the acquisition of case particles in Korean is linked to the fact that these particles are not consistently produced by native speakers in speech. For both the nominative and accusative, Korean case particles can be rather freely dropped in informal speech once they have been established in the discourse context, although such is governed by various grammatical and pragmatic constraints (Sohn, 1999). Studies of L1 acquisition of Korean (and Japanese) show that children drop case particles more often than adults, and drop accusative more than nominative (for an in depth discussion, cf. Ko, 2005). Interestingly, adult L2 (Anglophone) learners of Korean also drop case more frequently than do native speakers, both when licensed and not (Ahn & Herschensohn, 2013). However, such was true principally for oral as opposed to written production. These facts led Ahn and Herschensohn (2013) to assume that L2 learners of Korean have difficulty with the overt realization of morphology in general and case particles in particular, rather than with the underlying syntax per se.

Both linguistic theory and production data provide evidence that in languages that overtly mark case, case-marking may in fact be optional, although it is indeed governed by numerous principles (Aissen, 2003; Kwon and Zribi-Hertz, 2008; Sohn, 1999). Aissen (2003) focuses her discussion on “differential object marking” (DOM), i.e. the variability of case marking, and couches her arguments in Optimality Theory (Prince & Smolensky, 1993). As stated in Aissen (2003), while “the boundaries that separate the obligatory case-marked objects from those which are optionally case-marked or never case-marked may shift (according to the language in question) they nonetheless obey the general principle outlined by Bossong (1985: 3) that “the higher in prominence a direct object, the more likely it is to be overtly case-marked.” Aissen (2003) cites evidence from numerous typologically distinct languages, including Korean and Turkish, to bolster her argument (cf. Kornfilt, 2007 for a

discussion of DOM in Turkish and related languages). In addition, Aissen (2003) cites evidence for "differential subject marking" or DSM, although she argues that this phenomenon is overall less frequent and more restricted than DOM. Kwon and Zribi-Hertz (2008) suggest that Aissen's (2003) theory is "to the best of our knowledge, the only available theory of DM which covers both DOM and DSM" and use it as a starting point to consider the phenomenon in Korean (and Japanese). Kwon and Zribi-Hertz (2008) provide various examples of both bare objects (DOM) and bare subjects (DSM)—that is, nouns whose case marks are missing; their examples of both bare and obligatorily case-marked nouns pose a challenge for Aissen's (2003) claims concerning the factors that govern the ranking of constraints. Kwon and Zribi-Hertz (2008) show that information structure must also be taken into account, and they conclude by showing how their analysis can be reconciled with Aissen's theory. The present paper does not allow us to adjudicate between the various linguistic models of case ellipses. For the present purposes it is simply important to note that this phenomenon is clearly attested in Korean and is observed less often for dative than accusative or nominative case.

The present study

In the present study we examined the online processing of Korean case in native Korean speakers and in L2 learners whose native language was either French or Kazakh. We predict that the acquisition of case particles in L2 Korean may prove difficult, independent of the properties of the learner's L1 grammar (Hopp, 2010, 2015). Nonetheless, based on the results from previous studies of adult non-native processing in Korean, the protracted difficulty in computing structural relations from case in an L2 may be more apparent in learners whose language does not have nominal case marking than those that do. Hence, at a macro level we predict that L2 learners of Korean whose L1 is typologically similar Kazakh

may show a pattern of online processing that is more similar to native Koreans than do L2 learners whose native language is French (cf. Rothman, 2011 for the Typological Primacy Model). However, one can also take a more fine grained approach by examining processing as a function of the type of case markers. Indeed, as illustrated in the examples 9 through 12 below, we compared processing for monotransitive accusative structures and for dative structures, in both canonical and scrambled word order; these sentences were all marked for case, as would be appropriate for sentences devoid of context (Ahn, 2015).

(9) Accusative canonical :
소녀가 요리사를 민다
sonyeo-ka yorisa-lul minta
girl-NOM chef-ACC push-PRES_IND
”The girl pushes the chef.”

(10) Accusative scrambled :
요리사를 소녀가 민다
yorisa-lul sonyeo-ka minta
chef-ACC girl-NOM push-PRES_IND
”The girl pushes the chef.”

(11) Dative canonical :
간호사가 선생님에게 이야기한다
kanhosa-ka seonsaengnim-eykey iyakihanta
nurse-NOM teacher-DAT say hello to-PRES_IND
“The nurse says hello to the teacher”

(12) Dative scrambled :
선생님에게 간호사가 이야기한다
seonsaengnim-eykey kanhosa-ka iyakihanta
teacher-DAT nurse-NOM say hello to-PRES_IND
“The nurse says hello to the teacher”

To examine online processing, we used a modified version of the visual world paradigm. In the typical visual world paradigm, participants hear an utterance as they view a single visual scene in which the target item is displayed along with distractors that bear some grammatical, semantic or phonological resemblance to the target. In our paradigm, we used

two scenes, which were counterbalanced on the left and right hand side of the screen, one which correctly depicted the utterance and the other in which the roles of the agent and the patient were reversed. All depicted agents and patients were of animate objects. Participants were presented with the entire visual display one second prior to the onset of the spoken sentence and their eye movements were recorded from the onset of the display until they manually selected one of the two scenes by means of a joystick. The auditory stimuli were marked with inaudible triggers that signaled the onset of each noun and sentence final verb, such that we could time lock the participants' eye movements to each element as the utterance unfolded while they scanned the two scenes.

Figure 1. about here

As illustrated in examples 9 through 12, all sentences were verb final with two (or in some cases three) overtly marked full nouns prior to the verb. The paradigm allowed us to test 3 hypotheses. First, we examined whether native and non native participants differed in the online use of case as determined by preferential looks to the correct image. We did not expect listeners to show a statistical preference for either image during the processing of the first NP. Although NP1 was overtly marked, for NOM in canonical structures and either ACC or DAT in scrambled structures, the listener could construe the first noun as either the agent or the patient depending upon the subsequent verb. It is also unlikely that any clear preference should be found during the auditory processing of NP1 due to the rapidity of the speech signal in comparison to the physiological constraints of eye movements. The average time needed to program and launch a saccade is roughly 200 ms (Rayner, 1998) while the duration of the morphological suffixes never exceeded such. We thus predicted that listeners should begin to look at the correct image only after having processed the second NP, which was always NOM in scrambled structures and either ACC or DAT in canonical structures. This pattern is

predicted for native speakers who should immediately exploit case information (cf. Koh, 1997; Lee, 1999). For L2 learners, if they do not process the utterance incrementally and or cannot do so quickly enough to show immediate effects, we should not see preferential looking to the correct image prior to the processing of the verb. Second, by presenting both scrambled and canonical word order, we can determine whether our participants are truly using case morphology or if they are preferentially using word order. If participants are using word order, despite the availability of case marking, for both SOV and OSV structures they should look at the image depicting the first auditory noun as agent (Kim et al., 2018). This would lead to a preferential gaze to the incorrect image for OSV sentences, for which the first auditory noun is the patient. We predicted that native speakers would exploit case marking. Last, based on the properties of DAT compared to NOM and ACC, we predicted that listeners may make immediate use of case faster and more reliably for dative than accusative structures. How L2 learners may perform in relation to native speakers is yet another question. For online integration of case, if the presence of overt case marking on the L1 plays a prominent role in acquisition we can predict that our Kazakh participants should show patterns of eye movement behavior that is more similar to native Koreans than our French participants, however; this effect should interact with the factor case marker. We predicted that the two L2 groups should be more similar to each other and closer to native speaker performance for dative structures, since both Kazakh and French have distinctive morphological marks for dative case. In as far as accuracy is concerned we predicted ceiling level performance for native speakers. For the L2 learners, if word order is used over case, we predicted a drop in accuracy for OSV utterances and, a greater differential between SOV and OSV structures for French than Kazakh learners if the L1 features play a predominant role.

Methods

Participants. Twenty-one native speakers of French and 16 native speakers of Kazakh enrolled in the 3rd semester of Korean intensive language classes at Seoul National University (SNU) based on their performance on placement tests were recruited as L2 learners, along with a control group of 18 native Korean speakers enrolled as undergraduate students at SNU. Two native Korean participants were later excluded from analyses due to either poor quality of eye-movement recording (1) or failure to follow instructions as concerns responses (1). All participants were over 18 years of age with no ocular-motor deficits or history of neurological insult. All participants gave informed written consent prior to taking part in the study and were monetarily compensated for their participation. The study was approved by the Internal Ethics Committee at Seoul National University.

L2 participants filled out a language background questionnaire as well as a measure of vocabulary in Korean and case morphology for the nominative, accusative and dative, following the main experiment. For all L2 participants, the mean length of formal learning of Korean at SNU was 160 hours across 3 semesters of Korean intensive language classes. As revealed by the language background questionnaire, the two learner groups had similar characteristics as concerns mean age, mean length of residence in Korea mean onset of first exposure to Korean and mean number of months studying Korean prior to arriving in Korea (see Table 1). The language background questionnaire also queried numerous aspects of self-rated proficiency, from the ability to hold a casual conversation to being able to follow university level classes in Korean. Overall, the two L2 groups differed only in their subjective ability to read a Korean language newspaper. All participants were able to produce the written translations of all nouns and verbs used in the materials in either French or English as well as give the correct grammatical description of the three case markers used across the different nouns.

Table 1 about here

Stimuli. Experimental stimuli consisted of 40 auditory sentences, each paired with a visual scene comprised of 2 line drawings created by a professional artist (the full set of stimuli are available upon request). The experimental sentences were constructed according to a 2 (Case: accusative vs. dative verb) x 2 (Order: canonical (SOV) vs. scrambled (OSV)) within subjects design. Five accusative and 5 dative verbs and 20 concrete nouns were used to create sentences. Accusative verbs varied in length from 2 to 4 syllables (average of 2.8) and dative verbs from 2 to 5 syllables (average of 3.4). Each verb was presented in 4 auditory sentences with 4 different noun pairs (*e.g. 학생이 선생님을 본다* ($student_{nom}$ $teacher_{acc}$ see_{Pres_Ind}) *"the student sees the teacher", 남자가 여자를 본다* (man_{nom} $woman_{acc}$ see_{Pres_Ind}), "the man sees the woman" etc.). For each verb type, each of the 20 critical nouns was seen either once or twice as the subject and as the object noun across sentences (e.g. 어른이 아이를 민다 ($adult_{nom}$ $child_{acc}$ $push_{Pres\_Ind}$) "*the adult pushes the child*" and 아이가 어른을 깨운다 ($child_{nom}$ $adult_{acc}$ $wake_{Pres\_Ind}$) "*The child wakes the adult*", and 환자가 의사에게 인사한다 ($patient_{nom}$ $doctor_{dat}$ say $hello_{Pres\_Ind}$) "*The patient says hello to the doctor*" and 의사가 환자에게 이야기한다 ($doctor_{nom}$ $patient_{dat}$ $speak_{Pres\_Ind}$) "*The doctor speaks to the patient*"). For 3 of the 5 dative verbs a third (accusative) noun was heard prior to the verb (e.g. 아이가 여자에게 우산을 전달한다 "*The $child_{nom}$ the $woman_{dat}$ the $umbrella_{acc}$ gives*"). Using dative verbs that require the third noun, marked for the accusative, was to ensure that verbs were all high frequency. For all dative utterances, the first and second noun were always marked for either nominative or dative depending upon word order (SOV or OSV). All nouns and verbs were

selected to be part of the L2 learners' vocabulary, which was also verified in the post-experiment questionnaire. The pairing of two nouns as well as the use of a pair with a given verb was performed to meet semantic restrictions. Sentence creation was further restricted by the possibility of creating unambiguous visual scenes to depict the sentences.

Each auditory sentence was produced in canonical (SOV) and scrambled (OSV) word order (eg. 요리사가 소녀를 쫓는다 ($chef_{nom}$ $girl_{acc}$ $chase_{PRES\_IND}$) and 소녀를 요리사가 쫓는다 ($girl_{acc}$ $chef_{nom}$ $chase_{PRES\_IND}$) "*The chef chases the girl*"). All verbs were produced in the inflected form for present indicative for standard newspaper reporting and all nouns were fully marked for case (nominative, accusative, dative). Two counter-balanced lists were created such that all participants heard 20 accusative and 20 dative sentences, with 10 of each verb type in canonical and 10 in scrambled word order, and no repetition of sentences within a list. Twenty filler sentences comprised of a copula and 2 nouns were also created and presented in each of the two lists.

Sentences were recorded by a linguistically trained female native Korean speaker in a sound attenuated recording studio at 48kHz (32-bit float) at a rate of roughly 550 ms per word. The mean duration of experimental sentences was roughly 2 seconds. The speaker used a neutral intonational pattern that did not accentuate either noun. All sentences were recorded in a single session and all sentences were produced twice. Post recording, the list of sentences was split into individual tracks. For each experimental sentence, the onset as well as duration of each auditory element (N1, N2, VB) was determined using SPAAS software adapted for Korean (www.sppas.org) and verified using PRAAT. These onsets were used as triggers sent during the eye movement recording and later used to compute the location of the participants' gaze as the auditory sentence unfolded.

All line drawings were created by a professional artist using India ink and paper, and

were subsequently digitized for purposes of the experiment. All drawings were created on a template comprised of 2 equally sized rectangles, one on the left and one on the right half of the screen at a resolution of 1024 x 768 pixels. Each drawing consisted of 2 complementary scenes, one depicting the first noun as the subject of the action and the other the second noun as the subject (see Figure 1). The correct image appeared equally often on the left and right side of the screen across trials and experimental conditions. All visual stimuli were presented only once, in conjunction with an experimental or filler trial.

Procedure. Participants were tested at Seoul National University in a sound attenuated room. The experiment began with a series of 4 warm up trials to familiarize the participant with the procedure, followed by a randomized list of 40 experimental and 20 filler trials. Participants sat 60 cm away from a CRT screen with their head restrained by a chin/forehead rest and were asked to listen to sentences and press one of two response buttons corresponding to the image depicting the sentence. Participants' eye movements were recorded using an Eyelink 2 Head mounted eye-tracker and were sampled at 250 hz. Participants' eye movements were calibrated at the outset of the experiment using a nine point calibration grid that randomly presented fixation points at 500 ms intervals. Recalibrations were performed roughly every 10 trials and drift checks were performed as necessary. Each trial began with a central fixation point for 500 ms and warning tone followed by the presentation of the visual scene. The auditory sentence was presented 1000 ms after the display of the visual scene, which remained on the screen until the participants' response on the button box. The next trial began immediately following the participants' response and no feedback was provided. The entire session lasted roughly 30 minutes.

Results

Eye movement data and response accuracy were extracted using the Data Viewer

software (Eyelink). Trials contaminated by loss of the tracker or excessive movement were discarded (resulting in 3%, 3,5% and 4% of trials for native Koreans, Kazakh L2 learners and French L2 learners respectively). Two items were excluded from the analyses due to native speakers' showing chance level accuracy as a result of ambiguity in the line drawing.

Statistical analysis.

We ran logistic regressions using generalized mixed effects models (glmer) to analyze both accuracy and dwell time. We used R packages lme4 (Bates et al., 2015) and LMER convenience functions (Tremblay & Ransij, 2015). Below we report the results from the models with a random effect structure justified by the data, which show the smallest Akaike Information Criterion (AIC) (Matuschek, Kliegl, Vasishth, Baayen & Bates, 2017). Models were constructed from the simplest to the maximal model and model comparisons were systematically performed, however; the majority of the models for dwell times also met the criterion of being the maximal model (Barr, Levy, Scheepers & Tily, 2013). For dwell times, a binary variable was constructed based on the amount of time spent on the correct and incorrect image during each auditory word. For example if on a given trial a participant spent 350 ms on the correct and 100 ms on the incorrect image respectively, then 350 "1" and 100 "0" responses were entered into the logistic regression model. As such, the variability in dwell times across participants and trials was retained in the model. Dwell times were calculated from the auditory onset of a given region of interest (ROI) to the onset of the next ROI for the first two ROI (N1 and N2) and from the onset of the ROI to the onset of the manual response for the final ROI (VB). For the dative sentences that contained a third (accusative) noun prior to the verb, this time was not included in the ROI analyses. The specific models are described below, for accuracy and dwell time analyses.

Accuracy.

Three models were fitted to determine whether the 3 groups differed in performance. The first model compared Korean controls to Kazakh learners and included the sum-coded factors Group (Korean native vs. Kazakh learners), Case (Accusative vs. Dative) and Order (Canonical vs. Scrambled) and their interactions. The second model compared Korean controls to French learners and included the same sum-coded factors: Group (Korean native vs. French learners), Case, Order and their interactions. The third model again included the same sum-coded factors and directly compared the 2 learner groups : Group (Kazakh vs. French learners), Case, Order and their interactions. Participant was included as a random factor; Item was not included due to non-convergence when added. No slope was included due to non-convergence of the model when added. Figure 2 illustrates the accuracy results for the observed data.

Figure 2 about here

The model comparing Korean controls to Kazakh learners revealed an effect of Group ($\beta = 0.75$, se = 0.18, $z = 4.23$, $p<.0001$) due to higher overall accuracy for Koreans (94%) than Kazakh learners (79%), which was modified by interactions involving Group x Order ($\beta = 0.28$, se = 0.11, $z = -2.44$, $p<.01$) and Group x Case ($\beta = 0.50$, se = 0.11, $z = 4.36$, $p<.0001$). The comparison of Koreans to French learners revealed the same effects, with a main effect of Group ($\beta = 1.03$, se = 0.17, $z = 6.23$, $p<.0001$) due to lower overall accuracy for French learners (68%), and interactions between Group x Order ($\beta = -0.44$, se = 0.11, $z = -4.01$, $p<.0001$) and Group x Case ($\beta = 0.36$, se = 0.11, $z = 3.34$, $p<.0001$). The model comparing the 2 learner groups directly revealed a main effect of Group ($\beta = -0.29$, se = 0.14, $z = -2.02$, $p<.04$), indicating overall higher accuracy for Kazakh than French learners, as well as interactions between Group x Order ($\beta = 0.16$, se = 0.08, $z = 2.02$, $p<.04$) and Group x

Case x Order (β = 0.20, se = 0.08, z = 2.60, p<.01). Based on the interactions found in these models, we performed independent analyses on the data for each group, with the sum coded factors Case and Order. The best model included for the Korean data included only Participant as a random intercept, whereas the model for the French and Kazakh learners included both Participant and Item as random intercepts. No random slope was included to any of the models due to non convergence of the model when added.

For the Korean natives, there was an effect of Case (β = 0.54, se = 0.20, z= 2.72, p<.01) but not of Order (β = -0.14, se = 0.20, z= 0.71, ns), nor the interaction (β = 0.08, se = 0.20, z= 0.39, ns). Korean controls performed at practically ceiling level for all conditions, with slightly better accuracy for accusative than dative sentences.

For the French L2 learners, there was an effect of Order (β = 1.07, se = 0.12, z= 8.68, p<.00001), which was modified by the interaction with Case (β = 0.41, se = 0.12, z= 3.55, p<.0004). The subsequent treatment coded model revealed that for dative sentences performance was above chance for both canonical (β = 2.00, sd = 0.31, z = 6.40, p<.0001) and scrambled (β = 0.69, sd = 0.27, z = 2.59, p<.01) word orders. In contrast, for accusative sentences accuracy was above chance for canonical word order (β = 2.44, sd = 0.32, z = 7.52, p<.0001) but below chance for scrambled (β = -0.54, sd = 0.26, z = 2.09, p<.04).

For the Kazakh learners, both the effects of Case (β =-0.48, se = 0.15, z =-3.25, p<0.001) and of Order (β = 0.76, se = 0.15, z = 4.92, p< .0001) were significant with no interaction (β = 0.01, se = 0.15, z = 0.08, ns). Kazakh learners showed above chance accuracy for all conditions, but higher accuracy for dative than accusative sentences and for canonical than scrambled word order.

Eye tracking analyses

Independent analyses were performed on the 3 ROI (N1, N2 and Verb). In like manner to the models for accuracy, we first ran 3 independent generalized linear mixed effects models (glmer) to compare the Korean controls to Kazakh learners, the Korean controls to the French learners and then the 2 learner groups to each other, for each ROI. All models included the sum coded factors Group, Case, Order and their interactions. Participant and Item were both included as random intercepts and random slopes of both Case and Order for Participant. The models met the requirements of being both the maximal model and that with the lowest AIC value.

At the first noun (N1), we found that the interactional terms involving Group, Case and Order were significant across all models (Korean vs. Kazakh learners (β = 0.05, se = 0.003, z = 17.72, p <.0001; Korean vs. French learners (β = 0.02, se = 0.003, z = 9.13, p <.0001; Kazakh vs. French (β = 0.03, se = 0.003, z = 9.61, p <.0001). At the second noun (N2), we observed the same interactional terms involving Group, Case and Order across all models (Korean vs. Kazakh learners (β = -0.03, se = 0.003, z = -10.05, p <.0001; Korean vs. French learners (β = -0.07, se = 0.003, z = -28.36, p <.0001; Kazakh vs. French (β =0.04, se = 0.002, z = 17.73, p <.0001). At the Verb, we also found the same interactional terms involving Group, Case and Order across all models (Korean vs. Kazakh learners (β = 0.04, se = 0.002, z = 21.19, p <.00001; Korean vs. French learners (β = 0.03, se = 0.002, z = 15.25, p <.00001; Kazakh vs. French (β =0.004, se = 0.001, z = 3.17, p <.002).

Given the above interactions with Group, we performed independent analyses on the 3 groups for each of the 3 ROI using sum-coded fixed factors. For all three groups and for all ROI, we report the complete model, which included random intercepts for Participant and Item and random slopes of both Case and Order for Participant.

For the Korean native controls, at the first ROI, N1, we found no effects: Intercept (β =-0.09, se = 0.11, z = -0.86, ns); Case (β =-0.04, se = 0.11, z = -0.35, ns); Order (β =-0.09, se

= 0.10, z = -0.90, ns), Case x Order (β =-0.06, se = 0.09, z = -0.66, ns). Participants did not look at either of the two images above chance level during the auditory presentation of the first noun, whether the sentence was in canonical or scrambled order and independent of the case marking on the noun. At the second ROI (N2) we found a significant effect for the Intercept (β =0.54, se = 0.17, z = 3.26, p<.001), but no effect of either Case (β =-0.08, se = 0.15, z = -0.54, ns) or Order (β =0.18, se = 0.15, z = 1.18, ns) nor their interaction (β = -0.06, se = 0.12, z = -0.46, ns). Native Koreans looked at the correct image above chance when listening to the second auditory noun, irrespective of Case or word Order. At the final ROI (Verb), the same pattern was observed, whereby there was a significant effect of the Intercept (β =0.99, se = 0.11, z = 8.63, p<.00001) but no effect of either Case (β =-0.14, se = 0.10, z = -1.39, ns) or Order (β =0.15, se = 0.10, z = 1.51, ns) nor their interaction (β = -0.13, se = 0.08, z = 1.59, ns). Independent of Case or Order, participants looked at the correct image the vast majority of the time during the processing of the verb and until their response. These results are illustrated in Figure 3 for the 3 ROI for all items and in Figure 6 for an example using heat maps.

Figures 3 and 6 about here

For the French learners, no effects were found at the first ROI, N1 (Intercept (β =-0.01, se = 0.11, z = 0.05, ns); Case (β =-0.08, se = 0.10, z = 0.82, ns); Order (β =-0.05, se = 0.10, z = -0.50, ns), Case x Order (β =-0.01, se = 0.08, z = 0.15, ns). At the second ROI, N2, there was no effect of the Intercept (β =-0.07, se = 0.11, z = 0.61, ns) nor of Case (β =--0.00, se = 0.11, z = -0.02, ns) or Order (β = -0.06, se = 0.11, z = -0.60, ns), however the interaction of Case x Order was significant (β =-0.17, se = 0.09, z = 1.95, p<.05). Subsequent sub-analyses of only Accusative case on one hand and Dative on the other did not reveal any significant effects at N2, however. At the final ROI, the Verb, there were effects of Intercept (β = 0.31, se

= 0.08, z = 3.71, p<.0002), Case (β = -0.14, se = 0.08, z = -2.23, p<.03) and Order (β =-0.20, se = 0.07, z= -3.08, p<.002) but not their interaction (β =-0.07, se = 0.05, z= 1.44, ns). During the processing of the auditory verb, French learners looked at the correct image above chance. The effect was larger for dative than accusative sentences, and for canonical than scrambled word order. These results are illustrated in Figure 4 for the 3 ROI for all items and in Figure 7 for an example using heat maps.

Figures 4 and 7 about here.

For the Kazakh learners, again, no effects were found at the first ROI, N1: (Intercept (β =-0.09, se = 0.13, z = -0.66, ns); Case (β =-0.05, se = 0.14, z = -0.37, ns); Order (β =-0.01, se = 0.13, z = 0.11, ns), Case x Order (β =--0.04, se = 0.10, z = -0.40, ns).: The same was true for the second ROI, N2 (Intercept (β =-0.04, se = 0.13, z = 0.28, ns); Case (β =-0.09, se = 0.11, z = -0.84, ns); Order (β =-0.13, se = 0.11, z = 1.15, ns), Case x Order (β =--0.06, se = 0. 09, z = 0.65, ns). In contrast, at the final ROI, the Verb, there was an effect of the Intercept (β =-0.32, se = 0.06, z = 5.47, p<.00001), but no effect of either factor nor their interaction: Case (β =-0.09, se = 0.05, z = -1.83, p<.07); Order (β =-0.08, se = 0.06, z = 1.39, ns), Case x Order (β =-0.03, se = 0. 04, z = 0.83, ns). Hence, the Kazakh group did not look at the correct image above chance during the processing of either the first or second noun, but did look preferentially at the correct image during the processing of the final verb, and this did not depend upon either Case or Order. These results are illustrated in Figure 5 for the 3 ROI for all items and in Figure 8 for an example using heat maps.

Figures 5 and 8 about here

Discussion.

The present ensemble of results depicts a complex pattern of processing of case

markers during auditory sentence processing in Korean. The online nature of the current experiment allowed us to determine not only whether, but indeed when listeners used case marking to determine the syntactic structure of utterances. Our results provide important and novel information as concerns the online auditory processing of case in both native speakers and L2 learners. Indeed, to our knowledge, ours is the first study to have used a design that allowed us to follow participants' online use of case in Korean during auditory processing. In typologically similar languages, such as Japanese, several studies have shown that native speakers use case and lexical semantics during auditory processing to predict upcoming elements in an utterance (Kamide, Altmann et al., 2003; Mitsugi & MacWhinney, 2016). Our results produce converging evidence of incremental processing in native Korean speakers during the processing of utterances. As discussed below, our L2 learners did not demonstrate this capacity, in line with previous studies of auditory processing in Japanese and German L2 learners (Hopp, 2015; Mitsugi & MacWhinney, 2016). In relation to previous studies of case marking in Korean by L2 learners and heritage speakers, our results provide important complementary information to the offline measures (Ahn, 2015; Ahn & Herschensohn, 2013; Kim et al., 2018).

Consider first the data obtained for the group of native Korean speakers. As could be expected, accuracy was at ceiling level; participants had no difficulty understanding the utterances or choosing the correct image based on case marking. This is in line with the results from offline studies of native Korean speakers in various tasks requiring the interpretation and production of case (Ahn, 2015; Ahn & Herschensohn, 2013; Kim et al., 2018) as well as online reading studies that involved syntactic ambiguity resolution (Koh, 1997). The more compelling pattern is that found for the eye movement record as the utterance unfolded. Despite the relative simplicity of the utterances, native speakers only showed a statistically robust commitment to the correct interpretation of the utterance during

the processing of the second noun and, even then, the percentage of looks to the correct image was roughly 60%. During the processing of the auditory verb, native Koreans showed a definitive preference for the correct image, with an average of roughy 80% of the total gaze to the correct image at this point in the auditory input. These results clearly show that native Korean speakers build a syntactic representation incrementally, in line with previous studies of Korean and Japanese (Kamide, Altmann et al., 2003; Kim, 1999; Koh, 1997; Koizumi & Tamaoka, 2010; Mitsugi & MacWhinney, 2016; Miyamoto & Takahashi, 2004). Importantly, the eye movement data for the native speakers revealed, akin to the accuracy data, that they exploited case independently of word order. For both canonical (SOV) and scrambled (OSV) structures, native speakers looked towards the correct image starting from the second noun. In addition, they did so independently of the type of case marking, i.e. for both accusative and dative structures. As a whole, thus, it can be said that native Korean speakers used case over word order for both dative and accusative and showed the computation of the correct structure as soon as enough grammatical information was present to clearly rule out any possible alternative interpretations.

The results for the L2 learners contrast in numerous ways from that found for the native Korean speakers. Furthermore, the two groups of L2 speakers differed statistically from each other on both accuracy and gaze to the correct image. As outlined below, the Kazakh group showed a pattern of performance that was more similar to the native Korean group than did the French group, although the Kazakh group indeed differed from the control group. Prior to discussing the various theoretical accounts for the greater convergence of the Kazakh group compared to the French group, we provide an overview of the patterns of results found for each.

For the French learners, their accuracy data was consistent with their eye movement data in that they revealed a clear use of word order over case. They showed better

comprehension for canonical than scrambled structures, but this was particularly true for accusative structures. They showed a sharp decrease in the correct choice of images specifically for OSV utterances for the accusative, which showed only 38% correct choice compared to 89% for SOV word order. For dative structures, they also showed a decrease in accuracy for OSV compared to SOV structures but were still above chance for both canonical (85%) and scrambled structures (65%). This pattern is reminiscent of data found for heritage speakers of Korean (Kim et al., 2018). In the absence of context or prosodic focus, heritage speakers—children who were exposed to Korean from birth but who were raised in an English speaking environment--used word order over case as shown by only 29% of correct interpretations for accusative OSV utterances compared to ceiling level performance for SOV utterances. Even when a prior context was provided in which the accusatively marked noun was presented with a topic case marker, these 8 to 12 year old heritage speakers were not able to drop their preference for word order, as shown by chance level performance for accusative OSV utterances preceded by context (42% correct). The same was found when the acoustic salience of the morphological markers was enhanced (48% correct).

These Korean heritage children share characteristics with Spanish heritage children in an English majority environment. Cuza and Pérez-Tattam (2016) explored noun-adjective word order discrepancies and gender leveling (predominance of masculine as default) of heritage Spanish children compared to monolingual Spanish controls. They adopted the Feature Re-assembly Hypothesis (Lardiere, 2009; Putnam & Sánchez, 2013) to account for a high degree of phrasal word order errors and gender mismatch in the children's production data, proposing that the Spanish nominal features had been reassembled in part due to contact with English, which is genderless and shows a different noun phrase order. For the heritage Korean children, one can see the influence of strict word order from English strongly influencing their performance as well.

Interestingly, Kim et al. (2018) found in a second experiment that their heritage speakers fared better for OSV utterances when the bisyllabic dative marker (-hanthey) was used (54% correct) as opposed to the accusative (22%). The pattern found for offline comprehension is surprisingly similar across Kim et al's (2018) study and ours for the adult L1 French participants; our French learners nonetheless performed numerically better than the group of heritage Korean speakers for OSV utterances, whether for the accusative (38% correct) or dative (65% correct). It is noteworthy that Kim et al. (2018) also showed substantial variation in their participants' performance as a function of proficiency, although this is speculative as no statistics were reported to support these differences. Our data allow us to go a step farther. The eye movement record allowed us to demonstrate, first, that the French learners did not show any evidence of computing the structure of the utterance prior to having heard the verb, as revealed by their chance level gaze to the correct and incorrect image up until the processing of the final verb. At the verb, participants showed a strong effect of both word order and case, with a greater percentage of looks to the correct image for canonical (SOV) than scrambled (OSV), and dative than accusative structures. Despite numerical differences, however, we did not find the interaction that obtained for the accuracy results, whereby there was a specific deficit for the scrambled accusatives. It is possible, given the trend in the eye movement data that this interaction would hold with a larger sample size.

The Kazakh learners showed yet another pattern of response. For end of utterance accuracy, they showed a greater percentage of looks to the correct than incorrect image in all conditions although they still showed higher accuracy for canonical than scrambled utterances and for dative than accusative structures. However, these learners did not show a greater drop in accuracy specifically for scrambled accusatives (61% correct), in contrast to the group of French learners (38%). The pattern of eye movements for this group was intermediary between that of the native Koreans and the French. The Kazakh learners, akin to the French,

did not look preferentially to the correct image prior to the processing of the verb. Thus, they showed later use of case than native Koreans. However, in similar fashion to the Koreans, they looked at the correct image more often than the incorrect image during the processing of the verb independent of word order or case. Hence, unlike the French learners but akin to the Koreans, the Kazakh learners showed reliance on case marking in all conditions, and they were not disadvantaged by scrambled word order as concerns their gaze to the correct image. One can conclude, thus that the Kazakh learners did not compute the syntactic structure of the utterance until all information was available, but then were able to use their knowledge of case marking to correctly interpret the utterances. This pattern is similar to that found for the "intermediary" and "high" proficiency heritage speakers reported in Kim et al. (2018) although, as stated, these authors unfortunately failed to report any statistics to validate their between group differences.

The difference in patterns of accuracy and eye movements between the French and Kazakh learners, as well as the greater similarity in patterns between the Kazakh and Korean participants, can be viewed in light of typological similarity. Rothman (2011) proposes the Typological Primacy Model to account for transfer preferences in L3 acquisition, a model whose main tenets can be applied to any multilingual context. He suggests that learners select syntactic competencies in their repertoire based on the perceived typology of the languages (or «psycho-typological proximity»). For our French and Kazakh learners, we infer that the latter perceived (albeit unconsciously) a typological similarity between Korean and Kazakh in terms of word order (SOV), case marking and scrambling options and were able to transfer their competencies in those areas into Korean, both for its grammatical representation and for processing strategies. The French learners could perhaps relate the dative more easily to the dative marked "à NP" in French and dative pronouns (with SOV word order), but these small grammatical pieces are much more selective. One might think the French left dislocation SOV

order could provide another selective transfer, but their poor performance on scrambled sentences seems to obviate that interpretation. Mitsugi and MacWhinney (2010) examined whether linguistic typology played a role in the capacity to compute sentence structure for scrambled and canonical sentences in Japanese. They used a self paced reading paradigm to compare the performance of native Japanese participants and 3 groups of L2 learners whose L1 was either typologically similar to Korean (Japanese) or distant (English and Chinese). Based on a series of null results, which showed no differences in the time needed to process OSV and SOV sentences for any of the participant groups, the authors concluded first, that there is no processing cost associated with scrambling and second, that linguistic typology played no role in acquisition. These results are at odds with numerous other studies showing a clear processing cost for scrambled sentences for native Japanese readers in grammaticality judgment tasks (Imamura, Sato & Koizumi, 2016; Iwasaki, 2008; Koizuma & Tamakoa, 2006; 2010; Miyamoto & Takahashi, 2002). In addition, it is quite difficult to base any strong conclusions on an absence of an effect, such that the claim for a lack of typological effects is weak.

It is of interest to note that both of our L2 learner groups demonstrated better comprehension for dative than accusative structures. Kim et al. (2018) reported similar results for their heritage speakers and attributed the effect to the saliency of phonetic realization of the dative in comparison to the accusative. This indeed may be one factor although, as outlined in the introduction, dative case differs from accusative and nominative in relation to numerous semantic and grammatical factors. Goldschneider and DeKeyser (2001) note a number of variables that could determine acquisition order for L2A morpheme order studies: perceptual salience, semantic complexity, morphophonological regularity, syntactic category and frequency. When we compare Korean accusative to dative case, we observe several significant differences. The two syllable dative –eykey, used for animate objects, is more

perceptually salient than the monosyllabic –(l)ul. The dative may serve several semantic functions, but it is usually a source or goal in thematic terms, and has a consistent morphological form that differs only in terms of the animate versus inanimate allomorphs (a consistent semantic alternation); accusative, in contrast, may serve a broader range of thematic roles. In terms of morphophonological regularity, dative varies according to semantic constraints, whereas accusative varies in form according to its phonological environment. More significantly, accusative is very frequently omitted in discourse contexts where its presence is optional, whereas dative is not. Accusative nouns are more frequent in occurrence, but they may not be case-marked, so the accusative case marking is less transparent to learners. All these factors could contribute to the better performance of our participants on dative over accusative case. Finally, both French and Kazakh mark dative case on nouns and pronouns, whereas French shows no overt mark of accusative on direct objects in French.

Pertaining to the above, the difference in performance as a function of verb class cannot be attributed to any potential confounds such as subtle differences in length or lexical frequency for the dative and accusative. First, as concerns accuracy rate, Korean natives showed no effect of Case, although they were indeed at ceiling level. For the L2 learners, the French and Kazakh L1 groups showed different patterns of results across groups. If the effect were simply frequency, we should have seen a similar pattern across the two groups, with better accuracy for one of the two cases. Second, as concerns the eye movement record, the Korean native group showed no effect of either Case or Order at the verb or earlier, which again argues against any simple frequency effects. The same was true for the Kazakh group. For the French group, however; there was an effect of Case at the verb. If the advantage for the dative were purely driven by frequency; we should have observed a similar case effect with the other groups.

The present study looked exclusively at comprehension. Various L2 studies on case

have examined either the difference between comprehension and production capacities or differences in production as a function of the task (Ahn & Herschensohn, 2013; Iwasaki, 2008; Kim et al., 2018). These studies have shown that L2 participants produce case markers more accurately and more often in written than oral production (Ahn & Herschensohn, 2013) In oral production, learners make more errors during spontaneous speech than scripted speech (Ahn & Herschensohn, 2013; Iwasaki, 2008; Kim et al., 2018). Production capacities also surpass comprehension for 10 to 12 year old Korean heritage speakers, at least for low proficiency speakers (Kim et al., 2018), in like manner to what has been reported for children acquiring Korean or Japanese as an L1 although this conclusion has been questioned (cf. Ahn, 2015 for a review). Our study does not allow us to make such comparisons, but given the common pattern of results reported above it would be of interest to determine whether our adult L2 learners would show better production of case than their comprehension scores revealed for scrambled structures. In a similar vein, it is possible that the low scores we found for scrambled accusative utterances may also be attributed to the transient nature of speech. We are currently investigating this by comparing comprehension in reading to that for the current auditory design, using the same materials and recording eye movements. Preliminary results for a new sample of French learners showed an improvement in comprehension for scrambled sentences in reading compared to auditory processing (Frenck-Mestre, Choo, Kim, Ghio, Herschensohn & Koh, in preparation).

Our results show that neither French nor Kazakh learners of Korean were able to exploit case morphology to determine the meaning of utterances prior to the onset of the verb, whereas native Korean speakers already showed preferential looking at the image that correctly depicted the utterance from the second noun. It can thus be concluded that our L2 learners did not demonstrate the kind of incremental, predictive processing based on case marking that the native speakers did. This result is in line with those from a visual world

paradigm study of Japanese auditory processing conducted with Japanese native speakers and L2 learners of Japanese whose L1 was English (Mitsugi & MacWhinney, 2016). The study replicated seminal work (Kamide Altmann et al., 2003) showing that native Japanese speakers make anticipatory looks to the upcoming element in the auditory sequence based on the case marking of the nouns, and this held true for both canonical (SOV) and scrambled (OSV) word orders. In contrast, in a separate analysis that specifically investigated the performance of L2 Japanese speakers, Mitsugi and MacWhinney (2016) did not find statistical evidence that the L2 learner group demonstrated any such anticipatory looks; these listeners only showed an increase in the number of looks to the structurally predictable element after it had actually been uttered. Mitsugi and MacWhinney concluded that L2 learners of Japanese, at least at intermediary levels of proficiency, do not use nominal case morphology to incrementally build sentence structure.

The question whether L2 learners recruit morphosyntactic cues to form predictions during auditory processing was also addressed by Hopp (2015) in a visual world paradigm adapted from Kamide, Scheepers et al. (2003). L2 German learners, who were categorized into 4 groups according to proficiency on a standardized test of German, and native German speakers listened to auditory sentences that provided unambiguous nominative and accusative case marking on the two nouns in SVO and OVS structures. The results showed, first, statistically robust interactions which allowed the data for native speakers and L2 learners to be analyzed independently. Native speakers showed anticipatory looks to the element in the visual scene depicting the second noun, based on case morphology provided by the first noun, prior to the actual onset of NP2. In the L2 groups, none showed anticipatory looks to the second NP as a function of case marking on NP1. At the second NP, however, the effect of proficiency came into play. Only L2 learners with a higher level of proficiency demonstrated the capacity to integrate case morphology rapidly enough for it to play a role prior to the

complete processing of the second noun. Nonetheless, it is notable that the L2 groups did not statistically diverge from each other prior to the final region of the auditory sentence and did not show the same type of anticipatory processing based on nominal case marking that native listeners did. Hence, both studies corroborate our finding that L2 learners have difficulties processing case information during auditory processing quickly enough for it to produce anticipatory eye movements to the correct visual scene. It is nonetheless possible that L2 learners are simply slower at morphosyntactic feature extraction and, as a consequence, do not show "predictive" processing but still indeed have knowledge of these features. Our current eye movement research on reading, where participants are able to re-read segments rather than be constrained by the transient nature of the speech signal, should help to elucidate this question.

To conclude, the present study provides evidence of the immediate and predictive use of Korean case marking in auditory sentence processing in native speakers, which corroborates previous results in the online computation of written materials (Koh, 1997, Lee, 1999). This was found independent of the particular case marker (dative versus accusative) and word order (canonical SOV or scrambled OSV). The data for L2 learners show that the ability to process case morphology online depends on both word order and the specific case marking. In addition, overlap as concerns grammatical features across the L1 and L2 (canonical word order and the possibility to transpose arguments, overt realization of case morphology and the factors that regulate ellipsis) played an important role. Kazakh learners of Korean were at an advantage compared to French learners as concerns comprehension of scrambled structures, for both accusative and dative, while both L2 groups showed superior comprehension for dative. The eye movement record revealed that Kazakh learners, akin to French learners, failed to exploit case morphology prior to the sentence final verb however; whereas French revealed difficulties related to both case and scrambling, the Kazakh learners

showed a pattern similar to native speakers, albeit delayed. In sum, the present work provides compelling evidence of the incremental nature of processing in L1 Korean, significant effects of the particular case marking for L2 learners and effects of their L1 in the capacity to exploit case morphology.

REFERENCES

Ahn, H. (2015). *Second Language Acquisition of Korean Case by Learners with Different First Languages* (Doctoral dissertation). University of Washington.

Ahn, H., & Herschensohn, J. (2013). Anglophone acquisition of case particles in L2 Korean. In Jennifer Cabrelli Amaro et al (Eds.). *Proceedings of the 12th Generative Approaches to Second Language Acquisition*. (pp 1-10). Somerville, MA: Cascadilla Proceedings Project.

Aissen, J. (2003). Differential Object Marking: iconicity vs. economy, *Natural Language & Linguistic Theory,* 21: 435-483.

Barr, D. J., Levy, R. Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, 68, 255-278.

Brown, L. & Iwasaki, N. (2013). Cross-linguistic influence in the L2 acquisition of Korean case particles by Japanese-speaking and English-speaking learners: L1-L2 proximity and learner perceptions. *Electronic Journal of Foreign Language Teaching*, 10, 176-195.

Chomsky, N. (1981). *Lectures on Government and Binding*. Dordrecht: Foris.

Chomsky, N. (1995). *The Minimalist Program.* Cambridge, MA: The MIT Press.

Chung, G. (1994). *Case and its acquisition in Korean* (Doctoral dissertation). University of Texas.

Clahsen, H., & Felser, C. (2006). Grammatical processing in language learners. *Applied Psycholinguistics*, 27, 3–42.

Clifton, C.Jr. & Staub, A. (2008). Parallelismn and competition in syntactic ambiguity resolution. *Language and Linguisitics Compass*, 212, 234-250.

Cuza, A. & Pérez-Tattam, R. (2016). Grammatical gender selection and phrasal word order in child heritage Spanish: A feature-reassembly approach. *Bilingualism, Language and Cognition,* 19, 50-68.

Fine, A.B., Jaeger, T.F., Farmer, T.A., & Qian, T. (2013). Rapid expectation adaptation during syntactic comprehension. *PLoS ONE*, 8: e77661

Foraker, S. & Murphy, G. L. (2012). Polysemy in Sentence Comprehension: Effects of Meaning Dominance. *Journal of Memory and Language*, 67, 407-425.

Goldschneider, J. M. & DeKeyser, R. M. (2001). Explaining the "natural order of L2 morpheme acquisition" in English: A meta-analysis of multiple determinants. *Language Learning*, 51, 1-50.

Henry, N., Hopp, H., & Jackson, C. N. (2017). Cue additivity and adaptivity in predictive processing. *Language, Cognition and Neuroscience, 32*, 1229-1249

Herschensohn, J. (2001). Missing inflection in L2 French: Accidental infinitives and other verbal deficits. *Second Language Research*, 17, 273-305.

Herschensohn, J (2000). *The Second Time Around: Minimalism and L2 acquisition*. Philadelphia/Amsterdam: John Benjamins

Herschensohn, J. (2004). Functional categories and the acquisition of object clitics in L2 French. In P. Prevost, & J. Paradis (Eds.), *The acquisition of French in different contexts*. (pp. 207-242). Amsterdam/Philadelphia: John Benjamins.

Hoffman, B. (1992, June). A CCG approach to free word order languages. In *ACL '92 Proceedings of the 30th annual meeting on Association for Computational Linguistic* (pp. 300-302). Newark, Delaware

Hopp, H. (2010). Ultimate attainment in L2 inflection: Performance similarities between non-native and native speakers. *Lingua*, 120, 901-931.

Hopp, H. (2015). Semantics and morphosyntax in predictive L2 sentence processing. *International Review of Applied Linguistics in Language Teaching*, 53, 277–306.

Imamura, S., Sato, Y., & Koizumi, M. (2016). The Processing Cost of Scrambling and Topicalization in Japanese. *Frontiers in Psychology*, doi.org/10.3389/fpsyg.2016.00531

Iwasaki, N. (2008). L2 acquisition of Japanese: Knowledge and use of case particles in SOV and OSV sentences. In S. Karimi (Ed.), *Word order and scrambling*. (pp. 273–300). Malden, MA: Blackwell.

Kamide, Y., Altmann, G. T. M. & Haywood, S. L. (2003). The time-course of prediction in incremental sentence processing: Evidence from anticipatory eye movements. *Journal of Memory and Language*, 49, 133-156.

Kamide, Y., Scheepers, C. & Altmann, G. T. M. (2003). Integration of syntactic and semantic information in predictive processing: Cross-linguistic evidence from German and English. *Journal of Psycholinguistic Research*, 32, 37-55.

Kim, Y. (1997). The acquisition of Korean. In D. I. Slobin (Ed.*), The crosslinguistic study of language acquisition* Vol. 4, (pp. 335–443). Mahwah, NJ: Lawrence Erlbaum.

Kim, Y. (1999). The effect of case marking information on Korean sentence processing. *Language and Cognitive processes, 14*(5/6), 687-714.

Kim, S., O'Grady, W. & Cho, S. (1995). The acquisition of case and word order in Korean: A note on the role of context. *Language Research*, 31(4), 687-695.

Kim, K., O'Grady, W., & Schwartz, B.D. (2018). Case in Heritage Korean. *Linguistic approaches to bilingualism*. 8(2), 252-282.

Kirchner. M. (1998). Kazakh and Karakalpak. In Johanson & É. Á. Csató (Eds). *The Turkic Languages* (pp. 318-332). London: Routledge.

Ko, I. (2005). Nominative case-marker omission and A-chain deficit in child language acquisition of Korean. *Working Papers in Linguistics*, University of Manoa Hawaï, 36, 1-13.

Koh, S. (1997). The Resolution of the Dative NP Ambiguity in Korean. *Journal of Psycholinguistic Research*, 26, 265-273.

Koizumi, M. & Tamaoka, K. (2004). Cognitive processing of Japanese sentences with

ditransitive verbs. *Gengo Kenkyu* (Journal of the Linguistic Society of Japan), 173-190.

Koizumi, M. & Tamaoka, K. (2010). Psycholinguistic evidence for the VP-internal subject position in Japanese. *Linguistic Inquiry*, 41, 663-680.

Kornfilt, J. (2003). Scrambling, Subscrambling, and Case in Turkish. In S. Karimi (Ed.), *Word Order and Scrambling* (pp. 4–125). New Jersey: Blackwell.

Kornfilt, J. (2007). DOM and two types of DSM in Turkish. In H. de Hoop and P. de Swart (Eds.), *Differential Subject Marking*, (pp. 79–111). New Yrok: Springer.

Kwon, S. N., & Zribi-Hertz, A. (2008). Differential function marking, cases, and information structure: Evidence from Korean. *Language*, 84, 258–299.

Lardiere, Donna. (2009). Some thoughts on the contrastive analysis of features in second language acquisition. *Second Language Research,* 25, 173-227.

Lee, E. (2007). Types of scrambling in Korean syntax. (Doctoral dissertation). University of North Carolina at Chapel Hill.

Lee, H. (2007). Case ellipsis at the grammar/pragmatics interface: a formal analysis from a typological perspective. *Journal of Pragmatics*, 39, 1465–1482.

Lee, H. (2011). Gradients in Korean case ellipsis: An experimental investigation. *Lingua*, 121, 21-34.

Lee, I. (1999). *A Principles-and Parameters Approach to the Acquisition of IP in Korean* (Doctoral dissertation). University of Essex.

Lee, Q. (1997). *Dative constructions and Case theory in Korean* (Doctoral dissertation). Simon Frazier University, Canada.

MacDonald, M. C., Pearlmutter, N. J., & Seidenberg, M. S. (1994). Lexical nature of syntactic ambiguity resolution. *Psychological Review*, 101; 676-703.

Matuschek, H., Kliegl, R., Vasishth, S., Baayen, H., & Bates, D, (2017). Balancing Type I error and power in linear mixed models. *Journal of Memory and Language*, 94, 305–315

Mitsugi, S., & MacWhinney, B. (2010). Second language processing in Japanese scrambled sentences. In B.VanPatten and J. Jegerski (Eds.), *Research in second language processing and parsing* (vol. 53, pp. 159–175). Philadelphia, PA: John Benjamins.

Mitsugi, S., & MacWhinney, B. (2016). The use of case marking for predictive processing in second language Japanese. *Bilingualism, Language and Cognition*, 1, 19-35

Miyamoto, E. T. 2002. Case markers as clause boundary inducers in Japanese. *Journal of Psycholinguistic Review*, 31:307-347.

Miyamoto, E. T., & Takahashi, S. (2002). Sources of difficulty in the processing of scrambling in Japanese. In M. Nakayama (Ed.), *Sentence Processing in East Asian Languages*, (pp. 167-188). Stanford, CA: CSLI.

Miyamoto, E. T. and Takahashi, S. (2004). Filler-Gap Dependencies in the Processing of Scrambling in Japanese. *Language and Linguistics*, 5, 153-166,

Mukhamedova, R. (2015). *Kazakh: A Comprehensive Grammar*. London: Routledge

Murasugi, K. & Kawamura, T. (2004). On the Acquisition of Scrambling in Japanese. *Language and Linguistics*, 5, 131-151,

Otsu, Y. (1994). Early acquisition of scrambling in Japanese. In T. Hoekstra & B. D. Schwartz (Eds.), *Language acquisition studies in generative grammar*. (pp. 253-264). Philadelphia: John Benjamins.

Piantadosi, S. T., Tily, H., & Gibson, E. (2012). The communicative function of ambiguity in language. *Cognition*, 122, 280-290.

Prince, A., & Smolensky, P. (1993). Optimality Theory: Constraint Interaction in Generative Grammar. Rutgers University Community Repository, ROA Version, 8/2002

Putnam, M. & Sánchez, L. (2013). What's so incomplete about incomplete acquisition? *Linguistic Approaches to Bilingualism*, 3-4: 476-506.

Rayner, K. (1998). Eye Movements in Reading and Information Processing: 20 Years of

Research. *Psychological Bulletin*. 124, 372-422.

Rothman, J. (2011). L3 syntactic transfer selectivity and typological determinacy: the Typological Primacy Model. *Second Language Research*, 27, 107-27.

Ryu, B.-R. (2013). Multiple Case Marking as Case Copying: A Unified Approach to Multiple Nominative and Accusative Constructions in Korean. In S. Muller (Ed.) *Proceedings of the 20th International Conference on Head-Driven Phrase Structure Grammar*. (pp 182–202). Stanford: CSLI Publications.

Schütze, K. (2001). On Korean "Case Stacking: The varied functions of the particles ka and lul. *The Linguistic Review*. 18, 193–232

Schwartz, B. D. (1998). The second language instinct. *Lingua*, 106, 133-160.

Schwartz, B. D. & Sprouse, R. A. (2017). The role of Universal Grammar in nonnative language acquisition. In I. Roberts (Ed.), The Oxford Handbook of Universal Grammar. Oxford MA.: Oxford University Press.

Shibata, H., Suzuki, M., Kim, J., Gyoba, J., & Koizumi, M. (2005). Reading Times and Priming Effects in Japanese Scrambled Sentences. *Tohoku psychologica folia*, 63, 84-94.

Sneed, E., Herschensohn, J., & Frenck-Mestre, C. (2015). Pronoun processing in anglophone late L2 learners of French: Behavioral and ERP evidence. *Journal of Neurolinguistics*. 34, 15-40.

Sohn, H.-M. (1999). *The Korean Language*. Cambridge University Press, Cambridge

Sturt, P., Scheepers, C., & Pickering, P. (2002). Syntactic Ambiguity Resolution after Initial Misanalysis: The Role of Recency. *Journal of Memory and Language*, 46, 371–390.

Tremblay, A., & Ransij, J. (2015), LMER Convenience functions. https://cran.r-project.org/web/packages/LMERConvenienceFunctions.pdf

Yamashita, H. (1997). The effects of word-order and case marking information on the processing of Japanese. *Journal of Psycholinguistic Research*, 26(2), 163-188.

Yamashita, H. (2002). Scrambled sentences in Japanese: Linguistic properties and motivations for production. *Text*, 22(4), 597–633.

FIGURE TITLES

Figure 1. An example of a visual scene presented to participants 1 second prior to and throughout the auditory stimulus until the participant's response.

Figure 2. Percentage of correct response as a function of case marking, word order and participant group (ACC = accusative, DAT = dative, CAN = canonical, SCR = scrambled).

Figure 3. Native Korean participants' percentage of dwell time for the correct and incorrect image during the auditory presentation of each element (N1, N2 and VB), as a function of Case (ACC = accusative, DAT = dative) and word order (CAN = canonical, SCR = scrambled).

Figure 4. French-Korean learners' percentage of dwell time for the correct and incorrect image during the auditory presentation of each element (N1, N2 and VB), as a function of Case (ACC = accusative, DAT = dative) and word order (CAN = canonical, SCR = scrambled).

Figure 5. Kazakh-Korean learners' percentage of dwell time for the correct and incorrect image during the auditory presentation of each element (N1, N2 and VB), as a function of Case (ACC = accusative, DAT = dative) and word order (CAN = canonical, SCR = scrambled).

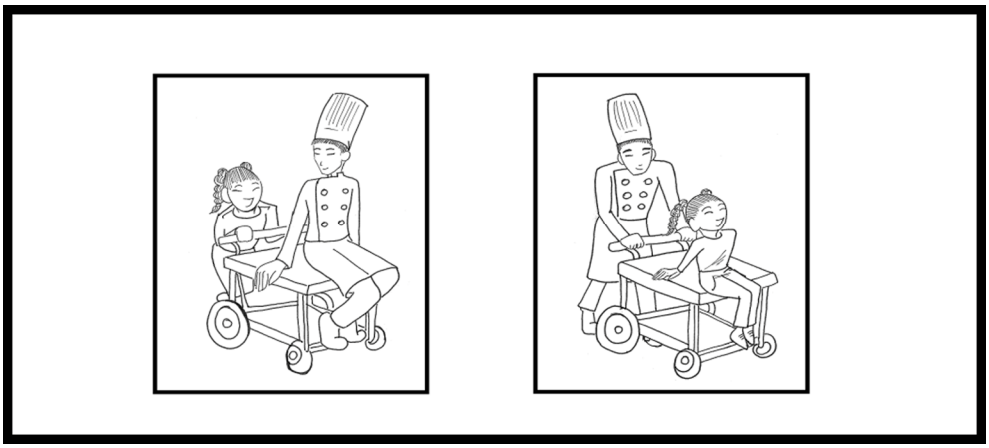
Figure 6. Heat maps showing Native Korean participants' dwell time for the correct and incorrect image during the auditory presentation of each element (N1, N2 and VB) for a canonical accusative utterance.

Figure 7. Heat maps showing French-Korean learners' dwell time for the correct and incorrect image during the auditory presentation of each element (N1, N2 and VB) for a canonical accusative utterance.

Figure 8. Heat maps showing Kazakh-Korean learners' dwell time for the correct and incorrect image during the auditory presentation of each element (N1, N2 and VB) for a canonical accusative utterance.

Group	**Mean Age**	**Age exposed**	**Months in Korea**	**Length of study at SNU**	**Score on vocabulary test**
French	24 (4.4)	21 (3.5)	10.5 (11)	3 semesters	98% (2.9%)
Kazakh	24 (2.5)	18 (2.5)	9.3 (4.7	3 semesters	99%(1.25%)
Korean	21 (1.2)	At birth	Since birth	First year undergraduate	100% (0)

Table 1. Demographics of participant groups. Means and standard deviations in parentheses



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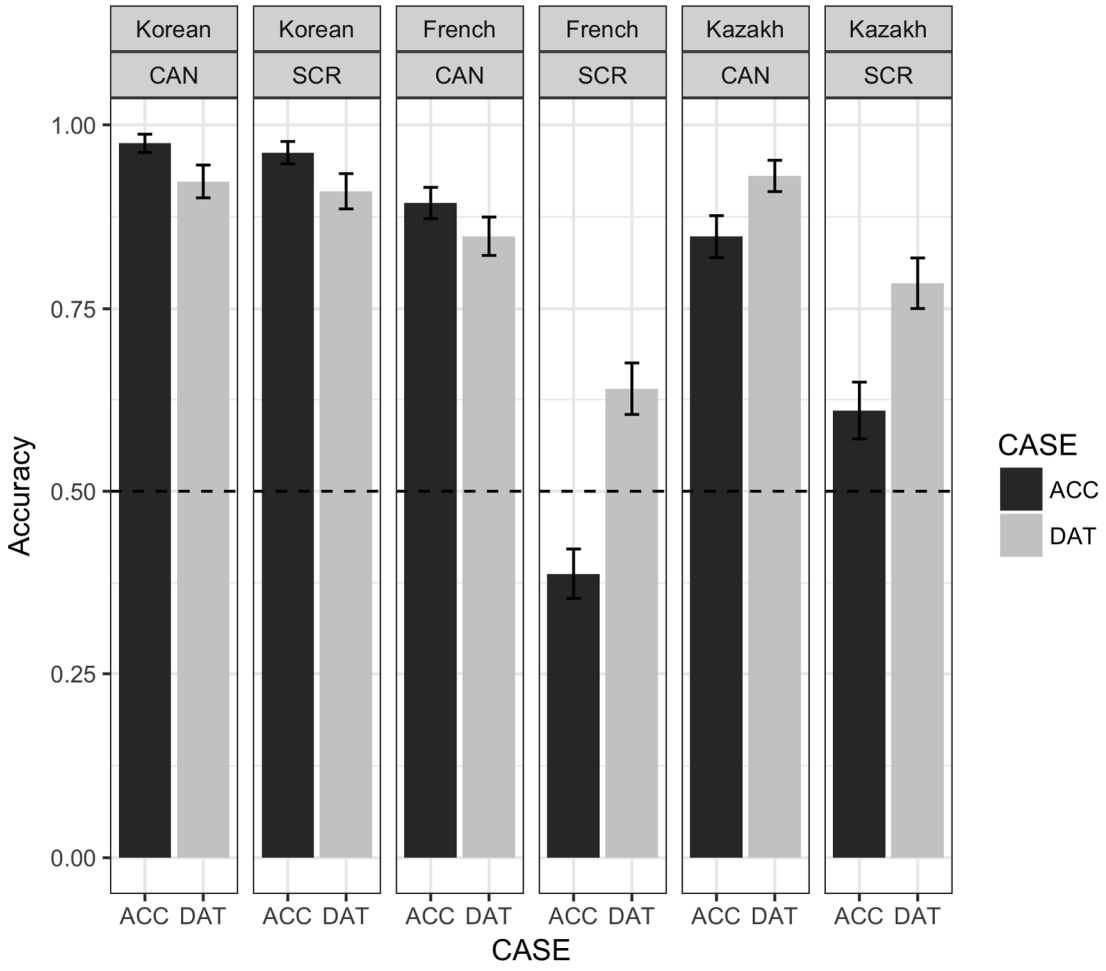

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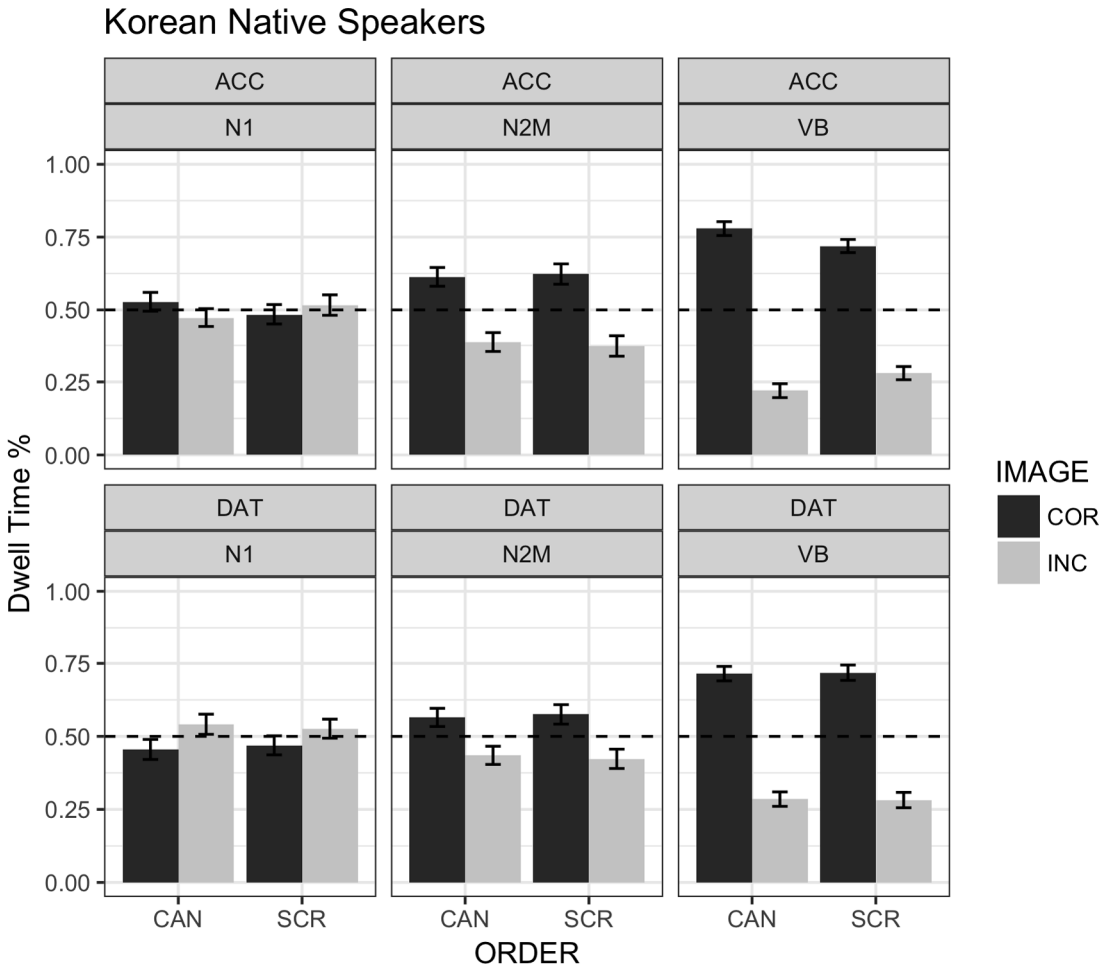

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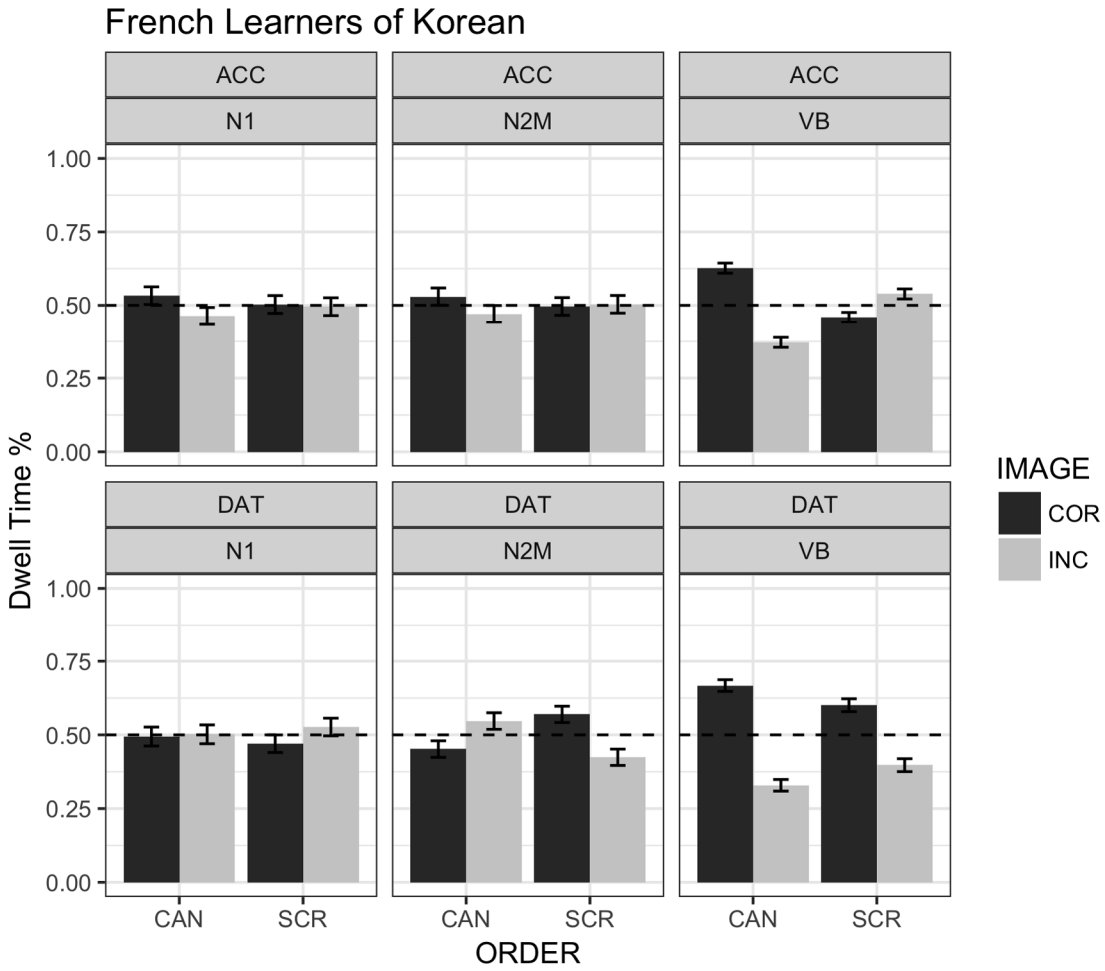

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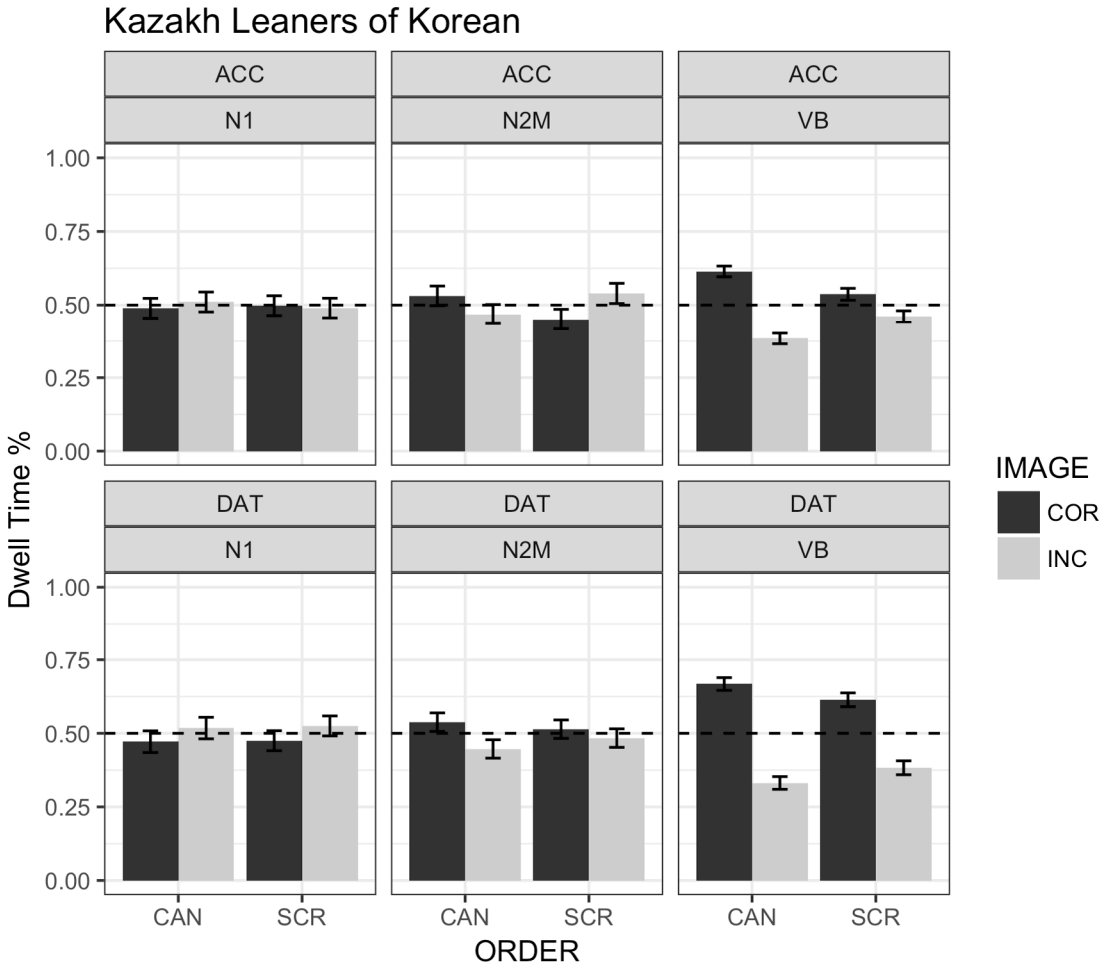

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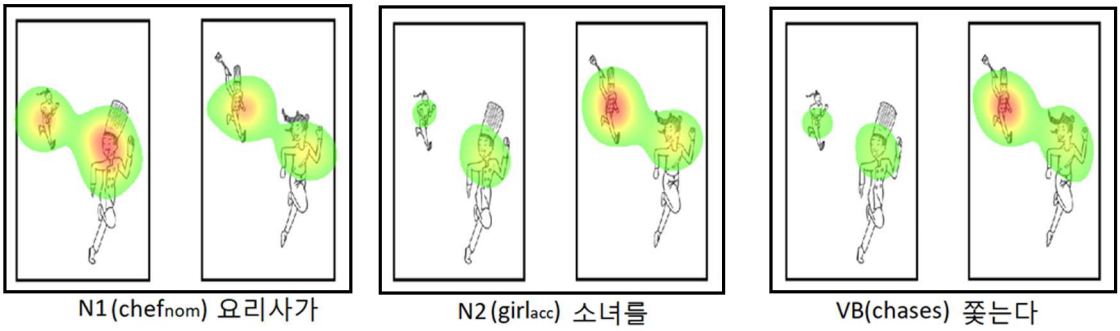

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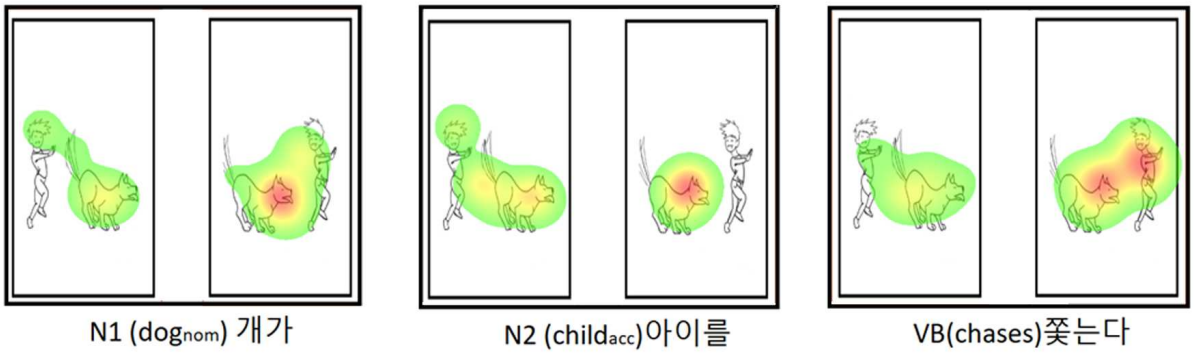

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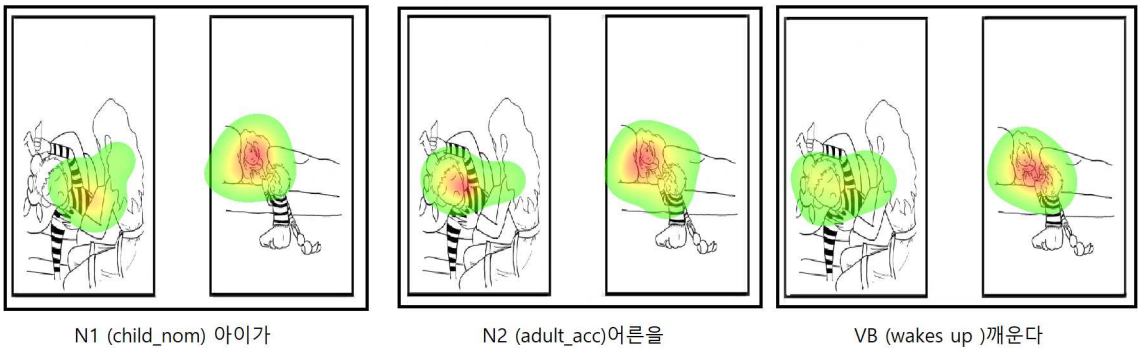

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