EMPIRICAL STUDY

Late Bilinguals Share Syntax Unsparsingly Between L1 and L2: Evidence From Crosslinguistically Similar and Different Constructions

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Languages often use different constructions to convey the same meaning. For example, the meaning of a causative construction in English (Jen had her computer fixed) is conveyed using an active structure in Korean (Jen-NOM her computer-ACC fixed), and yet little is known about how bilinguals represent and process such constructions. The present study investigated whether late bilinguals develop shared or language-specific representations for crosslinguistically different (causatives) and similar (transitives) constructions. Using between-language structural priming, Experiment 1 showed that proficient Korean-English bilinguals exhibited a stronger priming effect for transitives than did less proficient bilinguals. Using a picture–sentence verification task, Experiment 2 showed that proficient bilinguals were more likely to apply the rules of Korean causatives to the processing of English causatives than were less proficient bilinguals. Our results suggest that Korean-English bilinguals share syntactic representations for both similar and different constructions, indicating that the bilingual system is highly integrated.

Keywords shared syntax; bilinguals; syntactic representation; causatives; crosslinguistic similarity; English; Korean

Introduction

One of the central issues in bilingual sentence processing is how bilinguals represent and process syntactic structures of a first language (L1) and a second
language (L2). There are, broadly speaking, two accounts of bilingual syntactic processing: the shared syntax account and the separate syntax account (for a review of these models, see Hartsuiker & Pickering, 2008). The two accounts make different assumptions about whether syntactic processing in L1 and L2 is integrated or separate. The shared syntax account suggests that (a) bilinguals share syntactic representations between languages and (b) the grammatical rules of one language influence syntactic processing in the other (e.g., Bernolet, Hartsuiker, & Pickering, 2013; Hartsuiker, Pickering, & Veltkamp, 2004). In particular, Hartsuiker et al.’s model assumed that a lemma node (comprising semantic properties of a word) is linked to a combinatorial node, which specifies a syntactic structure (e.g., active, passive) with which a lemma can occur (Pickering & Branigan, 1998; see Chang, Dell, & Bock, 2006, for an alternative view). For example, the lemma for the English verb *chase* is linked to the active and the passive combinatorial node. Critically, the combinatorial nodes are connected to all lemmas with relevant properties, irrespective of language. The lemma for the Spanish verb *perseguir* (“chase”), which occurs in an active and a passive structure, shares the combinatorial nodes with the English lemma *chase* in English-Spanish bilinguals’ syntactic representations. Thus, under the shared syntax account, the grammatical rules of L1 can influence L2 processing (i.e., syntactic transfer) if a syntactic structure associated with L1 is activated during L2 processing.

In contrast, the separate syntax account (e.g., de Bot, 1992; Ullman, 2001) suggests that bilinguals store and access syntactic information separately for their two languages. In particular, de Bot has suggested that grammatical encoding processes that formulate sentence frames are separate in L1 and L2. The strong version of the model assumes that grammatical processes and representations are separate in L1 and L2 throughout L2 acquisition. Consequently, it suggests that syntactic processing in L2 should not be influenced by the grammar of L1 (i.e., no syntactic transfer). The weak version of the model suggests that the degree of separation in syntactic processing may vary depending on linguistic distance (with closely related languages having a smaller degree of separation) and proficiency (with balanced bilinguals having a greater degree of separation). Thus, it predicts that syntactic transfer should decrease as L2 proficiency increases (see also MacWhinney, 1997, for a similar prediction).

Previous research on bilingual sentence processing has suggested that for similar constructions in two languages, bilinguals share syntactic representations (e.g., Bernolet, Hartsuiker, & Pickering, 2007; Bernolet et al., 2013; Hartsuiker et al., 2004; Kantola & van Gompel, 2011). For example, English and Spanish express a transitive meaning (e.g., the taxi chasing the truck)
using an active (e.g., *the taxi chases the truck/el taxi persigue el camión*) or a passive structure (e.g., *the truck is being chased by the taxi/el camión es perseguido por el taxi*). Using a picture-description task, Hartsuiker et al. showed that Spanish-English bilinguals were more likely to produce a passive description in English when they were primed with a Spanish passive than with an active. Such a between-language structural priming effect suggests that Spanish-English bilinguals share transitive representations in Spanish and English. Between-language priming occurs even when two languages have different word order (e.g., Bernolet, Hartsuiker, & Pickering, 2009; Chen, Jia, Wang, Dunlap, & Shin, 2013; Shin, 2010; Shin & Christianson, 2009). This suggests that bilinguals share abstract syntactic representations, not necessarily surface representations. Representations may be shared in L1 and L2 due to functional relations, such as the mapping between thematic roles and grammatical functions (Shin & Christianson, 2009), thematic role order (Chang, Bock, & Goldberg, 2003), or information structure (Bernolet et al., 2009).

A recent study by Bernolet et al. (2013) further suggested that late L2 learners (i.e., those who begin L2 learning as adults) start out with separate representations of L1 and L2 syntactic structures but develop shared representations as they become proficient in L2. Specifically, Bernolet et al. found that when the use of English genitive structures was primed with Dutch genitive structures, proficient Dutch-English bilinguals showed stronger between-language priming than did less-proficient bilinguals, and that between-language priming became as strong as within-language priming as L2 proficiency increased. If between-language priming occurs as a result of shared syntactic representations, the results of Bernolet et al. provide evidence for a shift from language-specific to shared syntactic representations with increasing proficiency (see Hartsuiker & Bernolet, 2017, for more discussion).

Crucially, languages often use different structures to convey the same message. For example, the meaning of a causative structure in English (e.g., *Jen had her computer fixed*) is conveyed by an active transitive structure in Korean (e.g., *Jen-NOM her computer-ACC fixed*). That is, English requires a causative structure for a causative event and an active transitive structure for a transitive event whereas Korean requires an active transitive structure for both types of events. When L1 and L2 constructions are different and a single syntactic structure in L1 corresponds to two distinct syntactic structures in L2, a L2 structure cannot be mapped onto an existing L1 representation. This then might indicate that different structures are stored and processed differently from similar structures. That is, as suggested by the separate syntax account, bilinguals may develop separate representations for different constructions in L1 and L2. Such
acquisition of distinct representations would be beneficial because bilinguals can minimize errors of transferring grammatical rules from L1 to L2.

However, there has been little consideration of how bilinguals represent and process crosslinguistically different constructions. Continued existence of this gap creates an important problem because this means that our understanding of the nature of the bilingual mind and the mechanism by which structural selection is achieved remains incomplete. Additionally, for crosslinguistically similar constructions, the interaction between proficiency and structural priming deserves further investigation. Although Bernolet et al. (2013) showed that proficiency modulated structural priming of genitive constructions in two typologically similar languages (Dutch and English), it is not clear whether the finding extends to other syntactic constructions (e.g., actives vs. passives) and to typologically different languages (e.g., Korean and English). The present study aims to address these issues by investigating how bilinguals represent and process crosslinguistically similar and different constructions, focusing on late Korean-English bilinguals with lower-intermediate to advanced English.

The Present Study
Two experiments reported here investigated whether Korean-English bilinguals develop shared or language-specific syntactic representations for crosslinguistically similar (transitives) and different (causatives) constructions as a function of proficiency. Following Richards, Platt, and Platt (1992), we defined proficiency as an individual’s skill in language use and assumed that it can be evaluated through the application of a proficiency test.

Processing of Similar Constructions: Transitives
Korean and English convey transitive meanings (e.g., a policeman chasing a thief) using a transitive structure, such as an active (e.g., a policeman chased a thief, policeman-NOM thief-ACC chased) or a passive (e.g., a thief was chased by a policeman, thief-NOM policeman-DAT was chased). Although Korean transitive structures have a different word order (subject-object-verb [SOV]) from English transitives (SVO), they are similar in that they share functional relations and thematic role orders. In an active sentence, the agent is realized as the subject and the patient as the object, and the agent entity precedes the patient entity. In a passive sentence, the patient is realized as the subject and the agent as the oblique object, and the patient entity precedes the agent entity. Transitive structures in Korean and English also encode information structure (relative salience of thematic roles) in a similar fashion. An active sentence highlights the agent entity whereas a passive sentence highlights the patient
entity (Bernolet et al., 2009). Overall, then, transitive structures are largely similar in Korean and English despite word-order differences.

Experiment 1 investigated how Korean-English bilinguals represent and process transitive constructions that are similar in Korean and English. In particular, to see whether they develop shared or language-specific syntactic representations of transitive structures, we primed Korean-English speakers’ choice of an active or a passive structure in English by using Korean active or passive structures (e.g., Bernolet et al., 2013; Hartsuiker et al., 2004).

The shared and separate syntax accounts make different predictions. Specifically, the more recent version of the shared syntax account suggests that syntactic processes and representations become shared for similar structures in L1 and L2 as L2 proficiency increases and bilinguals accumulate considerable experience with L2 structures (Hartsuiker & Bernolet, 2017). That is, as they become more proficient in English and have more exposure to transitive structures in English, Korean-English bilinguals develop shared representations for transitive structures. The activation of a transitive structure in Korean leads to the activation of the active transitive in English, and vice versa. Thus, this account predicts that proficient Korean-English bilinguals should show a stronger between-language priming effect than less-proficient bilinguals (see Shin & Christianson, 2009, for evidence of shared representations for dative structures in English and Korean).

The separate syntax account makes the opposite prediction. The stronger version of the model claims that syntactic representations are separate in L1 and L2 and independent of L2 proficiency. Thus, it does not predict any structural priming between Korean and English. The weaker version of the model suggests that syntactic representations in L1 and L2 become separate as L2 proficiency increases. Thus, it predicts that proficient Korean-English bilinguals should show a weaker priming effect than less-proficient bilinguals in contrast to the shared syntax account.

**Processing of Different Constructions: Causatives**

Korean and English use different structures to convey a causative meaning (e.g., Jen having her computer fixed). English conveys the causative meaning by a causative structure (e.g., Jen had her computer fixed) whereas Korean uses an active transitive structure (e.g., Jen-NOM her computer-ACC fixed). The Korean structure is different from its English counterpart in that it dispenses with a causative verb (e.g., had) and the subject is not the agent.

The shared and separate syntax accounts both assume that proficient Korean-English bilinguals develop a representation of a causative structure
Late Bilinguals Share L1–L2 Syntax

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Causative event

Transitive event

Causative

Active transitive

Bill fixed a computer.

Jen had a computer fixed.

English

Korean

Causative event

Transitive event

Causative

Active transitive

KOCHITA ‘FIX’

Bill fixed a computer.

Jen had a computer fixed.

English

Korean

Figure 1 Example of the shared syntactic account based on Hartsuiker et al.’s (2004) model (Panel a) and the separate syntactic account based on de Bot (1992) (Panel b). For Korean, a conceptual node, a lemma node, and a combinatorial node are connected via a solid line. For English, they are connected via a dotted line.

in English, as the frequency with which it is encountered increases with their proficiency (Bernolet et al., 2013; de Bot, 1992; MacWhinney, 1997). Crucially, however, the two accounts make different predictions regarding whether or not the processing of a causative construction in English is influenced by the grammar of Korean (i.e., syntactic transfer). Figure 1 illustrates these two predictions.

The shared syntax account, counterintuitively, predicts that during the process of L2 acquisition the influence of Korean should increase as a function of proficiency (Figure 1a). When Korean-English bilinguals speak English, a causative event activates both a causative structure (via its link in English) and an active transitive structure (via its link in Korean). A strong link between a causative event and an active transitive structure in Korean leads to the increasing activation of active transitive structure as transitive structures become shared between Korean and English. Due to this increased activation, the shared syntax account predicts that Korean-English bilinguals increasingly would make the mistake of applying an active transitive structure to a causative event in English during L2 acquisition. However, under the shared syntax model, it is not clear to what extent the transfer errors would persist in the course of L2 acquisition. We return to this issue in the general discussion.

The separate syntax account, however, makes the opposite prediction (Figure 1b). The strong version of the account assumes that bilinguals have distinct syntactic representations for each language. The weak version of the model suggests that (a) the degree of separation in syntactic processing is
influenced by L2 proficiency and (b) syntactic processing becomes separate as L2 proficiency increases. Thus, the model predicts that the influence of Korean should be absent or decrease as English proficiency increases. That is, Korean-English bilinguals should be more likely to reject than accept an active transitive structure as a correct English description of a causative event as they become proficient in English.

In sum, Experiment 1 investigated how Korean-English speakers represent transitive structures that are similar in Korean and English by assessing the magnitude of between-language structural priming as a function of English proficiency (e.g., Bernolet et al., 2013; Hartsuiker & Bernolet, 2017). By examining the interaction between proficiency and structural priming in a construction and languages that have not previously been studied, Experiment 1 aimed to test the generalizability of the more recent version of the shared syntax account. The results were also critical for testing the prediction of the shared syntax account for causative constructions because it builds upon the assumption that transitive structures in Korean and English are shared as a function of proficiency. Experiment 2 widened the scope of previous research on bilingual sentence processing by investigating the representations of constructions that are different in the two languages. In particular, it examined whether late Korean-English bilinguals develop shared or separate representations of causative constructions by measuring the degree of syntactic transfer as a function of English proficiency (e.g., Dussias & Sagarra, 2007; Hohenstein, Eisenberg, & Naigles, 2006; Marian & Kaushankaya, 2007; Nicoladis, 2006).

**Experiment 1**

**Method**

**Participants**

Thirty-one bilingual Korean- and English-speaking university students in Seoul, Korea, participated in the experiment for course credit (16 males, 15 females; $M_{age} = 23$ years, range $= 20–28$). All were late bilinguals who had acquired English after early childhood and for whom Korean remained the dominant language. They reported having at least 6 years of formal instruction in English. All participants were asked to complete an English proficiency test consisting of a cloze passage, with three multiple-choice response options for each blank (e.g., Montrul & Ionin, 2009; Shin & Christianson, 2009). We excluded five participants who failed to complete the proficiency test. For the remaining participants, the mean percentage accuracy was 74.5% ($SD = 9.6$, range $= 52.5–92.5$). Table 1 summarizes the language background of the participants in Experiment 1.
Table 1  Participants’ language background in Experiment 1

<table>
<thead>
<tr>
<th>Measure</th>
<th>M</th>
<th>SD</th>
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<td>Age of acquisition</td>
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<td>TOEIC (10–990)</td>
<td>763–793&lt;sup&gt;a&lt;/sup&gt;</td>
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</tr>
</tbody>
</table>

*Note.* TOEIC = Test of English for International Communication. <sup>a</sup>Participants were asked to choose score ranges rather than to provide exact scores. This range is equivalent to iBT TOEFL scores ranging from 81 to 85.

Figure 2  Example of a target picture.

**Materials and Design**

Target images were taken from Bernolet et al. (2009) and Hwang and Kaiser (2015). The images depicted transitive events involving an agent and a patient, all reproduced in Appendix S1 in the Supporting Information online (see Figure 2 for an example); the events could be felicitously described with both active and passive sentences in English and Korean (see Hwang & Kaiser, 2016, for details).

There were 16 target trials. On each trial, a target image was preceded by a prime image depicting a transitive event. We constructed two lists by pairing each prime image with an active and a passive sentence in Korean. The locations of the agent and patient (left or right) were counterbalanced across two stimulus lists. The target trials were combined with 16 filler trials. The filler images were similar to the targets in style, but they did not depict
transitive events (e.g., intransitive events). All pictures were accompanied by a verb and nouns to make clear the event being depicted. Participants were told to describe pictures using the given words. The verb was always given in the (uninflected) dictionary form. Participants were told that they had to add articles and conjugate the verb to form a grammatical sentence. The trials were presented in a pseudorandom order, such that no more than two target trials appeared consecutively. Participants were randomly assigned to one of the lists.

**Procedure**
Following Bernolet et al. (2013), we employed a confederate scripting technique. A male graduate student with Korean as L1 and English as L2 acted as a confederate. The confederate and a participant sat opposite each other with computers between them. Neither of them could see what appeared on the other’s screen. They were told that one person would describe the pictures in Korean and the other in English. The experimenter assigned English to the participant and Korean to the confederate, making it look as if these languages were randomly assigned.

The confederate and the participant described pictures to each other and verified each other’s descriptions. The experiment was set up so that on each trial the confederate was the first to describe a picture (i.e., a prime picture). Instead of spontaneous descriptions, the confederate produced scripted prime sentences shown on the computer screen. Participants were told to press the J key (indicating “yes”) if the confederate’s description matched their own picture and to press the F key (“no”) otherwise. Immediately after a response, the prime picture was replaced by a target picture, and the participants described this target image. Participants’ speech was recorded with a desk microphone. When the confederate responded to the participants’ description, the target picture was replaced by a prime picture and sentence for the next trial. Before proceeding to the main experiment, an example item and four practice items were presented to familiarize participants with the procedure. The experiment session lasted about 30 minutes.

**Coding and Analyses**
Participants’ speech was transcribed and analyzed for their choice of sentence structure (active vs. passive). We excluded any utterances that did not contain a subject, verb, and object (e.g., *the dog . . . , the policeman and the thief ran*). We also excluded utterances that did not have a correct sentence form (e.g., *the policeman was biting by the dog, the policeman was bitten the policeman*). Because we were most interested in the structure of utterances, we did not
exclude utterances that did not contain articles (e.g., *policeman was bitten by dog*). In total, 30 out of 416 trial utterances, or 7.2%, were removed for one of these reasons. For the retained utterances, we analyzed the distribution of active sentences over passive sentences as a function of proficiency and prime type. The results were analyzed with logit mixed-effects models because these models are well suited for analyzing categorical data as in our study and are better able to deal with unbalanced data sets than are analyses of variance (see Jaeger, 2008). We first ran a full model with proficiency (cloze %), prime type (active vs. passive), and their interaction as fixed factors and crossed random effects of proficiency and prime type for participants and items. We then performed a stepwise reduction procedure to locate the simplest model that did not differ significantly from the full model in terms of variance explained. Prior to the analysis, we applied centering to continuous predictors, assigning numeric values with a range of 1 and a mean of 0 to levels within a predictor. The inclusion of random slopes for participants and items did not improve the model fit, so they were not included. The final model included proficiency and prime type as fixed effects and participant and item intercepts as random effects (Table 2). We report the log odds coefficient and its level of significance for each independent variable within each analysis.

### Results and Discussion

Participants produced predominantly more active sentences (60%) than passive sentences (40%). As demonstrated in Table 2, however, between-language priming had a significant influence on Korean-English speakers’ choice of sentence structure. A passive sentence in Korean resulted in a significant decrease in the rates of active sentences in English (56% in passive condition vs. 64% in active condition). The significant priming effect despite word-order differences in Korean and English contributes to the existing body of literature suggesting that between-language structural priming is independent of word order (Bernolet et al., 2009; Chen et al., 2013; Shin & Christianson, 2009).

### Table 2 Results of logit mixed-effects analyses in Experiment 1

<table>
<thead>
<tr>
<th>Predictor</th>
<th>β</th>
<th>SE</th>
<th>Wald z</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Intercept</td>
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<td>0.42</td>
<td>−2.04</td>
<td>.04</td>
</tr>
<tr>
<td>Proficiency</td>
<td>−0.02</td>
<td>0.02</td>
<td>−0.97</td>
<td>.33</td>
</tr>
<tr>
<td>Prime type</td>
<td>0.56</td>
<td>0.25</td>
<td>2.23</td>
<td>.02</td>
</tr>
<tr>
<td>Proficiency × Prime type</td>
<td>0.05</td>
<td>0.02</td>
<td>2.20</td>
<td>.02</td>
</tr>
</tbody>
</table>
Crucially, we found that the between-language structural priming effect (which was independent of word order) increased as Korean-English speakers became proficient in English. Figure 3 illustrates the between-language priming effect as a function of English proficiency, plotted as the proportion of utterances for which participants produced a primed sentence structure (1 means participants produced a primed structure for all trials and 0 for none of the trials). As shown in this figure, the strength of between-language priming increased with the participants’ proficiency in English. This suggests that Korean-English speakers develop shared representations of transitive structures that are similar in the two languages as they become more proficient in English.

In sum, our results showed that proficiency significantly modulated structural priming of transitive constructions in two typologically different languages, namely, Korean and English, providing support for the more recent version of the shared syntax account (Bernolet et al., 2013; Hartsuiker & Bernolet, 2017). The results are incompatible with the separate syntax account that predicts no between-language structural priming or a decrease in the priming effect as a function of proficiency. By demonstrating that the interaction between proficiency and structural priming was not specific to certain constructions (i.e., genitives) or languages (i.e., Dutch and English) targeted in previous research, the results suggested that bilinguals develop shared representations for a range of constructions and across typologically different languages if a L2 construction is similar enough to a L1 construction (in terms of functional
relations, thematic role orders, or information structure). More broadly, our results are in line with previous research suggesting that proficiency plays a pivotal role in bilinguals’ syntactic processing (e.g., Frenck-Mestre, 2002).

**Experiment 2**

The results of Experiment 1 suggested that late Korean-English bilinguals develop a shared representation for similar constructions in Korean and English as they become more proficient in English. Experiment 2 aimed to investigate whether Korean-English bilinguals develop shared or language-specific syntactic representations for different constructions in the two languages, namely, causatives. In order to evaluate the shared and separate syntax accounts, we investigated how the rates of syntactic transfer vary according to proficiency using a sentence–picture verification task (e.g., Carpenter & Just, 1975; Clark & Chase, 1972; Grüter, Lew-Williams, & Fernald, 2012; Montrul & Ionin, 2009). We chose a comprehension task (i.e., a sentence–picture verification task) rather than a production task (e.g., structural priming) because it has been suggested that a comprehension task provides a more sensitive measure of linguistic competence or knowledge (e.g., Thothathiri & Snedeker, 2008). Given that crosslinguistically different constructions are particularly difficult to learn (e.g., Johnson & Newport, 1989; MacWhinney, 2004), a production task may not be sufficiently sensitive to tap into bilingual speakers’ syntactic representations of different constructions. Assuming that representations are shared between production and comprehension processes (e.g., Pickering & Garrod, 2007), we presumed that bilingual speakers should tap into the same syntactic representations during comprehension and production tasks.

Specifically, in the sentence–picture verification task, we paired a causative event (as determined by a norming study), such as Jen having her computer fixed (see Figure 1), with either an active transitive (e.g., Jen fixed her computer) or a causative sentence in English (e.g., Jen had her computer fixed) and asked participants to decide whether the given sentence matched the depicted event. The degree to which participants considered the active transitive structure correct for a causative event revealed the degree of syntactic transfer.

As previously noted, both the shared and separate syntax accounts predict that the correct responses to a causative structure should increase as proficiency increases, given that the representation of a causative structure becomes more stable as the frequency with which it is encountered increases with proficiency. Thus, when a causative structure is paired with a causative event, proficient bilinguals should be more likely to identify it as a correct description of the event. Critically, if Korean-English bilinguals share syntactic processes and
representations for crosslinguistically different constructions, as suggested by the shared syntax account, transfer errors should increase as proficiency increases (prior to successful acquisition of L2 grammar) contrary to commonsense expectations. That is, given an active transitive structure, proficient Korean-English speakers should be more likely to identify it as a correct description of a causative event than less-proficient bilinguals. However, if bilinguals store and process syntactic information separately for different constructions, as suggested by the separate syntax account, transfer errors should be nonexistent or decrease as proficiency increases. That is, proficient bilinguals should be more likely to reject an active transitive structure as a correct description of a causative event during the process of L2 acquisition.

In sum, Experiment 2 aimed to evaluate the shared and separate syntax accounts by examining Korean-English speakers’ syntactic transfer errors in a picture–sentence verification task. In order to establish a baseline measure of native English speakers’ performance to which the performance of Korean-English speakers could be compared, we also investigated how native English speakers processed causative constructions using the same task.

Method
Participants
Twenty-six bilingual Korean- and English-speaking university students in Seoul, Korea, participated in the experiment for course credit or a small compensation (17 males, 9 females; \(M_{\text{age}} = 24\) years, range = 23–29). None of them had participated in Experiment 1. All were late bilinguals who had acquired English after early childhood and for whom Korean remained the dominant language. They reported having at least 6 years of formal instruction in English. We also recruited 20 native speakers of English in Hong Kong to establish the baseline performance measures against which to assess Korean-English speakers’ performance. They were either from the United States or the United Kingdom and had been living in Hong Kong for fewer than 2 years. They did not speak Chinese (Cantonese or Mandarin) at the time of testing. Table 3 summarizes the language background of the bilingual participants in Experiment 2.

In order to investigate the influence of L2 proficiency on syntactic transfer, Korean-English bilingual participants were asked to complete an English proficiency test—LexTALE (\(M = 67.77\%\), \(SD = 11.96\), range = 50.00–87.50; Lemhöfer & Broersma, 2012). We used the LexTALE test rather than a cloze test to disguise the experiment as a comprehension study in English. In the LexTALE test, participants are asked to indicate whether a given string of letters is an English word or not whereas a cloze test requires participants to
Table 3 Participants’ language background in Experiment 2

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<td>Age of acquisition</td>
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<td>Length of stay in English-speaking country (months)</td>
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<td>TOEIC</td>
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*Note. TOEIC = Test of English for International Communication.*

complete missing words in a text. Thus, the LexTALE test more closely involves comprehension processes. A correlation analysis based on assessment of a separate group of 22 Korean-English speakers revealed that their scores on the LexTALE were correlated with those that they received on the cloze test used in Experiment 1 ($r = .64, p < .001$).

We excluded eight participants with low English proficiency who had scored below 59% on LexTALE (see Lemhöfer & Broersma, 2012, for the relation between English proficiency levels and LexTALE scores). This was to make sure that participants had a fair command of English and that their responses were not based on a superficial connection between a picture and a sentence. For example, low-proficiency Korean-English bilinguals might consider a causative (*Jen had her computer fixed*) and/or an active transitive sentence (*Jen fixed her computer*) to be an acceptable description of a causative event because they can recognize *Jen*, *computer*, and a fixing event within the picture and the sentence. The mean LexTALE score of the remaining participants was 70.72% ($SD = 7.26$). For comparison purposes, the mean score for a large group of proficient Dutch and Korean speakers was 70.70% in Lemhöfer and Broersma.

**Picture Norming Study**

We conducted a norming study on Amazon Mechanical Turk to select target images for the experiment. Thirty-four native speakers of English participated in a picture–sentence verification task for a small compensation. Their task was to decide whether a given sentence matched an event depicted in a picture. Participants saw simple line drawings depicting 40 intransitive, 20 transitive, and 36 causative events. Intransitive and transitive pictures were paired with a correct or an incorrect description of the event. For example, an intransitive event (*a boy walking*) was paired with a correct description (*a boy was walking*) or an incorrect description using a different verb (*a boy was running*). For a transitive event (*a policeman chasing a thief*), a correct description occurred in an active
or a passive structure (active: *a policeman chased a thief*; passive: *a thief was chased by a policeman*). Incorrect descriptions were formed by interchanging semantic roles (active: *a thief chased a policeman*; passive: *a policeman was chased by a thief*). A causative event (Jen having a computer fixed) was paired with an active transitive or a causative description (active transitive: *Jen fixed her computer*; causative: *Jen had her computer fixed*). We constructed four lists, such that each transitive event occurred with a correct and an incorrect active and passive sentence. As there were two conditions for intransitive (correct/incorrect intransitive) and causative (active transitive/causative) events, each condition occurred twice across the lists. Participants were randomly assigned to one of the four lists.

For intransitive and transitive events, participants accepted correct descriptions of the event and rejected incorrect descriptions 98% of the time ($SD = 1.60$). In order to evaluate the influence of L2 proficiency on comprehension of similar structures, we selected 16 transitive and 20 intransitive images with high accuracy rates. The mean accuracy rates of the selected images were 99% ($SD = 1.80$). For causative events, participants considered a causative construction to be an appropriate description of the event 99.6% of the time ($SD = 1.30$); an active transitive construction was considered to be acceptable 44.9% of the time ($SD = 3.50$). A Pearson’s chi-square test over the frequencies of active transitive sentences revealed that the overall acceptance rate of active transitive constructions for a causative event was significantly less than would be expected by chance, $\chi^2(1) = 53.57, p < .001$, Cramér’s V = .19. In order to assess active transitive bias for each depicted causative event and select unambiguous causative events, we performed a Pearson’s chi-square test per image over the frequencies of active transitive sentences as an acceptable description of a causative event. The analyses showed that only one image had a significant active transitive bias (i.e., the acceptability rates of an active transitive construction for a depicted causative event higher than 50%), $\chi^2(1) = 5.24, p = .02$, Cramér’s V = .40.

Among the rest of the items, we chose 14 images with a strong bias against an active transitive construction (i.e., the acceptability rate of an active transitive construction for a depicted causative event lower than 50%). We chose these images as target images to increase our chance of successfully accessing Korean-English speakers’ representations of causative constructions. This is because participants’ use of a transitive structure can be driven by their interpretation of an image if the image is not clear about whether it depicts a transitive or causative event and not by an underlying syntactic representation associated with the event. Thus, we only chose images for which a causative
construction was clearly preferred to a transitive construction. The mean acceptability rate of an active transitive construction for the target images was 30% (SD = 5.10).

**Experimental Stimuli**
The main experiment used 50 images chosen in the norming study (14 causative, 16 transitive, and 20 intransitive events), with all events listed in Appendix S2 in the Supporting Information online. The pictures were accompanied by a verb and nouns to make clear the event being depicted. As in the norming study, each picture was paired with a correct or an incorrect description of the event: intransitive events with correct or incorrect intransitives, transitive events with correct or incorrect actives or passives, and causative events with active transitive or causative constructions. We constructed four lists, and participants were randomly assigned to one of the four lists. Given the variety of constructions and the number of items, we did not include any filler items.

**Procedure**
Participants were seated in front of a computer and instructed to determine whether a given sentence was an acceptable or an unacceptable description of a pictured event by pressing a “yes” or “no” button. The trials were presented in a pseudorandom order, with the constraint that no more than two trials of the same construction appeared consecutively. The experiment was run with Paradigm (Perception Research Systems, 2007). Upon the completion of the experiment, Korean-English speakers were administered the LexTALE test. After the experiment, participants were asked what they thought the experiment was about. No participant was able to correctly guess the purpose of the study.

**Coding and Analyses**
For intransitive and transitive trials for which the validity of a given sentence was easily determined, participants’ responses were categorized into correct and incorrect responses. For causative trials for which the validity of an active structure was more variable, participants’ responses were categorized into acceptable and unacceptable responses. The results were analyzed with logit mixed-effects models. We first ran a full model with all relevant predictors and their interactions as fixed factors and crossed random effects for participants and items. We then performed a stepwise reduction procedure to locate the simplest model that did not differ significantly from the full model in terms of variance explained. Random slopes for participants and items were not included if their inclusion did not improve the model fit. All continuous predictors were
Table 4 Results of logit mixed-effects analyses of causative trials

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>SE</th>
<th>Wald z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.72</td>
<td>0.77</td>
<td>4.84</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Proficiency</td>
<td>0.17</td>
<td>0.06</td>
<td>2.96</td>
<td>.003</td>
</tr>
<tr>
<td>Sentence structure</td>
<td>-3.35</td>
<td>0.53</td>
<td>-6.30</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Proficiency × Sentence structure</td>
<td>-0.03</td>
<td>0.01</td>
<td>-0.45</td>
<td>.650</td>
</tr>
</tbody>
</table>

centered prior to analysis. For intransitive and transitive trials, the final model included proficiency (LexTALE %) as a fixed predictor and participant and item intercepts as random effects. For causative trials, the final model included proficiency (LexTALE %) and sentence structure (causative vs. active transitive) as fixed predictors and participant and item intercepts as random effects (Table 4). We report the log odds coefficient and its level of significance for each independent variable within each analysis.

Results and Discussion

We first report native English speakers’ performance and then turn to the performance of the Korean-English bilinguals. We do not present the analysis of similar structures (intransitives and transitives) by each structure type because the results were independent of the structure type within the similar structures but differed in interesting ways for similar and different structures between the two groups of speakers.

For intransitive and transitive trials, native English speakers accepted correct descriptions of the event and rejected incorrect descriptions 94% of the time (SD = 5.60). We analyzed the reaction time data for correct trials. Using the median absolute deviation rule (e.g., Wilcox, 2012), we removed about 4% of outliers from the analysis (32 out of 720). For the remaining trials, the mean reaction time was 2,691 milliseconds (SD = 963). For causative events, English speakers considered a causative structure to be an appropriate description of the event 94% of the time (SD = 7.60) and an active transitive structure 15% of the time (SD = 7.60). This suggests that active transitive structures were not readily acceptable for causative events in our study. With exclusion of outliers (15 out of 280), the mean reaction time was 3,051 milliseconds (SD = 948) for causative structures and 3,272 milliseconds (SD = 1,117) for active transitive structures.

For Korean-English bilinguals, we first analyzed intransitive and transitive trials to see whether our participants’ performance on similar constructions improved with increased proficiency as bilinguals’ performance has been reported
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Figure 4  Participant accuracy (Panel A) and reaction times (Panel B) for similar constructions (intransitives and transitives) as a function of proficiency. The dotted line in Panel A indicates performance of native speakers of English in the norming study. The solid line indicates a regression line between proficiency and accuracy in Panel A and proficiency and reaction times in Panel B.

to improve in previous research (e.g., Kim & Kim, 2011; Lim & Christianson, 2013; Shin, 2010). Figure 4a shows participant accuracy for trials of similar constructions as a function of proficiency. Overall, Korean-English bilinguals performed with few errors ($M = 95\%$, $SD = 3.00$). Critically, however, there was a main effect of proficiency on accuracy, $\beta = 0.05$, $SE = 0.02$, $z = 2.14$, $p < .03$. Korean-English speakers were more likely to accept correct descriptions ($M = 96\%$, $SD = 4.70$) and reject incorrect descriptions ($M = 94\%$, $SD = 4.80$) as they became more proficient in English.

We also analyzed the reaction time data for correct trials. Using the median absolute deviation rule (e.g., Wilcox, 2012), outliers were removed from analysis (17 out of 648 trials). The analysis revealed a significant effect of proficiency on reaction times, $\beta = -18.36$, $SE = 6.97$, $t = -2.63$, $p < .001$. More-proficient bilinguals were faster in making correct decisions than less-proficient bilinguals ($M = 3,522$ milliseconds, $SD = 1,442$), as presented in Figure 4b. The results of the decision accuracy and reaction times suggested that, for similar constructions in Korean and English, Korean-English
Figure 5 Participant acceptability (Panel A) and reaction times (Panel B) of a causative and an active transitive structure for a causative event as a function of proficiency. The dotted line in Panel A indicates the mean acceptability of native speakers of English in the norming study. The solid line indicates a regression line between proficiency and acceptability of each structure in Panel A and proficiency and reaction times for each structure in Panel B.

speakers’ performance significantly improved as proficiency increased and converged with that of native English speakers.

Figure 5a plots participant acceptability of causative and active transitive sentences for a causative event as a function of proficiency. We first conducted separate analyses on the acceptability of causative and transitive structures as a function of proficiency. The analyses showed that Korean-English bilinguals were more likely to identify a causative structure as a correct description of a causative event as they became more proficient in English ($M = 90\%$, $SD = 16.80$), $\beta = 0.12$, $SE = 0.06$, $z = 2.08$, $p = .03$. Critically, more proficient bilinguals were also more likely to accept an active transitive structure as an appropriate structure for a causative event, as proficiency increased ($M = 50\%$, $SD = 33.00$), $\beta = 0.19$, $SE = 0.07$, $z = 2.55$, $p = .01$. This meant that more proficient bilinguals’ performance on active transitive trials diverged from that of native English speakers to a greater degree than the performance of less-proficient bilinguals. This strikingly contrasts with the processing of a causative structure (as well as intransitive and transitive structure), which became
nativelike as proficiency increased. A combined analysis of the two structures showed that there was a significant main effect of proficiency and sentence structure, but the interaction between proficiency and sentence structure was not significant (Table 4).

Figure 5b plots participant reaction times for causative and active transitive structures as a function of proficiency. For causative structures, proficiency had a significant effect on reaction times. The analysis of reaction times with exclusion of outliers (13 out of 252) revealed that more proficient bilinguals were faster in making decisions than were less-proficient bilinguals ($M = 4,843$ milliseconds, $SD = 1,135$), $\beta = -70.49$, $SE = 20.85$, $t = -3.38$, $p < .001$. For transitive structures, however, there was no effect of proficiency on reaction times, $\beta = -40.14$, $SE = 25.23$, $t = -1.59$, $p = .11$. This suggested that more-proficient bilinguals’ greater acceptance of an active transitive construction was not likely the result of careless processing (i.e., speed–accuracy tradeoff).

General Discussion
The present study set out to evaluate the shared and separate syntax accounts in late Korean-English bilinguals’ processing of similar and different constructions in Korean and English. Using between-language structural priming, Experiment 1 showed that Korean-English bilinguals develop shared representations of transitive constructions that are similar in Korean and English as they become more proficient in English. More proficient Korean-English speakers showed a greater between-language priming effect than less-proficient bilinguals. The results provide the first evidence that proficiency modulates structural priming of transitive constructions in two typologically different languages, suggesting that proficiency is an important factor in bilinguals’ syntactic processing in a wide range of constructions and languages.

Our results are consistent with multiple accounts of priming. It is possible that Korean transitives prime the use of English transitives with a different word order because they share functional relations. The agent entity is assigned as the subject in actives, and the patient is assigned as the subject in passives in both languages (Shin & Christianson, 2009). Alternatively, the priming of transitives in Korean and English could occur because (a) they encode information structure in a similar fashion, that is, actives highlight the agent entity whereas passives highlight the patient entity (Bernolet et al., 2009), or (b) they share the ordering of thematic roles, that is, the agent entity precedes the patient entity in actives whereas the patient entity precedes the agent entity in passives (Chang et al., 2003). Given these similarities between Korean and English transitive structures, we assume that one or more of the features can be
shared as Korean-English speakers become proficient. Although what is shared in the abstract syntactic representations in L1 and L2 is an important issue, our data did not allow us to address it. Given its theoretical importance, this issue will benefit from future research. Crucially, regardless of the locus of the shared representations, our results are consistent with the version of the shared syntax account that predicts an increase in the strength of between-language structural priming as a function of proficiency (e.g., Bernolet et al., 2013; Hartsuiker & Bernolet, 2017).

Using a picture–sentence verification task, Experiment 2 showed that for intransitive and transitive trials, proficient bilinguals were more likely to accept correct descriptions while rejecting incorrect descriptions. Similarly, Korean-English bilinguals were also more likely to identify a causative sentence as an appropriate structure for a causative event as proficiency increased. These results are compatible with both the separate and shared syntax accounts, which predict that correct identification of an English structure should increase as the frequency with which it is encountered increases with proficiency.

More importantly, however, Korean-English speakers made more syntactic transfer errors as their proficiency increased. Despite their successful understanding of a causative structure, more proficient bilinguals were more likely to accept an active transitive structure as an appropriate description of a causative event than were less-proficient bilinguals. The pattern of the transfer errors is incompatible with the separate syntax account, which predicts no or decreasing transfer errors as proficiency increases. The result is, however, precisely what is predicted by the shared syntax account. According to this model, a causative event activates both an active transitive structure and a causative structure in proficient bilinguals because an active transitive structure is used for a causative structure as well as a transitive event in Korean. As syntax is shared in Korean and English (as seen in Experiment 1), however, a strong link between a causative event and an active transitive structure in Korean leads to the greater activation of an active transitive structure in English, resulting in more transfer errors.

Taken together, our results suggest that proficient bilinguals share processes and representations for crosslinguistically different constructions as well as for similar constructions. Shared syntactic representations would be beneficial for bilingual language development because similar structures could be learned and stored only once. For structures that are crosslinguistically different, however, having separate processes and representations in L1 and L2 would be beneficial because this would result in fewer transfer errors. Yet, the results of our study suggest that this is not the case. The increasing number of transfer errors as
proficiency increased suggests that the bilingual system is highly integrated, as proposed by the shared syntax account. More broadly, our results indicate that proficient bilinguals may develop nativelike processing skills for similar constructions but not necessarily for different constructions. We suspect that this is not because they lack a representation of an appropriate L2 structure but because they may have difficulty in suppressing a competing L1 structure due to shared syntactic processes and representations. That is, proficient Korean-English speakers’ greater acceptance of an active transitive structure for a causative event is likely not due to the lack of knowledge of the causative structure but due to the failure to suppress the active transitive structure.

We suggest that bilinguals may avoid transfer errors by developing an inhibitory processing mechanism that effectively ignores irrelevant or conflicting syntactic information and only attends to relevant information in the target language (e.g., Bartolotti, Marian, Schroeder, & Shook, 2011; Linck, Hoshino, & Kroll, 2008; Weiss, Gerfen, & Mitchel, 2010). For example, as bilinguals become more proficient in English, a causative event will strongly activate both active transitive and causative structures. As they become aware of the interference from active transitive structures, however, bilinguals may learn to suppress active transitive structures and attend to causative structures only. Alternatively, bilinguals may recover from transfer errors without relying on inhibitory control. For example, as they become aware of the transfer errors, bilinguals may develop separate representations for causative constructions in Korean and English to avoid the interference from active transitive structures. If they share representations for similar constructions but develop separate representations for causative constructions, a causative event will only activate a causative structure in English. This would allow Korean-English bilinguals to activate the target structure without suppressing an active transitive structure.

Critically, we assume that bilinguals develop these mechanisms when they are able to detect discrepancies between their own grammar and the input (see MacWhinney, 2005, for a similar discussion). To detect their own errors, however, bilinguals may have to receive sufficient exposure to causative constructions and reach a certain proficiency level. If this is the case, it may explain why transfer errors increase up to a certain point during the course of L2 acquisition. As our data do not address how and when bilinguals recover from transfer errors, an important goal for future research is to identify mechanisms that allow bilinguals to recover from transfer errors and to isolate factors that influence the recovery process (e.g., age of L2 acquisition, frequency of L2 use).
Alternative Explanations
One may wonder whether the transfer errors in our study could be attributed to translation of L2 into L1 rather than to shared syntactic processing (e.g., Costa, La Heij, & Navarrete, 2006). If Korean-English speakers translated an active transitive structure in English into Korean, this would activate the transitive structure without assuming shared syntactic processes and representations in L1 and L2. Because an active transitive structure is grammatical for a causative event in Korean, the activation of the transitive structure may lead Korean-English speakers to commit transfer errors. Critically, however, this account does not explain why proficient bilinguals make more transfer errors. Cross-language intrusion is assumed to decrease as L2 proficiency increases, which is contrary to our results (e.g., Costa & Santesteban, 2004).

Another possibility is that Korean-English speakers make transfer errors because a transitive verb lemma (e.g., *fix*) activates a transitive structure. In English, a transitive verb is associated with both a transitive and a causative structure (see Figure 1). As Korean-English speakers become more proficient, the connection between a verb lemma and a transitive structure (as well as a causative structure) is assumed to grow stronger. The stronger activation of a transitive structure then may explain why proficient Korean-English speakers make more transfer errors without assuming the influence of Korean.

However, previous research has suggested that this explanation is not likely. In English, there are verbs that participate in the causative/inchoative alternation (e.g., *the vase broke* vs. *John broke the vase*), which involves two different syntactic structures. A previous study had shown that more-proficient Korean-English bilinguals had less difficulty in comprehension of these structures (i.e., faster reaction times and fewer errors) than less-proficient bilinguals (Ko, 2008). If (a) the connections between the verbs and the causative/inchoative structures grow stronger as Korean-English speakers become proficient and (b) the activation or availability of an alternative structure causes syntactic errors, this predicts that proficient Korean-English speakers should make more errors with causative/inchoative structures, contrary to the findings. This suggests that the activation or availability of an alternative structure per se is not sufficient to account for transfer errors.

Still another possibility is that proficient Korean-English speakers make more errors because they are more flexible in dealing with structural variability. That is, they are more aware that causative constructions exhibit structural variability and are more flexible in accepting active transitive sentences. If transfer errors indeed result from the increase in bilinguals’ flexibility and not from L1 interference, we would expect that bilinguals, regardless of their L1,
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should make more errors as proficiency increases. In particular, even when a causative structure in L1 and English is comparable and thus L1 is not likely to interfere with the processing of causative constructions in English, more-proficient bilinguals should be more likely to accept active transitive sentences for a causative event than do less-proficient bilinguals. Unfortunately, our study does not allow us to explore this possibility. Future research may address the issue by investigating a group of bilinguals whose L1 has a causative structure comparable to that of English.

Limitations and Future Research

Although our results suggest that proficient Korean-English speakers are more prone to transfer errors, our data are based on a rather small number of participants with lower-intermediate to advanced proficiency. Thus, the results provide a limited perspective on bilinguals’ processing of different constructions. To obtain a more complete picture of bilingual sentence processing, future research needs to test a larger population of bilinguals from a broader spectrum of proficiency levels. The present study also employed only a comprehension task to tap into the processing of crosslinguistically different constructions (Experiment 2). Although it is commonly assumed that representations are shared between comprehension and production, there are asymmetries in the two processes, for example, comprehension precedes production and the order of the processing steps is reversed in comprehension and production (Hendriks, 2013). Thus, whether bilinguals show similar error patterns in the production of causative constructions remains an open question. A production study would provide further insights into how bilinguals’ two languages influence the processing of similar and different constructions.

Finally, the present study measured English proficiency using a cloze test and a LexTALE test. Although the proficiency measures in our study have been shown to be accurate predictors of bilinguals’ comprehensive English knowledge and skills (e.g., Aitken, 1977; Lemhöfer & Broersma, 2012), it is possible that the measures were not sensitive enough to assess bilinguals’ knowledge of unique or complex constructions in English. Thus, using more sensitive proficiency measures might yield results different from those obtained from the measures used in this study. To explore this possibility, future research may adopt a proficiency test that is more sensitive to structural exceptions in English.

Conclusion

In sum, the present study provides initial evidence that bilinguals share syntactic processes and representations between L1 and L2 for crosslinguistically
similar as well as different constructions, supporting a highly integrated bilingual system. More generally, the study contributes to the development of a more complete picture of bilingual sentence processing by revealing how crosslinguistically different constructions are processed and represented during L2 acquisition.

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Notes
1 In our usage, the term *construction* entails mapping between concept and form in contrast to structure, which refers to the sentence form only.
2 The sentence *Jen-NOM her computer-ACC fixed* can mean that Jen fixed her computer herself, but the dominant interpretation is that Jen had her computer fixed.
3 Although the shared syntax model assumes that a syntactic structure is activated via a verb lemma (Bernolet et al., 2013; Hartsuiker et al., 2004), we assumed that a syntactic structure can be also activated via a direct link to a concept (e.g., causative event), as shown in Figure 1a. This is because the use of constructions like causatives is not determined by the argument structure of a main verb but rather by the conceptualization of an event (e.g., Goldberg, 1995, 2003).
4 The location of respondents’ Internet protocol addresses was restricted to the United States, and all participants indicated that English was their native language. Each participant was allowed to participate only once.

References


Supporting Information
Additional Supporting Information may be found in the online version of this article at the publisher’s website:

Appendix S1. Stimuli Used in Experiment 1.
Appendix S2. Stimuli Used in Experiment 2.