Late bilinguals share syntax unsparingly between L1 and L2: Evidence from cross-linguistically similar and different structures

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<th>Journal:</th>
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Abstract: Previous research suggests that bilinguals share syntactic processes and representations for constructions similar in two languages. However, languages often use different constructions to convey the same meaning, and little is known about how bilinguals represent and process such constructions. The present study investigated whether late bilinguals have shared or language-specific syntactic representations for cross-linguistically different constructions (causatives) as well as similar constructions (transitives) in two languages, Korean and English. Using between-language structural priming, Experiment 1 showed that proficient Korean-English bilinguals exhibited a stronger priming effect for transitives than 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 less proficient bilinguals. Taken together, our results suggest that late Korean-English bilinguals share syntactic processes and representations for both similar and different constructions, indicating that the bilingual system is highly integrated.
Late bilinguals share syntax unsparingly between L1 and L2:
Evidence from cross-linguistically similar and different structures

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 (see Authors, XXX for a review of these models). 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., Authors, XXX; Authors, XXX). In particular, Authors’ (XXX) model assumes that a lemma node is linked to a combinatorial node, which specifies a syntactic structure with which a lemma can occur (e.g., active, passive) (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 two languages. In particular, De Bot (1992) suggests 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 suggests that for similar constructions\(^1\) in two languages, bilinguals share syntactic representations (e.g., Authors, XXX; Authors, XXX; Kantola & van Gompel, 2010; Authors, XXX). 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 tasi persigue el camión*) or a passive structure (e.g., *the truck is being chased by the taxi/ El camion es perseguido por el taxi*). Using a picture description task, Authors (XXX) showed that Spanish-English bilinguals were more likely to produce a passive description in English when primed with a Spanish passive than an active. Such between-language structural priming effect suggests that

\(^1\) We use the term ‘construction’ to entail mapping between concept and form, in contrast to ‘structure’.
Spanish-English bilinguals share transitive representations in Spanish and English. Between-language priming occurs even when two languages have different word order (Authors, XXX; Authors, XXX; Authors, XXX). This suggests that bilinguals share abstract syntactic representations, not necessarily surface representations. Representations may be shared in L1 and L2 due to functional relations (the mapping between thematic roles and grammatical functions) (Authors, XXX), thematic role order (Chang, Bock, & Goldberg, 2003), or information structure (Authors, XXX).

A recent study by Authors (XXX) further suggests that late speakers of L2 start out with separate representations of L1 and L2 syntactic structures but develop shared representations as they become proficient in L2. Specifically, Authors (XXX) 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 less proficient bilinguals, and 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 Authors provide evidence for a shift from language-specific to shared syntactic representations with increasing proficiency (see Authors, XXX 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.

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.
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, an 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, as bilinguals can minimize errors of transferring grammatical rules from L1 to L2.

Yet, there has been little consideration of how bilinguals represent and process cross-linguistically different constructions. Continued existence of this gap represents an important problem because our understanding of the nature of the bilingual mind and the mechanism by which structural selection is achieved will remain incomplete.

Additionally, for cross-linguistically similar constructions, the interaction between proficiency and structural priming deserves further investigation. Although Authors (XXX) showed that proficiency modulated structural priming of genitive constructions in two typologically similar languages, namely Dutch and English, it is not clear whether the finding extends to other syntactic constructions (e.g., actives/passives) and to typologically different languages (e.g., Korean and English). The present paper aims to address these issues by investigating how bilinguals represent and process cross-linguistically similar and different constructions, focusing on late Korean-English bilinguals with lower-intermediate to advanced English proficiency (henceforth, we use Korean-English bilinguals or speakers to refer to such speakers).
The present study

Two experiments reported here investigate whether Korean-English bilinguals develop shared or language-specific syntactic representations for cross-linguistically similar (transitives) and different constructions (causatives) as a function of proficiency. Following Richards, Platt and Platt (1992), we define proficiency as individual's skill in language use, and assume that it can be evaluated through the application of a proficiency test. We briefly review how transitive and causative constructions are similar and different in Korean and English. We then turn to predictions that the shared- and separate-syntax accounts make about bilinguals’ processing of the two constructions.

**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*) and 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 (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 (Authors, XXX). Overall then, transitive structures are largely similar in Korean and English despite word order differences.

Experiment 1 investigates 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., Authors, XXX; Authors, XXX).

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 have considerable experience with L2 structures (Authors, XXX). 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 Authors, XXX for evidence for shared representations of dative structures in English and Korean).

The separate-syntax account predicts the opposite. The stronger version of the model claims that syntactic representations are separate in L1 and L2 independently 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.

**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-syntaxis accounts both assume that proficient Korean-English bilinguals develop a representation of a causative structure in English, as the frequency with which it is encountered increases with their proficiency (Authors, XXX; 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).

**The shared-syntax account** (counter-intuitively) predicts that during the process of L2 acquisition the influence of Korean should *increase* as a function of proficiency. 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

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3 Although the shared-syntax model assumes that a syntactic structure is activated via a verb lemma (Authors, XXX; Authors, XXX), we assume that a syntactic structure can be also activated via a direct link
Korean leads to the *increasing* activation of active transitive structure, as transitive structures are shared between Korean and English. Due to this increased activation, the shared-syntax account predicts that Korean-English bilinguals increasingly make the mistake of applying an active transitive construction to a causative event in English during the process of L2 acquisition. Note, however, that under the shared-syntax model it is not clear to what extent the transfer errors persist in the course of L2 acquisition. We return to the issue in the general discussion.

*The separate-syntax account,* however, predicts the opposite (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.

[Insert Figure 1 about here]

In sum, Experiment 1 investigates how Korean-English speakers represent transitive structures that are similar in Korean and English by assessing the magnitude of to a concept (e.g., causative event) (see Figure 1a). This is because the use of constructions like causatives is not determined by the argument structure of a main verb, but rather with the conceptualization of the nature of an event (e.g., Goldberg, 1995; 2003).
between-language structural priming as a function of English proficiency (e.g., Authors, XXX; Authors, XXX). By examining the interaction between proficiency and structural priming in a construction and languages that have not previously been studied, Experiment 1 aims to test the generalizability of the more recent version of the shared-syntax account. The results are also critical to test the prediction of the shared-syntax account for causative constructions, as it builds upon the assumption that transitive structures in Korean and English are shared as a function of proficiency.

Experiment 2 widens the scope of previous research on bilingual sentence processing by investigating the representation of constructions that are different in the two languages. In particular, it examines 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 college students in Seoul, Korea participated in the experiment for course credit (16 males and 15 females, mean age 23, range 20-28). All were late bilinguals who acquired English after early childhood and for whom Korean remains the dominant language. They reported to have 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; Authors, XXX). 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. Language background of participants in Experiment 1 (Mean (SD))

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<tr>
<th>Self-reported measures</th>
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<td>Length of stay in an English speaking country</td>
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<th>English proficiency test</th>
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<td></td>
<td>763-793</td>
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</table>

**Materials and design.** Target images were taken from Authors (XXX) and Authors (XXX) (see Appendix A). The images depicted a transitive event involving an agent and a patient (see Figure 2 for example) and could be felicitously described with both active and passive sentences in English and Korean (see Authors, XXX for details).

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4 Participants were asked to choose score ranges rather than to provide exact scores. This range is equivalent to iBT TOEFL scores ranged from 81 to 85.
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 location 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.

[Insert Figure 2 about here]

**Procedure.** Following Authors (XXX), 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 PCs between them. Neither of them could see what appeared on the other’s screen. They were told that one of them 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 of the experimenter 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 ‘J’ (YES) if the confederate’s description matched their own picture, and ‘F’ (NO) otherwise. Immediately after their response, the prime picture was replaced by a target picture and the participants described the target image. Their 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 min.

**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’). As we were most interested in the structure of the utterance, we did not exclude utterances that did not contain articles (e.g., ‘policeman was bitten by dog’). In total, 7.2% of the trials were removed for one of these reasons (30 out of 416).

For the remaining trials, 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 ANOVAs (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 step-wise reduction procedure to locate the simplest model that did not differ significantly from the full model in terms of variance explained. Prior to 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. Each model contained by-subject and by-item random intercepts. 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). For each result, we report the coefficient for each independent variable and its level of significance. Coefficients in mixed-logit models are given in log-odds.

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 (57% in passive condition vs. 66% 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 (Authors, XXX; Authors, XXX; Authors, XXX).

Crucially, we found that the word order independent between-language structural
priming effect increased as Korean-English speakers became proficient in English. Figure 3 plots per-participant between-language priming effect as a function of English proficiency (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 can be seen, 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.

[Insert Figure 3 about here]

In sum, our results show 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 (see also Authors, XXX). 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 is not specific to certain constructions (i.e., genitives) or languages (i.e., Dutch and English), the results suggest that bilinguals develop shared representations for a range of constructions and across typologically different languages if an L2 construction is similar enough to an 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).

Table 2. Results of the analyses of Experiment 1.

<table>
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<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>SE</th>
<th>Wald Z</th>
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<td>-2.04</td>
<td>.04</td>
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<tr>
<td>Proficiency</td>
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<td>0.02</td>
<td>-0.97</td>
<td>.33</td>
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<td>Prime type</td>
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<td>0.02</td>
<td>2.20</td>
<td>.02</td>
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</table>

**Experiment 2**

The results of Experiment 1 suggest that late Korean-English bilinguals develop a shared representation of similar constructions in Korean and English, as they become more proficient in English. Experiment 2 aims 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, & Fernand, 2012; Montrul & Ionin, 2009). We chose a comprehension task such as a sentence-picture verification task rather than a production task (e.g., structural priming), because a comprehension task is suggested to provide more sensitive measures of linguistic competence or knowledge (e.g., Thothathiri & Snedeker, 2008). Given that
cross-linguistically different constructions are particularly difficult to learn (e.g., Johnson & Newport, 1989; MacWhinney, 2004), a production task may not be sufficiently sensitive enough 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 suppose 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, e.g., *Jen having her computer fixed* in Figure 1) either with 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 matches the depicted event. The degree to which participants consider the active transitive structure correct for a causative event reveals 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 cross-linguistically 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
common-sense expectation. 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 non-existent 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 aims 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 Korean-English speakers’ can 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 college students in Seoul, Korea participated in the experiment for course credit or $10 per hour (17 males and 9 females, mean age=24, range=23-29). None of them participated in Experiment 1. All were late bilinguals who acquired English after early childhood and for whom Korean remains the dominant language. They reported to have at least 6 years of formal instruction in English. Table 3 summarizes the language background of the participants in Experiment 2.
Table 3. Language background of participants in Experiment 2 (Mean (SD)).

<table>
<thead>
<tr>
<th>Self-reported measures</th>
<th>Value</th>
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<td>Age</td>
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<td>Age of acquisition</td>
<td>8.1 (2.13)</td>
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<td>Length of stay in an English speaking country (months)</td>
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<td>Self-reported English proficiency (1-10)</td>
<td>7.53 (1.12)</td>
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<table>
<thead>
<tr>
<th>English proficiency test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOEIC (Test of English for International Communication)</td>
<td>856.67 (53.15)</td>
</tr>
</tbody>
</table>

We also recruited twenty 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 stayed in Hong Kong for less than two years. They did not speak Chinese (Cantonese or Mandarin) at the time of testing.

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 (mean=67.77%, SD=11.96, range=50-87.5%) (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 participants are asked to indicate whether a given string of letters is an English word or not, whereas a cloze test requires participants to 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 the scores of the LexTALE are highly correlated with those of the cloze test used in Experiment 1 (r = 0.64, p < .001).

We excluded eight participants with low English proficiency, who scored below 59% on LexTALE (see Lemhöfer & Broersma, 2012 for relation between English proficiency levels and LexTALE scores). This was to make sure that participants have a fair command of English and so their responses are 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) (The average score of a large group of proficient Dutch and Korean speakers was 70.70 in Lemhöfer & Broersma, 2012).

**Materials. 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 $3.00\textsuperscript{5}. Their task was to decide whether a given sentence matches an event depicted in a picture (i.e., picture-sentence verification task).

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

\textsuperscript{5} The location of their IP addresses was from the United States and all participants indicated that English was their native language. Each participant was restricted to participating only once.
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 once. As there were two conditions for an intransitive (correct/incorrect intransitive) and a causative event (active transitive/causeative), 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 sixteen transitive and twenty 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 rates 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 $V= 0.19$). 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 $V= 0.40$).

Among the rest of the items, we chose fourteen images with a strong bias against an active transitive construction (i.e., the acceptability rates 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 if an image is not clear about whether it depicts a transitive or causative event, participants’ use of a transitive structure can be driven by their interpretation of the image, not by an underlying syntactic representation associated with the event. Thus, we only chose images for which a causative construction is 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) (see Appendix B). 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). 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 is easily determined, participants’ responses were categorized into ‘correct’ and ‘incorrect’ responses. For causative trials for which the validity of an active structure is 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 step-wise reduction procedure to locate the simplest model that did not differ significantly from the full model in terms of variance explained. The inclusion of random slopes for participants and items did not improve the model fit so they were not included. All continuous predictors were centered prior to analysis. Each model contained by-subject and by-item random intercepts.

For intransitive and transitive trials, the final model included proficiency as a fixed predictor and participant and item intercepts as random effects. For causative trials, we first ran a full model with proficiency (LexTALe %), sentence structure (causative vs. active transitive), and their interaction as fixed factors and crossed random effects of proficiency and sentence structure for participants and items. The final model included proficiency and sentence structure as fixed predictors and participant and item intercepts as random effects (Table 4). For each result, we report the coefficient for each independent variable and its level of significance. Coefficients in mixed-logit models are given in log-odds.

Results and discussion

We first report native English speakers’ performance and then turn to 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 between 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 MAD (Median Absolute Deviation)-median rule (e.g., Wilcox, 2012), about 4% of outliers were removed from the analysis (32 out of 720). For the remaining trials, the mean RT was 2691 ms (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 RT was 3051 ms (SD = 948) for causative structures and 3272 ms (SD = 1117) 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 as their proficiency increased, as reported in previous research (e.g., Kim & Kim, 2011; Lim & Christianson, 2013; Authors, XXX). Figure 4a shows per-participant accuracy of trials of similar constructions as a function of proficiency. Overall, Korean-English bilinguals performed with few errors (mean accuracy = 95%, SD = 3.0). Critically, however, there was a main effect of proficiency on accuracy ($\beta = 0.05$, $z = 2.14$, $SE = 0.02$, $p < .05$); Korean-English speakers were more likely to accept correct descriptions (mean accuracy = 96%, SD = 4.70) and reject incorrect descriptions (mean accuracy = 94%, SD = 4.80), as they became proficient in English.

[Insert Figure 4 about here]
We also analyzed the reaction time data for correct trials. Using the MAD (Median Absolute Deviation)-median 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 ($\beta = -18.36$, $t = -2.63$, $SE = 6.97$, $p < .001$); proficient bilinguals were faster in making correct decisions than less proficient bilinguals (mean RT = 3522 ms, SD = 1442) as presented in Figure 4b. The results of the decision accuracy and reaction times suggest that for similar constructions in Korean and English, Korean-English speakers’ performance significantly improved as proficiency increased and converged to that of native English speakers.

Figure 5a plots per-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 proficient in English (mean acceptability = 90%, SD = 16.8) ($\beta = 0.12$, $z = 2.08$, $SE = 0.06$, $p = .03$). Critically, proficient bilinguals were also more likely to accept an active transitive structure as an appropriate structure for a causative event, as proficiency increased (mean acceptability = 50%, SD = 33.0) ($\beta = 0.19$, $z = 2.55$, $SE = 0.07$, $p = .01$). This means that proficient bilinguals’ performance on active transitive trials diverged from native English speakers’ to a greater degree than less proficient bilinguals’. This strikingly contrasts with the processing of a causative structure (as well as intransitive and transitive structure), which becomes native-like as proficiency increases.

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).

Table 4. Results of the analysis of causative trials.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</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>=.65</td>
</tr>
</tbody>
</table>

Figure 5b plots per-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 proficient bilinguals were faster to make decisions than less proficient bilinguals (mean RT = 4843 ms, SD = 1135; $\beta = -70.49$, $t = -3.38$, $SE = 20.85$, $p < .001$). For transitive structures, however, there was no effect of proficiency on reaction times ($\beta = -40.14$, $t = -1.59$, $SE = 25.23$, $p = .11$). This suggests that proficient bilinguals’ greater acceptance of an active transitive construction is not likely to be a 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 structures 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 -- i.e., the agent entity is assigned as the subject in actives and the patient is assigned as the subject in passives in both languages (Authors, XXX). Alternatively, the priming of transitives in Korean and English could occur because (a) they encode information structure in a similar fashion -- i.e., actives highlight the agent entity, whereas passives highlight the patient entity (Authors, XXX), or (b) they share the ordering of thematic roles -- i.e., 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 do not allow us to address the issue. Given its theoretical importance, the 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., Authors, XXX; Authors, XXX).

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. The 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, despite the successful understanding of a causative structure, proficient Korean-English speakers made more syntactic transfer errors during the process of L2 acquisition; they were more likely to accept an active transitive structure as an appropriate description of a causative event than 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 the account, 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 cross-linguistically different constructions as well as similar constructions. Shared syntactic representations would be beneficial for bilingual language development, as similar structures could be learned and stored only once. For structures that are cross-linguistically different, however, having separate processes and representations in L1 and L2 would be beneficial, as it would result in fewer transfer errors. Yet, the results of our study suggest that is not the case. The increasing number of transfer errors as proficiency increases 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 native-like 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 not likely due to the lack of the 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 are 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 factors that influence the recovery process (e.g., L2 age of acquisition, L2 frequency of use).
Alternative explanations

One may wonder whether the transfer errors in our study could be due to translation of L2 into L1 rather than 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 -- as cross-language intrusion is assumed to decrease as L2 proficiency increases, 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.

Yet previous research suggests 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 showed that proficient Korean-English bilinguals had less difficulty in comprehension (i.e., faster RTs 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 explain syntactic 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, not from L1 interference, we would expect that bilinguals -- regardless of their L1-- 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, proficient bilinguals should be more likely to accept active transitive sentences for a causative event than less-proficient bilinguals. Unfortunately, our study does not allow us to explore the possibility. Future research may address the issue by investigating a group of bilinguals whose L1 has a comparable causative structure 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 cross-linguistically different constructions (Experiment 2). Although it is commonly assumed that representations are shared between comprehension and production, there are asymmetries in the two processes (e.g., comprehension precedes production, the order of the processing steps is reversed in comprehension and production) (Hendricks, 2013). Thus, it remains open whether bilinguals show similar error patterns in the production of causative constructions. 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 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; Lemhofer & Broersma, 2012), it is possible that the measures are not sensitive enough to assess bilinguals’ knowledge of unique or complex constructions in English. Thus, the use of more sensitive proficiency measures might yield different results from the use of current measures. 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 the first evidence that bilinguals share syntactic processes and representations between L1 and L2 even for cross-linguistically different constructions as well as similar 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 cross-linguistically different constructions are processed and represented during the process of L2 acquisition.
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Authors (XXX)

Authors (XXX)


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Szeged: Generalia, Veszprém.


Authors (XXX)

Authors (XXX)


Appendix A: Stimuli used in Experiment 1

*Target events used in the experiment*

1. The policeman chased the thief.
2. The dog bit the policeman.
3. The tornado overturned the car.
4. The cat scratched the nurse.
5. The peacock pecked the man.
6. The snake caught the mouse.
7. The cowboy hit the boxer.
8. The nun pushed the crown.
9. The ambulance hit the man.
10. The bird ate the fish.
11. The baseball broke the window.
12. The bull butted the fireman.
13. The porcupine pricked the rabbit.
14. The bee stung the boy.
15. The horse kicked the doctor.
16. The boy pinched the girl.
Appendix B: Stimuli used in Experiment 2

Causative events used in the experiment

1. John had his watch repaired.
2. Joe had his car washed.
3. Jen had her oil changed.
4. Jane had her temperature taken.
5. Bill had his air conditioner installed.
6. Julie had her sink fixed.
7. Sally had her picture taken.
8. Ken had his shoes polished.
9. Fred had his bike fixed.
10. Peter had his portrait painted.
11. Jen had her computer fixed.
12. John had his wounds treated.
13. Mary had her tire replaced.
14. Ann had her car fixed.

Intransitive and transitive events used in the experiment

1. The policeman hit the sailor.
2. The professor hit the monk.
3. The pirate followed the monk.
4. The nun followed the doctor.
5. The cowboy punched the boxer.
6. The artist punched the cowboy.
7. The professor scolded the sailor.
8. The policeman scolded the ballerina.
9. The chef shot the monk.
10. The cowboy shot the thief.
11. The chef pushed the ballerina.
12. The nun pushed the clown.
13. The artist tickled the sailor.
14. The artist tickled the ballerina.
15. The waitress kissed the boxer.
16. The nun kissed the pirate.
17. Mickey danced with Minnie.
18. Minnie sang with Mickey.
19. The woman shook hands with the man.
20. The man argued with the woman.
21. Daisy played tennis with Minnie.
23. Daisy roller-skated with Donald.
24. Donald boated with Daisy.
25. The man played cards with the woman.
26. The woman played chess with the man.
27. Mickey smiled.
29. The boy ran with the dog.
30. The boy walked with the dog.
31. The man skied.
32. The man snowboarded.
33. The man slept.
34. The man sweated.
35. The man flew.
36. The man smoked.
Figure 1. Example of the shared-syntactic account based on Hartsuiker et al.’s (2004) model (a) and the separate-syntactic account based on De Bot (1992) (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.
Figure 2. Example of a target picture
Figure 3. Per-participant priming effect as a function of proficiency. The solid line indicates a regression line between priming effect and proficiency. 1 means participants produced a primed structure for all trials and 0 for none of the trials.
Figure 4. Per-participant accuracy (a) and RTs (b) for similar constructions (intransitives and transitives) as a function of proficiency. The dotted line in (a) indicates performance of native speakers of English in the norming study. The solid line indicates a regression line between proficiency and accuracy in (a) and proficiency and RTs in (b).
Figure 5. Per-participant acceptability (a) and RTs (b) of a causative and an active transitive structure for a causative event as a function of proficiency. The dotted line in (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 (a) and proficiency and RTs for each structure in (b).