Accessibility effects on production vary cross-linguistically: Evidence from English and Korean

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ABSTRACT

Previous work on English suggests that accessibility of individual lexical items plays an important role in shaping speakers' choice of sentence structure, providing evidence for lexically incremental production. In order to investigate the role of accessibility in cross-linguistic production, we manipulated accessibility in English and Korean via semantic priming in Experiment 1 and visual cueing in Experiment 2. We recorded English and Korean speakers' speech and eye movements as they described pictured events. The production results show that English speakers' choice of sentence structure was significantly affected by semantic priming or visual cueing, consistent with the findings of prior research: Priming the patient entity significantly increased the production of passive sentences. In contrast, Korean speakers' choice of sentence structure was not influenced by accessibility of lexical items. Analyses of participants' eye-movements are consistent with the production results. In Experiment 1, English speakers fixated the semantically primed entity in the visual scene, whereas Korean speakers did not. Even when the visual cueing manipulation drew Korean speakers' focus of attention toward the cued entity in Experiment 2, Korean speakers' choice of the first referent was not influenced by the lexical accessibility. These findings strongly suggest that lexically incremental production is not a universal production mechanism. In light of the typological differences between English and Korean, we suggest that the relative contributions of accessibility during language production are mediated by the grammatical constraints of a language.

Introduction

A considerable body of psycholinguistic research on language production focuses on the production of single words. The production processes that underlie word production are fundamental to the understanding of the production architecture, as words are the building blocks of language. Yet, words rarely occur alone. In order to convey a complete thought, speakers often need to put more than one word together into a sentence. The process of retrieving and assembling words into sentences is commonly referred to as grammatical encoding.

One of the central issues in grammatical encoding is how speakers decide which word to put first in a sentence (e.g. Bock, Irwin, & Davidson, 2004). One of the proposed key factors is accessibility, i.e. how accessible words are in the speaker's mind. Previous studies showed that speakers tend to produce accessible words sooner, assigning them to earlier sentential positions; given a choice between semantically equivalent structures, speakers tend to produce the structure that enables earlier accommodation of the more accessible lexical item (see Ferreira & Slevc, 2007; Jaeger & Norcliff, 2009 for reviews).

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Two factors that are widely attested to increase accessibility are animacy and givenness. For example, when the patient noun is more accessible than the agent noun due to animacy or discourse salience (givenness), speakers are more likely to produce a passive sentence, mentioning the patient noun first (see e.g. Bock, Loebell, & Morey, 1992; Ferreira, 1994; Gennari, Mirkovic, & MacDonald, 2012; Prat-Sala, 1997; Tanaka, Branigan, McLean, & Pickering, 2011; Van Nice & Dietrich, 2003 for animacy; see e.g. Bock & Irwin, 1980; Christianson & Ferreira, 2005; Ferreira & Yoshita, 2003; Prat-Sala & Branigan, 2000 for givenness).

Accessibility can be also manipulated by means of semantic priming (Bock, 1986) or visual cueing (Gleitman, January, Nappa, & Trueswell, 2007). For example, if speakers whose task was to describe Fig. 1 were primed with the word *criminal*, a semantic associate of *policeman*, they were more likely to produce a patient-initial passive sentence such as *a policeman is being bitten by a dog*. Similarly, when speakers were presented with a subliminal visual attention-capturing flash that cued the location where the policeman would appear immediately afterwards, they were more likely to utter a passive sentence than mentions the policeman first than when the flash cued the location of the dog. Gleitman et al. suggest that – despite their non-linguistic nature – visual cues affect the choice of sentence forms by increasing the accessibility of the cued entity, akin to the process triggered by semantic primes: By drawing initial attention and looks to the cued scene entity, a visual cue immediately (even when subliminal) increases the accessibility of the corresponding lemma (semantic and syntactic representation of a word) and lexeme (phonological word-form) of the cued entity.

The immediate influence of accessibility on sentence structure provides support for the idea that sentence production is an incremental process, in which speakers create structures piecemeal, processing the more accessible items sooner (Ferreira & Slevc, 2007; *principle of immediate mention*, Ferreira & Dell, 2000). Lexical incrementality is suggested to be an important production mechanism because it allows grammatical encoding to proceed more efficiently (Ferreira & Slevc, 2007). By putting an accessible lexical item in an earlier sentence position, the production system can minimize disfluencies or errors, and thus production can proceed more smoothly (Bock & Ferreira, 2014). Consistent with this possibility, Ferreira (1996) found that English speakers produced utterances faster and with fewer errors when they had an opportunity to accommodate lexical variability by assigning accessible words to early sentence positions and prominent grammatical functions.

Note, however, that animacy and givenness effects may not provide the strongest evidence for *lexically* incremental production. This is because their effects can potentially be construed as stemming from the relational structure among event entities such as figure-ground assignment, rather than the accessibility of individual lexical items *per se*. For example, animate entities are more likely to be interpreted as agents, and construed as 'figure', which are subsequently more likely to be mentioned early and to occur in subject position than inanimate, backgrounded

Fig. 1. A scene depicting a biting event.

entities (e.g. Bock et al., 2004; Gleitman, Gleitman, Miller, & Ostrin, 1996; Jackendoff, 1987; Talmy, 1978). Similarly, entities that have been mentioned in prior discourse are foregrounded in the discourse context (e.g. Firbas, 1971) and are more likely to be assigned to an earlier sentence position or to the subject function than entities being mentioned for the first time (e.g. Clark & Clark, 1977; Clark & Haviland, 1977; Halliday, 1967). As animacy and givenness influence not only the accessibility of an entity but also reflect the relationship between event elements as a whole, they do not necessarily provide direct evidence for lexically incremental production.

Critical evidence for lexical incrementality rather comes from semantic priming (Bock, 1986) and visual cueing (Gleitman et al., 2007). When an entity is made accessible by a semantic prime or a visual cue, it is more likely to be mentioned first in the sentence and to be realized as the grammatical subject. These manipulations boost the accessibility of entities independently of givenness and animacy. Thus, semantic priming and visual cueing provide persuasive evidence that English speakers tend to produce accessible lexical items sooner, assigning them to earlier sentential positions (Bock & Ferreira, 2014).

Although semantic priming and visual cueing suggest that individual lexical items exert a strong influence on the formulation of sentence structures in English (and presumably other typologically similar languages), it is not clear whether lexically incremental production is a cross-linguistically universal production mechanism – that is, whether speakers of typologically different languages also build sentences starting with the more accessible lexical items, with the syntactic structure guided by accessibility.

Cross-linguistic research suggests that in flexible word order languages like Finnish and Russian, accessibility effects might be manifested in terms of word order (positional processing) rather than grammatical function assignment (functional processing). That is, when the patient entity is more accessible than the agent entity, speakers of Finnish and Russian may realize the patient entity as the sentence-initial object with non-canonical word order such as OVS and OSV. For example, Myachykov and Tomlin (2008) found effects of accessibility on word order in Russian with an explicit

(non-subliminal) manipulation of visual salience ('fish film' paradigm, see Tomlin, 1995, 1997). Russian speakers viewed animated cartoons of two fish swimming toward each other on a collision course and one fish ultimately eating the other fish (target event). Speakers were asked to describe the event as it unfolded, while keeping their eyes on the fish with the explicit visual cue (arrow pointer) above it. The results showed that Russian speakers described the target event with object-initial sentences (OVS, OSV) in 20% of the patient-cued trials as compared to 2% of the agent-cued trials. Yet, they produced passive sentences in less than 2% of the patient-cued trials.

Similarly, Myachykov, Garrod, and Scheepers (2010) did not find significant effects of visual salience on speakers' structural choice in Finnish. Using the visual cuing paradigm from Gleitman et al. (2007), Myachykov et al. found that the visual cue effectively shifted Finnish speakers' gaze to the cued entity, but it did not significantly influence their structural choice: Finnish speakers produced active sentences in 99% of the patient-cued trials, with the remaining 1% of patient-cued trials consisting of object-initial active sentences with non-canonical OVS order.

Myachykov and Tomlin (2008) and Myachykov et al. (2010) attribute the absence of a visual-cueing effect on structural choice to the relative unavailability (or absence) of passives in Russian and Finnish. Because the mapping between the patient entity and the subject function is not readily available in these languages due to the rarity or grammatical absence of passives, the visual cueing manipulation fails to influence grammatical function assignment. Finnish and Russian, however, have a relatively flexible word order as compared to English. Myachykov and colleagues suggest that in these languages, visual salience might be accommodated in terms of word order during positional processing, rather than grammatical role assignment.

This view, however, is not yet clearly empirically supported: As Myachykov, Thompson, Scheepers, and Garrod (2011) note, the manipulation of visual salience in Myachykov and Tomlin (2008) is confounded with discourse salience. As speakers were instructed to describe the unfolding event focusing on the cued fish, the cued fish was not only visually salient but also mentioned in the prior discourse context, promoting the cued fish as the topic. Thus, it is possible that the increase in the rate of object-initial sentences in Russian resulted from discourse salience rather than visual salience. Furthermore, the rate of object-initial sentences was very low in Finnish as noted earlier.

In sum, while the results of Myachykov et al. (2010) and Myachykov and Tomlin (2008) contribute to our understanding of sentence production in flexible word order languages, they do not allow us to conclusively assess the impact of accessibility in languages typologically different from English. Thus, the question of whether lexically incremental production is a universal production mechanism is still open.

The present study

The current study aims to critically test whether lexically incremental production is a universal production mechanism by evaluating accessibility effects in two typologically different languages – English and Korean. Korean is typologically different from English in various aspects: It has a different basic word order from English (Korean is Subject Object Verb (SOV) while English is Subject Verb Object (SVO)), allows word order flexibility (unlike English which has a fairly fixed word order), and uses extensive case-marking on lexical items (English has very limited overt case-marking). Thus, the investigation of English and Korean can provide key insights into the question of whether language production in languages beyond English is lexically incremental.

To see how accessibility of individual lexical items (henceforth, lexical accessibility) influences syntactic processing in these languages, we conducted a series of visual-world eye-tracking experiments during language production, and examined how manipulations of lexical accessibility guide speakers' eye-movements and structural choices. We manipulated lexical accessibility using two different paradigms to increase our chances of detecting any accessibility effects and provide strong evidence for or against lexical incrementality. Experiment 1 manipulated lexical accessibility by presenting a *semantic prime* word before each picture, similar to Bock (1986). Prime words were semantically associated with one of the two entities (agent or patient) in the picture. Experiment 2 manipulated lexical accessibility via *visual cues*, following the methodology of Gleitman et al. (2007). In both experiments, the participants' task was to describe pictured events, which could be described with active or passive structures.

As previously noted, in order to directly assess the role of accessibility in word order or grammatical function assignment, it is crucial to separate accessibility from animacy and discourse salience. This is because animacy and discourse salience increase the accessibility of an entity, but may also influence the relationship among scene entities (e.g. figure-ground). Furthermore, object-initial sentences are often used to encode the discourse status of a referent (e.g. *given* vs. *new*) in flexible word order languages, including Finnish (Kaiser & Trueswell, 2004), Russian (Comrie, 1987, 1989; Yokoyama, 1986) and Korean (Choi, 1996). Thus, to avoid confounding accessibility with animacy or givenness, (i) the depicted events in our studies involved two animate entities, and (ii) the accessibility of the agent and the patient was manipulated in the absence of discourse context. This will allow us to test whether lexically incremental production is a universal mechanism across languages.

We also designed our stimuli such that potential accessibility effects can be easily detected. Although passives are more constrained and less frequent in Korean than in English (see e.g. Lee, 1969; Oshima, 2006; Park, 2005 for detailed discussion of the syntactic, semantic and pragmatic constraints for passive structures), we made sure that all critical pictures could be felicitously described with both active and passive sentences in English and Korean (as determined by a norming study, following Gleitman et al., 2007). This is important, since Myachykov and colleagues' finding that Finnish and Russian did not show effects of visual salience could be due to the unavailability

of the passive structure in these languages and/or incompatibilities between the passive voice and the critical items used in those studies (see Myachykov et al., 2011 for further discussion). Thus, we wanted to make sure that the passive structure is indeed a felicitous and an available option for our participants for all target items, so that any potential effects of visual accessibility have a chance to be detected by our experimental set-up.

In both experiments, we analyze participants' structural choices and eye-movements in a picture-description task. We expect that the two different manipulations of accessibility with eye-movement monitoring should provide a clearer picture of the role that accessibility plays in cross-linguistic production.

Predictions for structural choices

If grammatical function assignment in English is influenced by lexical accessibility as suggested by previous research, we expect both semantic priming and visual-cueing to have a significant influence on English speakers' choice of sentence structure. In particular, priming patient entities via semantic primes (Experiment 1) or visual cues (Experiment 2) should increase the use of passive sentences, in line with the results of the previous studies on English.

The predictions for Korean production are less clear, however. Let us first consider the rate of *passive sentences*. On the one hand, if lexical accessibility influences grammatical function assignment in Korean, priming patient entities should increase the rate of passive utterances – although the effect might be reduced in Korean as compared to English due to the availability of alternative syntactic structures (e.g. object-initial sentences such as OSV in Korean) (e.g. Gennari et al., 2012; Prat-Sala & Branigan, 2000). On the other hand, if the patient-subject mapping is not readily available in Korean due to the relative rarity and/or the marked nature of passives, we expect that Korean speakers should overwhelmingly produce active sentences regardless of which entities are primed (in line with the reasoning of Myachykov & Tomlin, 2008; Myachykov et al., 2010, 2011, see also Gennari et al., 2012).

In terms of the production of *object-initial OSV sentences* (in the active voice), if speakers of flexible-word order languages produce object-initial sentences due to discourse salience (e.g. Choi, 1996 for Korean; Comrie, 1987, 1989; Yokoyama, 1986 for Russian; Kaiser & Trueswell, 2004 for Finnish), we do not expect that priming patient entities *per se* (without the support of a discourse context) should increase the rate of object-initial sentences. However, as suggested by Myachykov et al. (2010, 2011) and Myachykov and Tomlin (2008), if a flexible word order language accommodates lexical accessibility in terms of word order rather than grammatical function assignment, we might find that priming patient entities increases the rate of object-initial sentences even in the absence of discourse context.

Predictions for eye-movements

The manipulation of accessibility was accompanied by an assessment of eye fixations, to ensure that participants actually looked at the more accessible entity. If the entity that is ultimately mentioned first is also likely to be looked at early in the display of the image, this provides strong evidence that an individual lexical element can drive sentence production (Gleitman et al., 2007). Previous eye-tracking production experiments found an orderly linkage between successive fixations and word order (Bock et al., 2004; Gleitman et al., 2007; Griffin & Bock, 2000; Meyer & Dobel, 2003 among others). This leads us to expect that, relative to speech onset, both English and Korean speakers will look earlier to the entity that they will mention first than to the entity that they will mention second. Thus, we predict that in both Experiments 1 and 2, speakers will first fixate the entity that they will subsequently begin their utterances with.

Crucially, however, the predictions for eye movements toward the semantically primed entity (Experiment 1) differ depending on the relationship between lexical accessibility and word order. Bock et al. (2004, p. 261) suggest that if the selection of a starting point for an utterance is sensitive to the focus of a speaker's attention, the speaker is likely to be looking at the corresponding entity when it is present in the visual field at the outset of sentence formulation. Thus, we predict that speakers would look more at the semantically primed entity *only if* they pay attention to the primed entity or take account of semantic relatedness in the selection of a starting point. That is, if word order is influenced by semantic priming, we predict that speakers will look more at the semantically primed entity than the unprimed entity. If speakers' choice of word order is not influenced by semantic priming, they are not expected to fixate the semantically primed entity more than the unprimed entity.

In Experiment 2, where we used visual cuing – known to elicit reflexive, involuntary eye movements to the cued entity (Gleitman et al., 2007; Remington, Johnston, & Yantis, 1992; Theeuwes, Kramer, Hahn, & Irwin, 1998) – we expect that both English and Korean speakers should initially look at the cued entity, independently of whether their word order choice is contingent on visual salience.

Experiment 1: Semantic priming

Methods

Participants

Twenty-four native speakers of English and twenty-four native speakers of Korean[1] from the University of Southern California participated in the experiment for $10 per hour.

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[1] All Korean speakers were dominant in Korean (born and raised in Korea), and were late learners of English. Since they were attending a U.S. university at the time of testing, however, one might wonder whether English could have an influence on their processing of Korean. Given existing evidence suggesting that late bilingual speakers use the same processing strategies as monolingual speakers even when they process a second language (e.g. Fernández, 2003), we do not expect the Korean participants' knowledge of English to have a significant effect on their Korean production. Furthermore, if the Korean speakers *were* influenced by English, this would lead to a minimization of any differences between the English and Korean speakers – i.e. Korean speakers should be more likely to exhibit lexical accessibility effects. As we will see in the results section, there are robust differences between groups, which further alleviates any potential concerns in this direction.

Stimuli

Picture norming study. In order to select the target images for Experiment 1, a norming study was conducted over the Internet on a separate group of 24 native English speakers and 25 native Korean speakers. Participants wrote a single-sentence description for 27 images. Each image consisted of a simple color drawing depicting a transitive event involving two animate entities (e.g. a fox chasing a chicken). Following Gleitman et al. (2007), an image was selected to be a target if active and passive constructions occurred at least once among the descriptions of the pictures in both English and Korean. In addition, when selecting the items, we made sure that the pair of entities in each item was sufficiently distinct from each other in order to prevent a semantic prime for one entity from priming the other. This resulted in the selection of 16 target images.

Experimental stimuli. The same set of images was used for both English and Korean. The main experiment used the 16 target images chosen in the norming study, as well as 26 filler images. The target images were always preceded by a semantic prime word associated with one of the two scene entities (either the agent or the patient). English prime words were chosen based on the University of South Florida Free Association Norms (Nelson, McEvoy, & Schreiber, 1998) and Korean primes were chosen based on Park (2004). The mean prime-to-target association strength is 0.412 for English and 0.498 for Korean. A two-tailed *t*-test showed that the two did not differ significantly ($p > .1$).

The filler images were similar to the targets in style but they could only be described with active sentences. The fillers were preceded by either words or non-words (11 fillers were preceded by words and 15 by non-words). The words that preceded filler images were not related to any of the entities in the scene (e.g. 'watch' for an image of a nun reading a book). The words and non-words were distributed so that half of them occurred in the first half of the list and the other in the latter half of the list.

Procedure and design. Participants were seated in front of a 21-in. CRT monitor and instructed to orally describe the pictured event in one sentence using all entities present in the picture. Before proceeding to the main experiment, an example item and four practice items were presented.

Fig. 2 shows how the stimuli were presented. On each trial participants were first presented with a crosshair for 500 ms. A semantic prime word immediately followed the crosshair and stayed on the screen for 200 ms. The primes were presented in 120-point Batang font in English and Korean and replaced by a blank screen after 200 ms. To make sure that participants pay attention to and process the prime words, they were asked to make a lexical decision: When they saw a real word, they were told to press the right button of a game controller and for a non-word, they were told to press the left button. Immediately after the lexical decision task, a target picture appeared and the participants' speech was recorded with a desk microphone. Participants' eye movements were also recorded with an SR Research EyeLink II head-mounted eye-tracker. At the end of the description, participants pressed a controller button to proceed to the next trial.

Participants saw the crosshair for 500 ms and the semantic prime for 200 ms. After making a lexical decision, they saw the scene and described the event.

The priming condition of a scene entity (agent or patient) and the location of the agent and patient (left or right) were counterbalanced across two stimulus lists so that agents and patients on the right and left were primed equally often in each list. There were two additional lists in which the order of the items was reversed. This was to make sure that the order of presentation did not have any effects on the description of the pictures. Participants were randomly assigned to one of these four lists.

After the experiment, participants were asked what they thought the experiment was about. Most participants said that they had noticed that some words were related to the immediately following pictures, but no participant was able to correctly guess the purpose of the study.

Coding and analyses

Participants' speech was transcribed and analyzed for their choice of sentence structure (active vs. passive). Although Korean allows object-initial OSV sentences such as *a policeman a dog bit*, those sentences were rare (less than 1% of the trials) and thus were not classified into a separate category. Trials containing disfluencies (fillers or repairs) were included unless they altered the referential and structural choices (e.g. "A doctor, uh, a bear is hitting a doctor" was not included because the speaker corrects the choice of the first referent). We excluded utterances with conjoined NP subjects (e.g. "a bear and a doctor"), as NP conjunctions are processed differently from active and passive sentences (e.g. Branigan, Pickering, & Tanaka, 2008; Onish, Murphy, & Bock, 2008). All utterances not
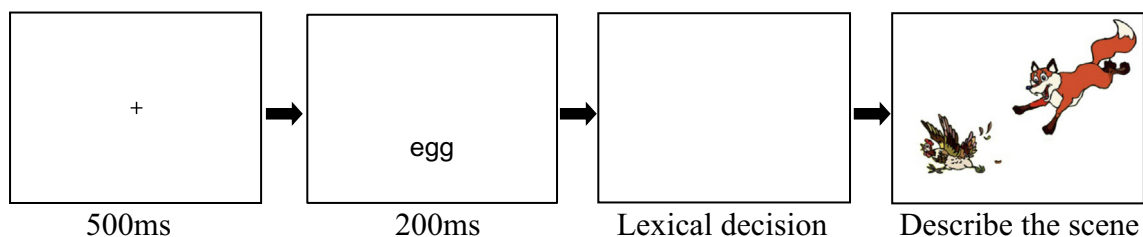

Fig. 2. Display sequence for Experiment 1 in a patient prime condition where the patient entity *chicken* is primed with the semantically associated word *egg*.

containing two NPs were also excluded. In total, less than 3% of the trials in both languages (11 out of 384 in English, 11 out of 384 in Korean) were removed for one of these reasons. The results reported below do not depend on this removal. For the remaining trials, utterance onset latencies were manually determined using the phonetic software package Praat (Boersma & Weenink, 1992).

We analyzed the distribution of active sentences over passive sentences as a function of the prime condition. The results were analyzed with logit mixed-effects models (Bates & Sarkar, 2007; Breslow & Clayton, 1993; DebRoy & Bates, 2004) 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). Our statistical analyses closely follow the approach argued for by Baayen (2008) and Jaeger (2008). We ran separate mixed logit models for English and Korean with prime condition as a fixed effect, and participant and item as random effects. In order to examine how priming effect is modulated by language, we also ran a model over both languages including main effects of prime condition and language as well as the interaction between the two. Following Barr, Levy, Scheepers, and Tily (2013), the models included the maximal random effects structure justified by the design. For each model, stepwise model reduction was performed in order to determine the random effect structure warranted by the design. 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

Production

Fig. 3 shows the proportion of active sentences produced by English and Korean speakers as a function of whether the agent or the patient entity was semantically primed. (Averages and standard errors were computed using participant means.) Consistent with Bock (1986), semantic priming had a significant influence on English speakers' choice of structural choice: Priming patient entities resulted in a significant decrease in the rate of active
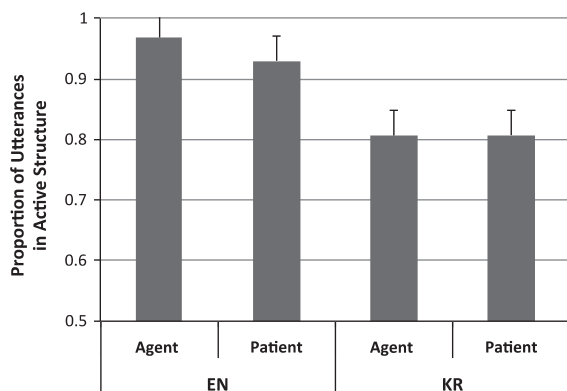
Fig. 3. Proportion of active sentences produced by English and Korean speakers in Experiment 1 when agent and patient entities were primed. Error bars indicate standard error.

sentences (i.e. an increase in the rate of passives) ($\beta = -3.151$, $z = -2.812$, $p < .01$, $SE = 1.121$). In contrast, Korean speakers' choice of word order was not affected by semantic priming: Priming patient entities did not decrease the production of active sentences ($p = 1$). Although Korean allows object-initial sentences, those sentences occurred on less than 1% of the trials (4 out of the 373 utterances).

Cross-linguistic analyses of English and Korean revealed a main effect of prime condition ($\beta = -0.6397$, $z = -2.727$, $p < .01$, $SE = 0.2346$) and a main effect of language on structural choice ($\beta = -1.7810$, $z = -4.248$, $p < .001$, $SE = 0.4193$) (i.e. Korean speakers were more likely to produce passive sentences compared to English speakers). There was also a significant interaction between prime condition and language ($\beta = 0.4906$, $z = 2.028$, $p < .05$, $SE = 0.2420$).

Eye movements

Following Gleitman et al. (2007), the eye movements are analyzed in terms of word order (first-mentioned entity vs. second-mentioned entity) rather than grammatical function such as subject and object. In English, word order is closely correlated with grammatical functions (e.g. the first noun is usually the subject). In Korean, however, word order does not necessarily correspond with grammatical functions, because words in the same sentential position may have different grammatical functions as seen in an object-initial sentence (*a policeman-ACC a dog-NOM bit* 'a policeman a dog bit') and a passive sentence (*a policeman-NOM a dog-DAT was bitten* 'a policeman was bitten by a dog'). The difference between the two, however, is negligible in the current study as Korean speakers rarely produced object-initial sentences. Fixation probabilities were examined in 200 ms time windows, following the traditional approach in visual-world eye-tracking (see e.g. Altmann, 2011; Salverda, Kleinschmidt, & Tanenhaus, 2014).

Before discussing effects of semantic priming on eye movements, we made an initial assessment of the temporal relationship between eye movements and speech by plotting the eye movement data in terms of looks to the first-mentioned entity and second-mentioned entity. Given that both Griffin and Bock (2000) and Gleitman et al. (2007) found strong effects of word order on eye fixations at utterance onset, we predict that both English and Korean speakers should fixate scene entities one after the other in the order of mention. Indeed, this can be seen in Fig. 4, which plots the mean proportion of looks to the first referent (N1) and the second referent (N2) relative to utterance onset in English and Korean. As expected, participants fixated the entity that they would subsequently mention first before starting to speak.

The linkage between successive fixations and word order is also observed in English and Korean when the mean proportion of looks to the first referent (N1) and the second referent (N2) was plotted relative to image onset (when the image appears on the screen) (Fig. 5). Before fixating N2, both English and Korean speakers fixated N1. As shown in Fig. 5, looks to N1 began to diverge from looks to N2 at about 400 ms after image onset. The difference reached significance during 600–800 ms time
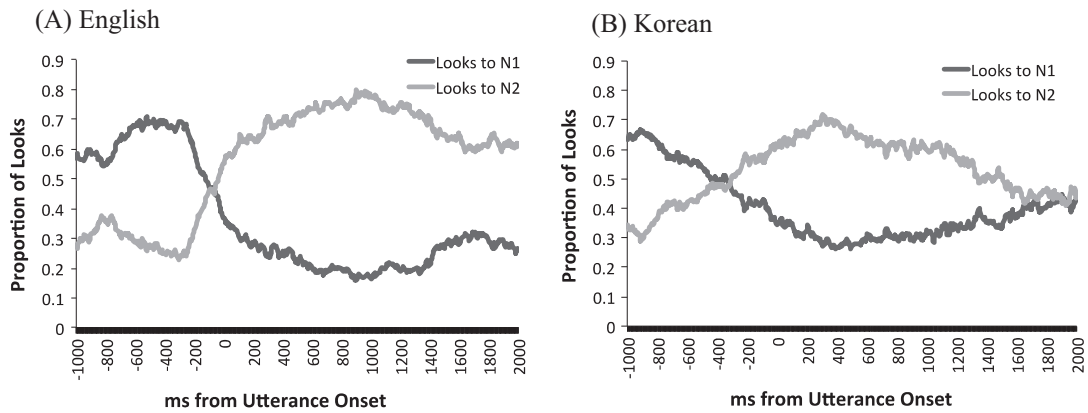
(A) English

(B) Korean

Fig. 4. Patterns of eye movement to the first and second referents relative to utterance onset in English and Korean in Experiment 1.
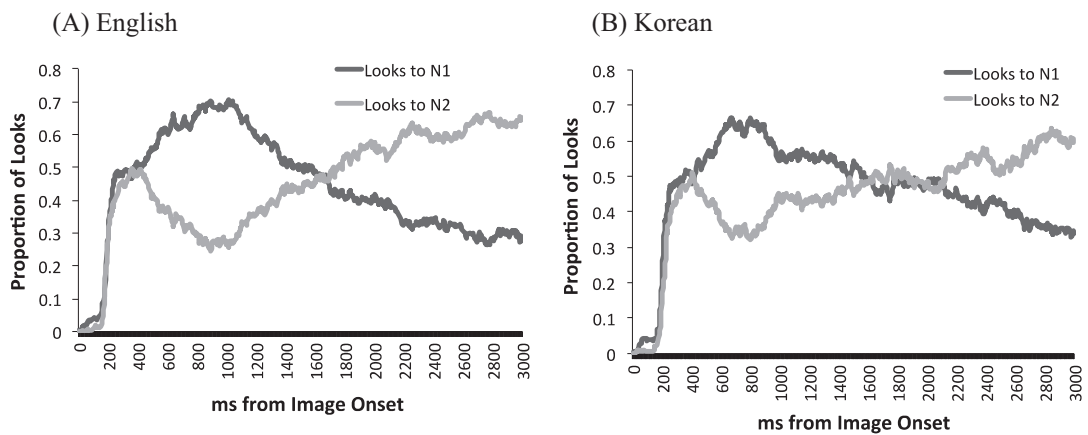
(A) English

(B) Korean

Fig. 5. Patterns of eye movement to the first and second referents relative to image onset in English and Korean in Experiment 1.

window in both English and Korean ($t_1(23) = 4.4542$, $p < .001$; $t_2(15) = 3.1305$, $p < .01$ in English, $t_1(23) = 3.521$, $p < .001$; $t_2(15) = 3.3073$, $p < .01$ in Korean).

Given that both English and Korean speakers initially looked at the scene entity that they subsequently started their utterance with (N1), an important question is whether these initial fixations on N1 (and by inference, the selection of N1) are influenced by semantic priming. To determine whether speakers' choice of word order was sensitive to semantic priming, we plotted the mean proportion of looks to the primed entity versus the unprimed entity, as shown in Fig. 6. If speakers' word order choices are influenced by semantic priming, they should fixate the semantically primed entity more than the unprimed entity, as the primed entity is likely to be the subject of an utterance. If word order choices are not influenced by semantic priming, however, the semantically primed scene entity is not expected to draw more looks compared to the unprimed entity.

Consistent with the production results, English speakers fixated the semantically primed entity significantly more than the unprimed entity, starting at 400 ms after image onset (during the 400–600 ms time window: $t_1(23) = 3.2053$, $p < .01$; $t_2(16) = 3.1156$, $p < .01$; during the

0–400 ms time window, there was no significant difference in fixations proportions, p's > .1). In Korean, however, looks to primed and unprimed scene entity did not significantly diverge at any time window during the first 3000 ms of image display (p's > .1).

Discussion

In order to evaluate the role of lexical accessibility in typologically different languages, Experiment 1 investigated effects of semantic priming on English and Korean speakers' choice of sentence structure and word order. Previous findings on English suggest that lexical accessibility plays an important role in English speakers' production (e.g. Bock, 1986; Gleitman et al., 2007): Priming patient entities via semantic priming or visual cueing increased English speakers' production of passive sentences. On the basis of these findings, our expectation was that semantic priming would have a significant influence on English speakers' choice of sentence structure.

Production data

Consistent with the findings of Bock (1986) and Gleitman et al. (2007), the analyses of the production data
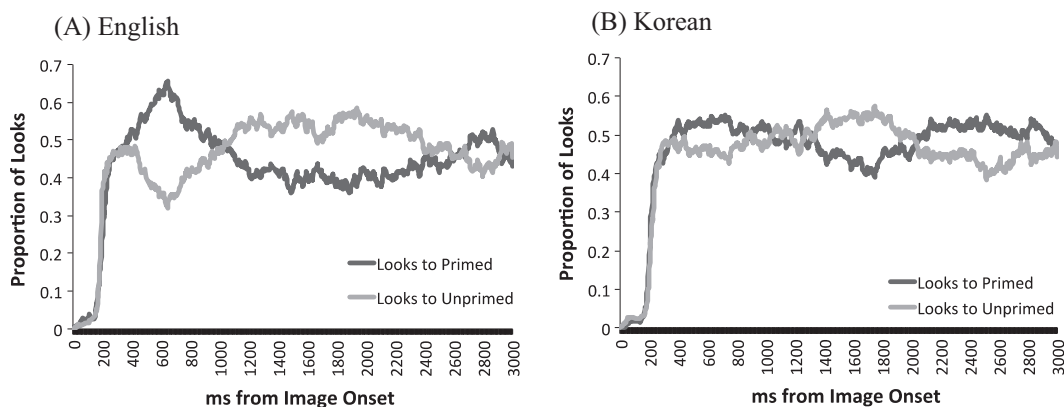
Fig. 6. Patterns of eye movement to semantically primed and unprimed scene entities relative to image onset in English and Korean in Experiment 1.

showed that semantic priming significantly affected English speakers' choice of sentence structure: Priming the patient entity increased the use of passive sentences. In contrast, Korean speakers' choice of sentence structure was *not* affected by semantic priming. Korean speakers also very rarely produced object-initial sentences to accommodate accessible entities to the sentence-initial position. Note, however, that Korean speakers produced *more* passives than English speakers (as noted in the results section), although passive structures in Korean are more constrained than in English (as noted in the introduction). These findings provide evidence against the account suggested by Myachykov et al.(2010, 2011) and Myachykov and Tomlin (2008). That is, the lack of a lexical accessibility effect in a flexible word order language cannot be attributed to the unavailability of the patient-subject mapping. Nor did we find any evidence of lexical accessibility being accommodated in terms of word order. We discuss why lexical accessibility might not have a universal influence on grammatical encoding in the general discussion section after we consider effects of visual salience on production in English and Korean (Experiment 2).

Eye-movement data

The eye-movement analyses for Experiment 1 are consistent with the production results. English speakers fixated the semantically primed (and thus accessible) entity significantly more than the unprimed entity. Critically, for English speakers, the onset of fixations on the semantically primed entity precedes the onset of fixations on the first-mentioned referent. Together with the finding that English speakers were more likely to start their utterances with the primed entity, this suggests that lexical accessibility drives English speakers' choice of sentence structure.

In contrast to English speakers, Korean speakers did *not* selectively fixate the semantically primed entity during the 3000 ms of image display. However, just like English speakers, they fixated the scene entity that they would subsequently mention first in their sentence, starting at 400 ms after the image had appeared. The fact that Korean speakers (i) significantly fixated the first referent during the same time window as English speakers (pointing toward a similar time course of sentence formulation

in both languages) but (ii) quite strikingly, did *not* fixate the semantically primed scene entity, suggests that what drives speakers' choice of sentence structure might not be universal across languages. (Note that as the prime-to-target association strength did not significantly differ between English and Korean, the different patterns of eye movements cannot be attributed to the effectiveness or ineffectiveness of primes in these languages.)

Experiment 2 further investigates whether lexical accessibility can guide structural choice in English and Korean by manipulating visual salience. The use of visual cues allows us to test whether the differences between English and Korean are replicated when the primes are in the visual modality. It also allows us to make maximally similar comparisons of lexical accessibility between English and Korean: Because both English and Korean speakers are tested with identical primes and targets, Experiment 2 eliminates any potential confounds that could be associated with slight differences in the English and Korean sematic primes used in Experiment 1.

Experiment 2: Visual cueing

Methods

Participants

Sixteen native speakers of English from the University of Southern California and twenty-four native speakers of Korean from Seoul National University participated in the experiment. Participants received $10 per hour or course credit.

Stimuli

Experiment 2 used 16 target images and 26 filler images. Six of the target images were from Experiment 1. Ten new target images (same images for both English and Korean) were added to replace images which predominantly elicited active utterances in Experiment 1. (We chose to eliminate these images in order to make it easier to detect potential priming effects, since a strong active bias may trigger ceiling effects for active voice and hide potential priming effects.) The newly added critical images

were again selected from a larger set based on a norming study, which was conducted on a separate group of twenty native English speakers and twenty native Korean speakers. Participants wrote down single-sentence descriptions of 50 images. To be selected as a target, an image had to elicit at least one occurrence of an active and a passive construction in English and Korean, following the criteria of Gleitman et al. (2007).

Experiment 2 manipulated lexical accessibility by visual cues. Target images were preceded by a visual cue. The cue consisted of a 0.5 × 0.5-in. black square and flashed briefly where one of the entities (either the agent or the patient of the depicted action) would subsequently appear. Filler images were also preceded by a cue, but in the case of fillers, the square was randomly located on the screen.

Procedure and design

The procedure closely matched that of Gleitman et al. (2007). As in Experiment 1, participants were seated in front of a computer monitor and instructed to orally describe the pictured event in one sentence using all entities in the picture. On each trial, participants first focused on a crosshair which was placed neutrally between the two entities. Then they were presented with the visual cue, which consisted of a 0.5 × 0.5-in. black square against a white background. The cue appeared for 60 ms, and was immediately followed by the critical image. Fig. 7 shows how the stimuli were presented. Participants' speech was recorded with a desk microphone and their eye gaze data were collected with as SR EyeLink II eye-tracker. At the end of each description, participants pressed a controller button to proceed to the next trial.

As in Experiment 1, the priming condition of a scene entity (agent or patient) and the location of the agent and patient (left or right) were counterbalanced across two stimulus lists. There were also two additional lists with reversed item order.

After the experiment, participants were asked what the experiment was about and whether they noticed any flash or disruption in the presentation of the scenes. No participant correctly guessed the purpose of the study or reported being aware of the visual cue.

Coding and analyses

The criteria for coding and analyses were identical to those used in Experiment 1. In total, less than 3% of the trials in English (7 out of 256 in English) and 7% of the trials in Korean (25 out of 384 in Korean) were removed. The results reported below do not depend on this removal.

Results

Production

Fig. 8 presents the mean proportion of active sentences produced by the English and Korean participants as a function of whether the location of the agent or the patient entity was cued. (Averages and standard errors were computed using participant means.) As we were most interested in the influence of the visual cue on production when it successfully captured speakers' eye gaze, we excluded trials on which the visual cue was not effective at shifting gaze for the analyses of production results. This resulted in the exclusion of 68 trials in English (26%) and 119 trials (30%) in Korean. These rates resemble those found by Gleitman et al. (2007), where participants fixated the cued entity about 70% of the time.

Consistent with Gleitman et al. (2007), the visual cueing manipulation had a significant influence on English speakers' choice of sentence structure: Priming patient entities significantly decreased the production of active sentences in English ($\beta = -1.0835$, $z = -2.437$, $p < .05$, $SE = 0.4437$). However, we did not find any effects of visual cueing in Korean: Korean speakers' choice of syntactic structure (active vs. passive) was not significantly influenced by the location of the visual cue ($p = .371$). As in Experiment 1, Korean speakers rarely produced object-initial
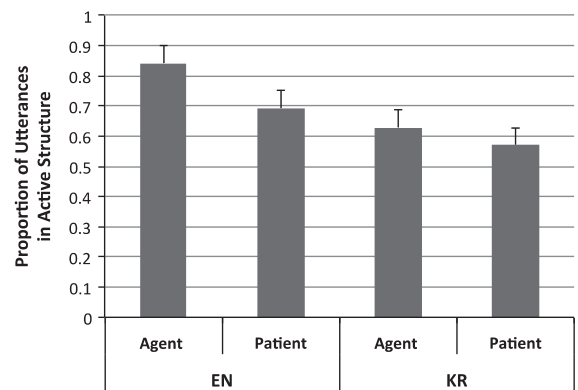

Fig. 8. Proportion of active sentences produced by English and Korean speakers in Experiment 2 when agent and patient entities were primed. Error bars indicate standard error.
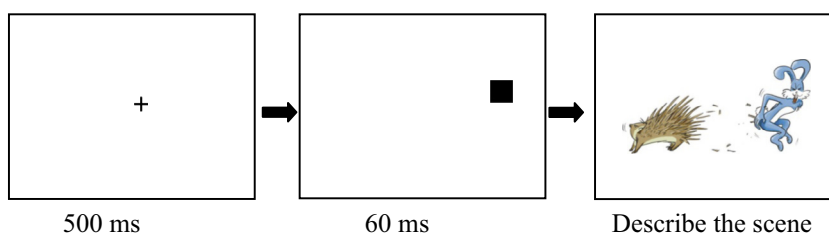

Fig. 7. Display sequence for Experiment 2. Participants saw the crosshair for 500 ms, the visual cue for 60 ms, and then viewed the scene and described the event.
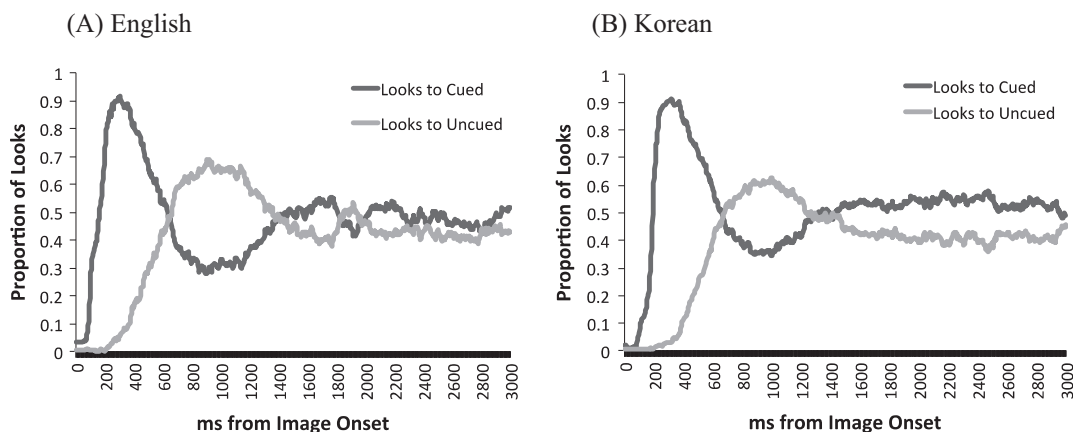
(A) English

(B) Korean

Fig. 9. Effects of visual cueing on eye movement patterns in English and Korean in Experiment 2.

sentences. They occurred in about 5% of the trials, 12 out of the 232 trials.

Cross-linguistic analyses of English and Korean revealed a main effect of prime condition ($\beta = -0.3106$, $z = -2.226$, $p < .05$, $SE = 0.1395$) and a main effect of language on structural choice ($\beta = -0.5602$, $z = -2.969$, $p < .005$, $SE = 0.1887$) (i.e. Korean speakers produced more passive sentences than English speakers). There was also a significant interaction between prime condition and language ($\beta = 0.2611$, $z = 1.887$, $p = .05$, $SE = 0.1384$).

Eye movements

To assess the effectiveness of visual cues, we performed analyses on English and Korean speakers' eye gaze data. Following the analyses reported in Gleitman et al. (2007), we performed one-sample, two-tailed *t*-tests on the proportion of first looks (aggregated by subjects and by items) to the cued entity. Eye movement analyses of all target trials show that both English and Korean speakers initially fixated the cued entity significantly more than would be expected by chance ($t_1(15) = 7.613$, $p < .001$, $t_2(15) = 7.4$ 508, $p < .001$ in English; $t_1(23) = 7.1362$, $p < .001$, $t_2(15) = 8.155$, $p < .001$ in Korean). Fig. 9 plots the mean proportion of looks to the cued and the uncued entities during the first three seconds after image onset. A significant divergence of looks to the cued vs. the uncued entities during the first 200 ms of image onset further shows that the cueing manipulation was effective in both English and Korean ($t_1(15) = 5.7882$, $p < .001$, $t_2(15) = 7.7327$, $p < .001$ in English; $t_1(23) = 3.9589$, $p < .001$, $t_2(15) = 6.06$, $p < .001$ in Korean).

In terms of the relationship between successive fixations and speech, we expect that, relative to speech onset, both English and Korean speakers will look earlier to the entity that they will mention first than to the entity that they will mention second. Fig. 10 plots the mean proportion of looks to the first and the second referents relative to utterance onset. As expected, English and Korean speakers fixated the entity that they would mention first before starting to speak and then fixated the entity they would mention second.

Fig. 11 shows that the relationship between successive fixations and word order also holds relative to the

appearance of the image on the screen (image onset). English and Korean speakers started to show a significant preference for the scene entity that they would begin their utterance with starting at 400 ms after image onset. The looks significantly diverged during 600–800 ms after the image appeared ($t_1(15) = 2.5204$, $p < .05$, $t_2(15) = 3.6295$, $p < .01$, in English; $t_1(23) = 3.0538$, $p < .01$, $t_2(15) = 2.9571$, $p < .01$ in Korean).[2]

Discussion

Experiment 2 extended the investigation of the role of lexical accessibility in production by looking at visual salience. If production is guided by lexical accessibility in English and Korean, the visual cueing manipulation should have a significant influence on speakers' choice of sentence structure or word order.

The results of the eye movement analyses showed that the visual cues were effective in directing both English and Korean speakers' initial gaze to the cued entity. Critically, however, when it comes to what speakers actually end up saying, the cueing manipulation had a significant influence *only on English speakers' production*: Cueing patient entities increased the use of passive sentences in English, but had no such effect in Korean. This provides further evidence that the role of lexical accessibility in determining structural choice is not universal but varies across languages. As in Experiment 1, Korean speakers produced more passives than English speakers, but hardly any object-initial sentences. Contrary to the account suggested by Myachykov et al. (2010, 2011) and Myachykov and Tomlin (2008), these findings suggest that (i) the lack of lexical accessibility effects in Korean cannot be attributed to the rarity of passives in Korean and (ii) lexical accessibility does not manifest (at least not in Korean) in terms of non-canonical constructions/word order choices.

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[2] We did not find significant divergence between looks to the first and the second referent during the first 200 ms of image display as reported by Gleitman et al. (2007). Given that the looks to N1 and N2 in active/passive sentences diverge even at 0 ms in Gleitman et al. (Figure 12-D in their paper), we suspect that this initial divergence might account for the different findings between ours and Gleitman et al.'s.
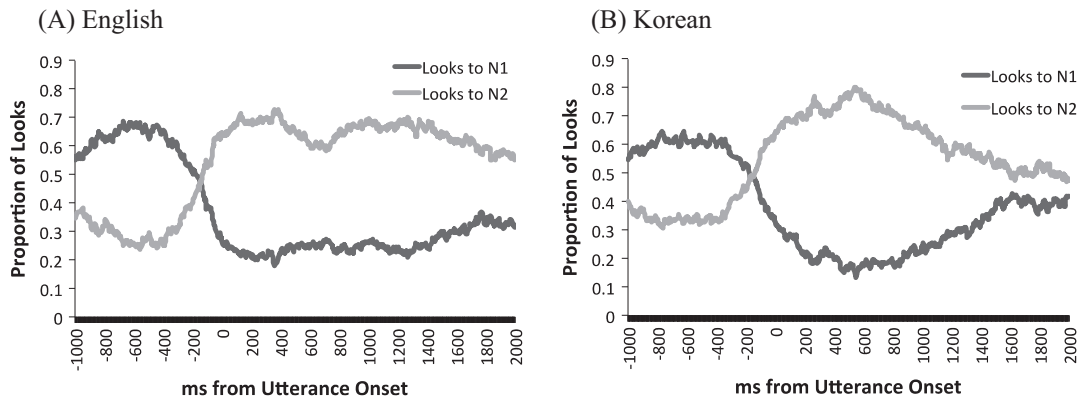
(A) English

(B) Korean

Fig. 10. Patterns of eye movement to the first and the second referents relative to utterance onset in English and Korean in Experiment 2.

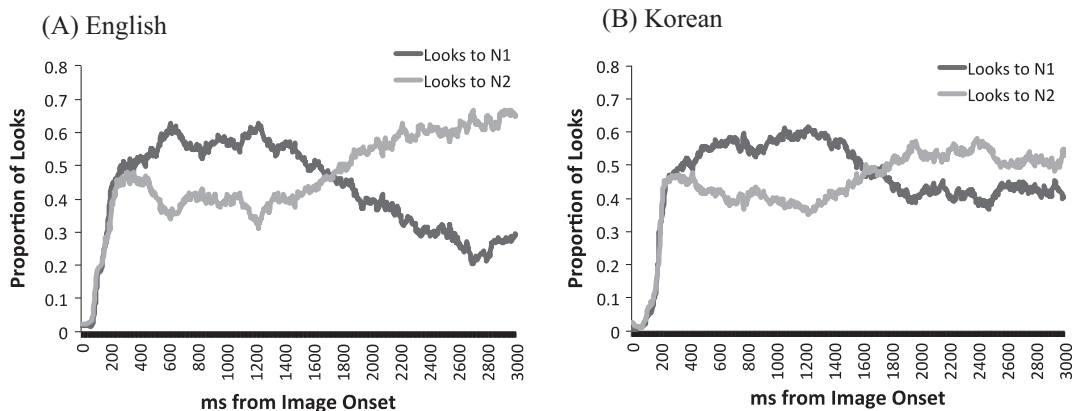(A) English

(B) Korean

Fig. 11. Patterns of eye movement to the first and the second referents relative to image onset in English and Korean in Experiment 2.

Analyses of eye movements in terms of word order showed that English and Korean speakers first fixated the scene entity that they would subsequently produce first, relative to image onset and utterance onset. Speakers also started to fixate the first-mentioned referent starting at 400 ms after image onset. The looks to the first- and the second-mentioned referent significantly started to diverge after 600 ms of image onset in both languages.

In sum, the finding that visual cues attracted both English and Korean speakers' attention to the cued entity before the onset of fixations to the first referent, but only influenced English speakers' production indicates that: (i) English speakers' choices regarding the starting point of their utterances are influenced by lexical accessibility, but (ii) Korean speakers' utterance starting points are *not* influenced by lexical accessibility. In the next section, we discuss how the different findings in English and Korean might be accommodated in accounts of grammatical encoding.

General discussion

In this paper, we investigated whether lexically incremental production is a universal sentence production mechanism, by exploring how lexical accessibility influences utterance formulation in English and Korean. Experiment 1 manipulated accessibility by presenting a *semantic prime* word before each picture, similar to Bock (1986). Prime words were semantically associated with one of the two entities (agent or patient) in the picture. Experiment 2 manipulated accessibility via *visual cues*, following the methodology of Gleitman et al. (2007).

In both Experiments 1 and 2, we found that manipulation of lexical accessibility had a significant influence on English speakers' choice of sentence structure, consistent with the findings of Bock (1986) and Gleitman et al. (2007): Priming the patient entity via semantic priming and visual cueing increased the production of passive sentences. However, we did not find such accessibility effects in Korean: Neither semantic priming nor visual cueing influenced Korean speakers' choice of sentence structure or word order.

Analyses of participants' eye-movements showed that English speakers fixated the entity made accessible via a semantic prime or a visual cue. This suggests that the more accessible entity was in the English speakers' focus of attention and was an important factor in guiding English speakers' decisions regarding which referent to mention first. Korean speakers, however, showed a very different

pattern. In the semantic priming study (Experiment 1), Korean speakers did not look more at the semantically primed entity (when compared to the unprimed entity). The lack of selective attention to the semantically primed entity suggests that Korean speakers' decisions about which referent to mention first were not sensitive to lexical accessibility. This difference between English and Korean suggests that language may well be a factor that modulates eye gaze during production (see also Hwang & Kaiser, 2014b).

Even when the manipulation of visual salience drew Korean speakers' focus of attention toward the cued entity (as shown by their fixation patterns in Experiment 2), their choice of which entity to mention first was not influenced by the visual cueing. Thus, both Experiment 1 and Experiment 2 suggest that lexical accessibility does not govern sentence formulation in Korean.

The findings in Korean are strikingly different from those in English. The fact that we replicated the accessibility effects in English observed by Bock (1986) and Gleitman et al. (2007) suggests that the lack of lexical accessibility effects in Korean is not likely due to experimental design or procedure (we used the same procedure and same items for English and Korean). In fact, English and Korean speakers' eye-movements show that although their sensitivity to lexical accessibility is different, the basic timing of eye-movements relative to image onset and speech onset is the same – i.e. people first look at the first-mentioned entity before they look at the second-mentioned entity. This confirms that in both languages eye-movements provide a window into speech planning processes, and indicates that the different consequences of lexical accessibility are indeed a real distinction between the utterance formulation process in English and in Korean.

Recall that Myachykov et al. (2010) and Myachykov and Tomlin (2008) attribute the absence of visual accessibility in Finnish and Russian to the passive not being an available alternative. They instead suggest that in these kinds of languages, lexical accessibility may be accommodated in terms of word order (e.g. OSV or OVS sentences). However, our results pose challenges for this view. We made sure in our design that all target pictures could be described with both passives and actives. Although Korean passives are less frequent and more constrained than English passives (Lee, 1969), we found that Korean speakers produced plenty of passive sentences – in fact, they produced more passives than English speakers. This result may be surprising in light of the marked nature of Korean passives, but makes sense if we consider that our target pictures were designed to be describable with both active passive sentences. Crucially, the result suggests that Korean speakers *did* have the patient-subject mapping available, but the mapping was simply not influenced by lexical accessibility. Thus, at least in the case of Korean, the lack of lexical accessibility effects cannot be attributed to the unavailability of the patient-subject mapping, contrary to what has been suggested by Myachykov et al. (2010, 2011) and Myachykov and Tomlin (2008) for typologically similar languages.

Furthermore, in our studies Korean speakers did not produce object-initial OSV sentences to accommodate accessible entities in the sentence-initial position. Given that object-initial sentences are commonly used to encode discourse status in flexible word-order languages (e.g. Choi, 1996 for Korean; Comrie, 1987, 1989; Yokoyama, 1986 for Russian; Kaiser & Trueswell, 2004 for Finnish), it seems that the increased production of object-initial sentences in Myachykov and Tomlin (2008) is likely to have been caused by discourse accessibility rather than visual accessibility. Thus, our findings indicate that a flexible word order language does not necessarily exploit word order variation to accommodate lexical accessibility in the absence of discourse context.

As a whole, our experiments provide novel evidence that even in a situation where both active and passive constructions are readily available, lexical accessibility (as manipulated via semantic priming or visual cueing) does *not* influence speakers' choice of syntactic structure in a flexible word order language. This contrasts starkly with our results for English, obtained using the same methods and same test items. In sum, our findings show that lexically incremental production is not a universal production mechanism, and that theories of language production need to be able to capture cross-linguistic variation in this domain.

Exploring possible sources of cross-linguistic differences

Why do English and Korean differ? In this section, we explore the question of *why* this might be the case. We suggest that contrasting effects of lexical accessibility in English and Korean can be explained when we consider (a) the idea that lexical accessibility (as manipulated via semantic priming or visual cueing) functions as a fall back mechanism in grammatical function assignment, and (b) the differing levels of flexibility that English and Korean offer in grammatical function assignment, which is closely linked to how they indicate grammatical functions – word order (English) and case-marking (Korean).

More specifically, in this section we provide support for the following ideas: In English, lexical accessibility might influence structural choice because it allows speakers to cope with a rather rigid relationship between word order and grammatical function, by allowing speakers to accommodate more accessible nouns earlier and to assign grammatical functions as early as possible (e.g. Ferreira, 1996). In contrast, in Korean where speakers have to choose between alternative grammatical function assignments due to flexibility in word order, lexical accessibility could rather hinder than facilitate grammatical function assignment (Hwang & Kaiser, 2014a). In essence, we suggest that the difference between English and Korean may be a natural consequence of the typological properties of these two languages.

To better understand these ideas, let's first consider the notion that lexical accessibility guides grammatical encoding as a 'last resort', an idea initially based on the findings of Kuchinsky and Bock (2010). Kuchinsky and Bock found that visual cueing had a significant impact on structural choice when a depicted event was hard to interpret. When English speakers had difficulty in selecting a suitable subject entity based on their construal of an event (e.g.

who did what to whom), they were more likely to start with the visually-cued entity. In contrast, for easy-to-interpret events, visual cueing had little effect on subject choice. This suggests that speakers tend to establish the subject first relying on their construal of an event (e.g. relational information, who did what to whom) and only turn to the more accessible entity when this is difficult to do[3] – that is, when the noun linked to the subject entity is not readily available or the event is hard to interpret (Bock & Ferreira, 2014, see also Konopka & Meyer, 2014; Van de Velde, Meyer, & Konopka, 2014 for more evidence). Crucially, in what follows, we suggest that the usefulness of lexical accessibility as a recourse against variability in lexical access or difficulty in event interpretability may depend on language-specific grammatical constraints, in particular how languages indicate grammatical functions.

In English, word order is relatively fixed and grammatical functions are defined in terms of word order. For example, when English speakers encounter a Noun–Verb–Noun sequence, the default processing strategy is to assume that the first noun is the subject and the second noun is the object (Bever, 1970; Ferreira, 2003). The rather rigid word order of English, however, can cause trouble for speakers as lexical items can vary in terms of how accessible they are at different points in time. For example, English speakers may initially bind a referent concept to the subject function based on their construal of an event (e.g. who did what to whom, what is it about). But if the lemma or lexeme of the concept linked to the subject function is not accessible, it could interfere with launching an utterance. By binding a more accessible word to the subject position, however, production can proceed more smoothly (see Bock & Ferreira, 2014 for further discussion). Consistent with this possibility, Ferreira (1996) found that English speakers produced utterances faster and with fewer errors when they could accommodate lexical variability by assigning accessible words to the earlier sentence position and accordingly the higher grammatical function. Thus, by providing the rigid word order system with recourse against variability in lexical accessibility or event interpretability, the *accommodation of lexical accessibility during grammatical function assignment can facilitate English production* (Ferreira & Slevc, 2007).

Unlike English, however, Korean indicates grammatical functions by case particles, largely independently of word order. Thus, active sentences can begin with either the subject or the object (SOV: *dog-NOM policeman-ACC bit* or OSV: *policeman-ACC dog-NOM bit*), and the same holds true of passives. If production proceeds in two stages, namely function assignment and constituent assembly (e.g. Bock & Levelt, 1994; Hartsuiker & Westenberg, 2000; Tanaka et al., 2011, and others, though see Pickering, Branigan, & McLean, 2002 for evidence for a single-stage account of the formulation of constituent structure), this means that when the subject noun is not accessible, Korean speakers

have at least two choices: (a) They can bind the more accessible word to the object function and assign it to the sentence-initial position or (b) they can assign the accessible word to the sentence-initial subject function. Thus, starting with the more accessible word still results in a situation where multiple grammatical function assignments (and multiple syntactic structures) are possible. If Korean speakers experience competition between two different grammatical function assignments, *the accommodation of lexical accessibility could hinder utterance formulation in Korean* – in contrast to the facilitatory effects on English. Indeed, Hwang and Kaiser (2014a) found that Korean speakers – in contrast to English speakers – initiated utterances more slowly when they could choose between alternative grammatical function assignments. If resorting to lexical accessibility causes difficulty in production in a flexible word order language as suggested by Hwang and Kaiser (2014a) (see also Myachykov, Scheepers, Garrod, Thompson, & Fedorova, 2013 for similar findings in Russian), then speakers of a flexible word order language might not exploit lexical accessibility during syntactic production.[4]

Note that we do not make specific claims about the degree to which case is morphologically realized in a particular sentence. For example, although Korean speakers may omit case markers in colloquial speech (e.g. Kim, 2008; Sohn, 1999), whether or not case is phonologically realized does not change the degree of flexibility in grammatical function assignment: Korean speakers can still assign the initial noun to the subject or the object role even if case-markers are omitted in colloquial speech (e.g. Mary ne mannassni? 'Mary$_i$ did you meet i?'). Similarly, overt case marking in English does not affect the degree of flexibility in grammatical function assignment for a particular sentence (compare 'Peter saw him', where 'him' is marked for case, and 'Peter saw John,' where 'John' is not marked for case). Thus, in our view, the degree of flexibility in grammatical function assignment in the language as a whole is what matters (rather than whether case is morphologically overt in a particular sentence, see Hwang & Kaiser, 2014a for more detailed discussion).

In sum, lexical accessibility might influence structural choice in English – and presumably other typologically similar languages – because it allows speakers to cope with a rather rigid relationship between word order and grammatical function by accommodating more accessible nouns earlier and assigning grammatical functions as early as possible. But in Korean – and presumably other typologically similar languages – where speakers have to choose between alternative grammatical function assignments, lexical accessibility could hinder, rather than facilitate, grammatical function assignment. The difference between

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[3] The minor influence of lexical accessibility on structural choice is also demonstrated in Slevc (2011). When under a working memory load, English speakers did not choose a structure allowing the earlier production of more accessible words, but predominantly produced a canonical sentence structure.

[4] If the cost of alternative grammatical assignments outweighs lexical accessibility effects in Korean, we suspect that lexical accessibility might manifest itself when the structural alternation only involves choice of word order without consequences on grammatical function assignment, as in ditransitive constructions (e.g. John-NOM apple-ACC Mary-DAT gave vs. John-NOM Mary-DAT apple-ACC gave). As many questions remain regarding when speakers prioritize accessibility of referents over their construal of an event in their decision of sentence structure (e.g. Bock & Ferreira, 2014), this possibility merits further research.

English and Korean then may in fact be a natural consequence of the typological properties of these two languages. Given that different languages map concepts in different ways, the modulation of lexical accessibility seems to be necessary (see also Hwang & Kaiser, 2014b for a different role of verb in sentence production in English and Korean).

Conclusion

We manipulated lexical accessibility both by means of semantic priming and visual cuing. The results of the present research on English and Korean suggest that lexically incremental production is not a universal production mechanism. Our analyses of participants' descriptions of pictured events and their eye-movement patterns showed that (i) in English, lexical accessibility can exert a significant influence on structural choice, but (ii) in Korean, lexical accessibility does not affect structural choice. Unlike English speakers, Korean speakers did not fixate the semantically primed entity. Even when the visual cue drew Korean speakers' focus of attention toward the visually-cued scene entity, Korean speakers' choice of the first referent was not influenced by the visual accessibility manipulation. These findings clearly demonstrate that the role of lexical accessibility in language production is subject to language-specific constraints. By providing insights into how the typological properties of a language modulate effects of accessibility, the present study contributes to our understanding of the broad question of how the specific grammatical properties of different languages influence the implementation of the architecture of real-time language production.

Acknowledgment

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