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Structural priming and the acquisition of novel form-meaning mappings

1 Introduction

Motivated by Pickering and Ferreira's (2008) suggestion that structural priming not only occurs with structures that speakers already know, but also plays a role in the acquisition of new knowledge, this study explores whether structural priming facilitates the acquisition of a new construction. Structural priming is a cognitive repetition phenomenon that refers to a speaker's tendency to produce a sentence with previously heard or produced syntactic structure rather than to use an alternative structure with similar message content (Bock 1986; Ferreira and Bock 2006). Structural priming experiments typically elicit a speaker's production of two alternative forms, such as double-object and prepositional dative constructions. Structural priming is evidenced when a speaker produces more double-object datives after double-object primes than prepositional primes, and produces more prepositional datives after prepositional primes than double-object primes. Structural priming has been widely attested in first language (L1) as well as bilingual and L2 speech production for a variety of structures in numerous languages.

An assumption underlying structural priming research is that mental representations of the target structures must exist in order for priming to occur (Conwell and Demuth 2007; Goldwater, Tomlinson, Echols and Love 2011; Rowland, Chang, Ambridge, Pine and Lieven 2012; Shimpi, Gámez, Huttenlocher and Vasilyeva 2007). Studies with young L1 children have provided evidence that structural priming depends on the strength of a speaker's linguistic representations. In other words, if speakers have not formed abstract linguistic representations of the target structure, their production of those structures is contingent on their ability to reuse lexical items (such as repeated pronouns or nouns) or semantic features of the prime sentences (Goldwater et al. 2011; Savage, Lieven, Theakston and Tomasello 2003; van Beijsterveldt and van Hell 2009). Because current L2 structural priming research has targeted structures that speakers either already knew or were familiar with (e.g., McDonough 2006; Shin and Christiansen 2012), it is not clear whether the same constraints apply in L2 speech production. However, studies using the elicited imitation task have found that L2 speakers cannot reconstruct sentences containing grammatical forms that they have not acquired (for reviews, see Erlam 2006; Tomita, Suzuki and Jessop 2009; Vinther

2002). Taken together, the child L1 structural priming research and the L2 elicited imitation research suggests that it may not be possible to prime L2 speakers to produce structures for which they do not have mental representations.

If true, this suggests that structural priming may not play a crucial role in the acquisition of new knowledge, contrary to Pickering and Ferreira's (2008) suggestion that it may be a vehicle for the acquisition of new knowledge. According to their framework, to acquire new structural knowledge, novice language users must learn to map specific meaning relationships (such as an agent doing something to a patient) onto functional elements (such as subject and object nouns) and constituent sequences (the order of noun and verb phrases). These mappings are acquired through experience with language during the comprehension and production of utterances that express these relationships. With experience, the form-meaning mappings are strengthened, which allows for similar meaning relationships to be mapped onto the same functional elements and constituent sequences in subsequent production. Structural priming is believed to serve this process because hearing prime sentences strengthens the form-meaning mappings, while producing new utterances reveals the strengthened knowledge.

In this model, structural priming could facilitate the production of a novel construction if a novice language user already had the ability to accurately comprehend the relationships among elements in the prime sentences and correctly map the meaning onto the relevant functional elements and constituent order. For example, child L1 studies have tested young children with structures that had yet to emerge in their own production, such as passives (Brooks and Tomasello 1999), and found that they can produce them during structural priming tasks. Put simply, if speakers comprehend the meaning of target structures but have not begun to produce them or produce them only rarely, then structural priming may reinforce form-meaning mappings, with the strengthened representations then facilitating production. Previous L2 studies have similarly shown that structures that are rarely produced by L2 speakers, such as *wh*-questions with obligatory auxiliary verbs, passives, and relative clauses, can be elicited during structural priming tasks (Kim and McDonough 2008; McDonough and De Vleeschauwer 2012; McDonough and Kim 2009; McDonough and Mackey 2008; McDonough, Neumann and Trofimovich in press). An interesting question, however, is whether structural priming can facilitate the initial stage in the acquisition process, specifically the initial detection of the form-meaning mappings in a novel construction. If a novice language user is unable to interpret the form-meaning mappings being modeled in prime sentences, then the relevant relationships are neither strengthened nor available for production. It remains unknown whether speakers who have neither correctly interpreted nor spontaneously produced a target structure can acquire it by participating in a structural priming task.

1.1 Challenges in detecting novel constructions

One obvious question is why L2 speakers might experience difficulty detecting novel constructions. Prior construction learning studies (Boyd, Gottschalk and Goldberg 2009; Casenhiser and Goldberg 2005; Goldberg and Casenhiser 2008; Goldberg, Casenhiser and Sethuraman 2004; Goldberg, Casenhiser and White 2007) have shown that English L1 speakers can comprehend and produce the novel construction of appearance (N_1N_2V), with the corresponding meaning of N_1 "appears in/on" N_2 (e.g., *the spot the king moopoed*) after relatively brief exposure. In contrast, construction learning studies with L2 English speakers reported greater difficulty in detecting a variety of constructions, including the appearance construction and the Samoan ergative construction (Nakamura 2012), English dative constructions (McDonough and Nekrasova-Becker 2014; Year and Gordon 2009), and Esperanto transitives (Fulga and McDonough ~~in press~~; McDonough~~,~~ ~~Trofimovich, &~~ Fulga ~~in press~~; McDonough and Trofimovich 2013). For example, only about one-fifth of all Thai participants tested by McDonough and Trofimovich (2013) were able to detect the Esperanto transitive construction.

Two factors that may negatively affect L2 speakers' ability to detect novel form-meaning mappings are the nature of the construction and its similarity to (or divergence from) similar constructions in their previously known languages. For example, the English L1 speakers' relative ease in acquiring the appearance construction in Goldberg's studies may be due to the use of two English nouns and an English-sounding nonce verb, which reduced the burden of processing new vocabulary. Furthermore, the argument roles could be mapped through reliance on word order only (N_1N_2V), which is the most important cue in English for mapping argument roles. Although the nonce verbs had inflectional morphology, the affixes were not necessary to assign argument roles, which is also true for English verbs and nouns. And in terms of novelty, both the structure of the construction (N_1N_2V) and its meaning (N_1 "appears in/on" N_2) were completely novel. In sum, when the learning contexts involves a construction that can be decoded through reliance on word order and novice users already know a language in which word order is a key cue, detection of both form and meaning may be fairly rapid. However, outcomes vary more dramatically when the learning conditions are not as favorable, which is the case for the Esperanto transitive construction.

For L2 speakers, the meaning expressed through the transitive construction may not be completely novel, as transitivity exists in their previously-known languages. One novel aspect of an L2 transitive construction concerns its form, or how the argument roles are mapped onto constituents in the new language. This scenario likely represents one of the major learning challenges for most L2 learners, which is to acquire novel forms to describe largely-familiar meanings.

For the Esperanto transitive, word order is variable, so argument roles are more reliably assigned through morphology. Whereas subjects appear in the bare form (*kato* [cat, subject]), objects are indicated by the *-n* affix (*katon* [cat, object]). For example, the transitive sentence "bull hits cat" can be expressed as either *tauro batas katon* (SVO) or *katon batas tauro* (OVS) because the affix marks the object. Speakers whose previously known languages rely on word order to assign argument roles are likely to interpret the first noun in the OVS transitive (*katon batas tauro*) as the agent, despite the presence of the accusative case marking (*-n*) (e.g. Kempe and MacWhinney 1998; VanPatten 1996, 2004). Furthermore, even when argument roles are assigned through morphology in a speaker's L1 (Hopp 2010; Jiang 2004, 2007; Papadopoulou et al. 2011), they may initially rely on word order as a single "what works best" strategy (Ferreira 2003) when processing L2 sentences. In sum, L2 speakers' ability to detect form-meaning mappings may be weakened when they must acquire morphology as a key cue for assigning argument roles, particularly if their previously known languages rely on another robust cue, such as word order, for decoding transitives.

1.2 The present study

In light of the difficulty that L2 speakers' experience when detecting novel form-meaning mappings and questions about the potential role of structural priming in facilitating their acquisition, this study focuses on 19 English L2 speakers from a larger data set (McDonough, Trofimovich & Fulga in press). The initial study consisted of two experiments to test whether Thai (*n* = 69) and Farsi (*n* = 70) L1 speakers could detect and produce the Esperanto transitive construction. Thai relies on word order (SVO) to assign argument roles in transitives. In contrast, Farsi transitives (SOV) have restrictive case marking based on definiteness and animacy. In other words, whereas Thai never uses morphological affixes to assign argument roles and relies on SVO word order (like English) for interpretation of transitives, Farsi transitives are largely SOV and have morphological affixes on nouns restrictively, depending on specific features of the nouns. The results of the larger study indicated that the participants had difficulty detecting the novel construction, with only 23 % (16/69) of the Thai speakers and 50 % (35/70) of the Farsi speakers able to detect the novel form-meaning mappings. The Farsi speakers' familiarity with case marking may have facilitated their higher detection rates of the Esperanto transitive than the Thai speakers.

In this study, we examine more closely the performance of 19 participants (Thai = 12, Farsi = 7) who detected neither the structural (variable word order) nor morphological (*-n* affix) features of the Esperanto transitive construction prior to

carrying out a structural priming activity. By selecting this subset of participants, we could test whether structural priming facilitated the acquisition of a new construction. These participants had not learned the key structural features of Esperanto transitives (i.e., variable word order and accusative case marking) despite being exposed to structured input designed to facilitate pattern detection. Therefore, we could determine the additional input provided through the Esperanto prime sentences would be sufficient to help them overcome reliance on word order, either due to L1 influence (e.g., neither Farsi nor Thai has OVS word order) or a general processing strategy (e.g., the tendency to interpret a first noun as the subject), and to detect and use morphology as the key functional element for assigning argument roles. If structural priming was useful for helping the participants detect the key features of the Esperanto transitive construction, then they may be able to access that new knowledge to produce Esperanto transitives in response to the prime sentences. However, it is also possible that the additional input provided by the prime sentences would simply be misunderstood, as the participants had incorrectly interpreted all of the previous input. If misinterpretation of the input continued during the priming activities, then it is unlikely that being asked to produce sentences immediately after the primes would facilitate learning. Thus, the guiding research question was whether structural priming facilitated the acquisition of the novel Esperanto transitive construction.

2 Method

2.1 Participants

Nineteen participants were selected from the original sample of 69 native Thai and 70 native Farsi learners of English. The Thai participants (female = 5, male = 7), who were on average 18.6 years old (SD = .52), were first-year students in the Faculty of Medicine at a university in Northern Thailand. They had studied English in Thailand for a mean of 13.6 years (SD = 1.86) and reported little exposure to English outside Thailand and no experience with additional languages besides Thai and English. The Farsi participants (female = 1, male = 6), who were on average 27.7 years old (SD = 1.3), came from undergraduate (1) or graduate (6) programs at English-speaking universities in the Montreal area. They had reported a mean of 6.4 years of prior English study (SD = 4.1) and had resided in Canada for an average of 2 years (SD = 2.8). As mentioned previously, these 19 participants were selected for more in-depth analysis because they performed at 0 % accuracy in terms of detecting the key properties of the Esperanto transitive,

(e.g., variable word order and accusative case marking) prior to carrying out a structural priming activity.

2.2 Materials

2.2.1 Input activities

The experimental sequence consisted of input activities (construction learning and test tasks) followed by production activities (baseline, structural priming, and post-exposure tasks). For construction learning, the participants listened to 30 simple Esperanto transitive sentences (15 SVO, 15 OVS) and chose one of two images (printed side-by-side on paper) which correctly depicted the meaning of each sentence. The sentences featured six nouns (*tauro* [bull], *makropo* [kangaroo], *kato* [cat], *kapro* [goat], *cevalo* [horse], and *pilko* [tennis ball]), each used four times as an object, and two verbs (*batar* [hit] and *pelar* [chase]), conjugated in the present tense (*batas*, *pelas*). All words had been introduced in an immediately preceding vocabulary learning task, in which the participants performed at or near 100 % accuracy. The sentences, which were spoken twice and presented at the rate of 7 s per sentence, were organized in five sets of six sentences (3 SVO, 3 OVS). The sets were designed to direct participants' attention to different components of the two picture alternatives: completely different nouns (Set 1), different verbs (Set 2), different subjects (Set 3), different objects (Set 4), and fully reversible actions (Set 5). For example, in Set 1, the sentence *cevalo pelas pilkon* (SVO [horse chases tennis ball]) occurred with a picture of a goat chasing a bull and a horse chasing a ball. In contrast, Set 5 featured a spoken sentence paired with images of reversible events, such that the sentence *cevalon batas makropo* (OVS [kangaroo hits horse]) was paired with a picture of a kangaroo hitting a horse and a horse hitting a kangaroo. Thus, to respond accurately, participants could use lexical knowledge in Sets 1–4 but had to rely on the knowledge of Esperanto word order and morphology in Set 5.

Immediately after the construction learning activity, the participants performed a test to determine whether they could generalize any knowledge of the Esperanto transitive construction to a new set of nouns. The test featured six new nouns (*zebro* [zebra], *automobilo* [car], *leporo* [rabbit], *tigro* [tiger], *pordego* [gate], and *bubalo* [buffalo]), which had been introduced immediately before the test and responded to at or near 100 % accuracy. The test consisted of 30 novel sentences (15 SVO, 15 OVS) featuring the six new nouns and the same two verbs (*batas*, *pelas*), with each noun occurring five times as a subject and five times as an object and the verbs appearing 15 times each. The test sentences, which were

spoken at the rate of 7 s per sentence, were paired with two images depicting fully reversible events, as in Set 5 of the construction learning task. The participants' task was to choose the image which correctly described the action in each sentence.

2.2.2 Production activities

The production activities consisted of the structural priming task preceded by a baseline phase and followed by a post-exposure phase. The goal of the baseline and post-exposure phases was to determine the rate at which the participants produced Esperanto transitives before and after the priming task, respectively. The baseline and post-exposure activities included 10 images (printed in a numbered column on paper) that depicted the nouns and verbs from the input activities in combinations that had not been previously seen or heard (i.e., a noun from the construction learning phase was paired with a noun from the test phase). The participants' task was to describe the depicted action in Esperanto by speaking into a personal digital recorder.

The priming task consisted of a sequence of 40 items, with alternating primes and prompts constructed from the nouns and verbs from the input activities. There were 20 prime sentences (10 SVO, 10 OVS), which were all heard previously in the input activities, and 20 prompt images, which were never described aurally/orally before the priming task. The prompt images either had been used as distracters during the construction learning and test tasks, or were created ~~new~~ using nouns from within the construction learning set or from within the test set. None of the prime-prompt sentences shared any lexical items to avoid lexical influences on priming. For example, a prime sentence with nouns from the construction learning phase was immediately followed by a prompt image with nouns from the test phase and a different verb. The participants received a handout with a 40-item grid, with alternating prime and prompt images. To ensure that the participants understood prime sentences as intended, they performed a cover task requiring them to decide if the prime sentence correctly matched the image. Thus, for each prime-prompt sequence, the participants first heard a prime sentence (spoken once), then indicated whether the sentence matched the prime image by circling "yes" or "no" next to it, and finally produced a sentence describing the prompt image. The prime sentences were heard at the rate of 9 s per sentence, and the participants had 9 s to describe each prompt image.

2.3 Procedure

The input and production activities were administered in a fixed order during several 60 min group sessions held in a university classroom. Input activities (construction learning followed by testing) were performed first (about 35 min), with all materials embedded in a PowerPoint slide sequence. This included brief vocabulary pre-teaching before the construction learning and testing tasks, where the researcher first introduced each new word by providing its English translation and the participants performed a vocabulary activity by matching spoken words to appropriate images. Production activities were administered next, with baseline, priming, and post-exposure phases completed in that order (about 20 min) and all audio files included in PowerPoint slides. Individual digital audio recorders were used to record each participant's production in the baseline, priming, and post-exposure phases.

3 Results

In order to address the research question, which asked whether structural priming facilitated acquisition of the novel Esperanto construction, it was important to establish that the participants had not learned the construction during the input tasks or the baseline production activity. Therefore, we first describe the participants' performance during the input activities (construction learning and test items), and report the sentences they produced during the baseline production phase. Next, we examine the participants' comprehension of prime sentences and production of Esperanto transitives during the priming activity to answer the research question. Finally, we explore whether any Esperanto transitives occurred in the post-exposure phase as a way to determine if the participants were able to produce the construction in the absence of prime sentences.

3.1 Esperanto transitive input activities

The participants listened to 30 (15 SVO, 15 OVS) sentences organized into five sets of six items, with each item set highlighting different words in the sentences. Because there were no differences in the performance of the Farsi and Thai participants, the scores for both groups combined in Table 1. They were able to correctly interpret both the SVO and OVS sentences for the first four set of items (mean scores ranging from 2.5 to 2.9), when correct identification could be derived from

lexical meaning only. However, in the last set, which consisted of fully reversible actions, the participants correctly interpreted SVO items only ($M = 2.9$, $SD = .2$). For the OVS items, where correct identification required knowledge of Esperanto's variable word order and *-n* affix, all of the participants answered all three items incorrectly.

Table 1: Performance on Construction Learning Items by Set and Type

	SVO			OVS		
	M	**SD**	**CI**	**M**	**SD**	**CI**
All nouns	2.9	.3	2.7, 3.0	2.5	.9	2.1, 2.8
Verb	2.5	.9	2.1, 2.8	2.5	.8	2.1, 2.8
Subject	2.5	.8	2.2, 2.8	2.8	.5	2.5, 3.0
Object	2.9	.3	2.7, 3.0	2.6	.8	2.2, 2.9
Reversible	2.9	.2	2.8, 3.0	0	–	–

Immediately following the construction learning activities, the participants were further tested on their interpretation of Esperanto transitives. The test contained 30 fully-reversible items that were created using the same two verbs and six new nouns. All 19 participants scored at 100 % accuracy for the SVO items (15/15), and completely failed to correctly identify any of the OVS items (0/15). Because there was no variation in the participants' scores for the SVO and OVS test items, no descriptive statistics or confidence intervals were calculated. To summarize, by the conclusion of the input phase of the experiment, none of the participants showed any evidence that they had detected the key features of the Esperanto transitive. Instead, their answers indicated that they relied on a word order strategy in which they interpreted the first noun as the agent, regardless of its morphological features.

3.2 Baseline production

Prior to carrying out the priming activity, the participants were asked to describe 10 previously unseen pictures whose corresponding sentences had not been heard during either input activity. This production task was used to establish the participants' existing production abilities prior to undertaking the priming activity. Of the 190 sentences produced by the participants (19 participants × 10 sentences), none of them contained an Esperanto transitive in either word order. Slightly more than half of the sentences (56 %, 106/190) were unanalyzable because they consisted of incomplete sentences or had incorrect lexical items.

Forty-four percent (83/190) of sentences occurred with bare (uninflected) nouns in both the subject and object slots, while one sentence had the -*n* affix on both nouns. Of the sentences with uninflected nouns or with two inflected nouns, all of them had the agent shown in the pictures in the first noun position. Put differently, when the participants produced a complete sentence, they always used SVO word order with the agent in the first noun position, but never produced accusative morphology on the object. Thus, the baseline production data provides further evidence that the participants had not detected the word order or morphological properties of the Esperanto transitive construction.

3.3 Priming activity

The purpose of this case study was to determine whether structural priming facilitated the acquisition of the Esperanto transitive construction. It is possible that structural priming drives the acquisition of new knowledge through the input provided through prime sentences or the repeated opportunities to produce novel constructions. Having shown that the participants had no knowledge of its key features prior to undertaking the priming task, our main question was whether structural priming helped them acquire the construction. To examine whether the priming task facilitated participants' interpretation of the Esperanto transitive sentences, we first analyzed the data from the cover task. As part of this task, participants were asked to indicate whether the picture shown on their handout illustrated the meaning of the prime sentences. In fact, all of the pictures corresponded to the meaning of the prime sentences. The goal was to determine whether the participants understood the prime sentences or whether they misinterpreted their meaning. For example, if participants heard an OVS prime sentence, but indicated that the picture did not match the sentence they heard, then they incorrectly interpreted the first noun of the sentence as the subject instead of the object. As shown in Table 2, the participants were successful at correctly interpreting SVO prime sentences ($M = 9.2$). However, after hearing OVS primes, the participants consistently answered incorrectly that the pictures did not correspond to the meaning of the sentences ($M = 9.1$). Put simply, the participants continued to misinterpret OVS transitives by interpreting the first noun as the subject rather than the object.

Table 2: Interpretation of Prime Sentences by Type

	Correct			Incorrect		
	M	**SD**	**CI**	**M**	**SD**	**CI**
SVO (n = 10)	9.2	.8	8.8, 9.5	.8	.6	.5, 1.2
OVS (n = 10)	.9	.8	.6, 1.3	9.1	.8	8.7, 9.5

To examine individual response patterns further, we divided the participants into two groups based on whether they had correctly interpreted an OVS prime sentence. Our assumption was that detecting the -*n* affix in OVS sentences would provide participants with the kind of evidence required for them to focus their attention on morphology as a cue to transitivity in Esperanto. Seven participants (four Thai and three Farsi speakers) incorrectly interpreted all 10 OVS items, indicating exclusive interpretation of the first noun in Esperanto transitives as the subject. In contrast, 12 participants (eight Thai and four Farsi speakers) correctly interpreted at least one OVS prime sentence (*M* = 1.42, *SD* = .52). We then considered whether structural priming differentially facilitated their production of Esperanto transitives. As shown in Table 3 however, there was little difference in the participants' production of Esperanto transitive constructions. Neither the participants who had correctly interpreted an OVS prime sentence nor those who had misinterpreted all of the OVS prime sentences produced an OVS transitive during the priming activity. Furthermore, their production of SVO sentences was nearly identical (*M* = .8 and .7, respectively). Almost all of the picture descriptions produced by the participants were unanalyzable, contained uninflected nouns, or had morphology on both nouns, regardless of whether they had correctly interpreted a prime sentence. In light of the fact that the participants produced zero OVS transitives and very few SVO transitives, it was not necessary to use inferential statistics to determine whether priming had occurred.

Table 3: Picture Descriptions during Priming Activity by Prime Comprehension Group

	Misinterpreted all OVS primes (n = 7)				Correctly interpreted an OVS prime (n = 12)			
	Sum (%)	**M**	**SD**	**CI**	**Sum (%)**	**M**	**SD**	**CI**
Unanalyzable	46 (33)	6.6	5.5	2.5, 11	117 (49)	9.8	3.9	7.7, 11.8
Uninflected nouns or both nouns inflected	89 (63)	12.7	5.2	8.9, 16.7	113 (47)	9.4	3.7	7.4, 11.4
SVO	5 (4)	.7	1.3	.3, 1.8	10 (4)	.8	.9	.3, 1.4

To summarize, the input provided during the structural priming activity facilitated little detection of the Esperanto transitive construction, as few participants could correctly interpret OVS prime sentences. Furthermore, the production opportunities afforded by structural priming also failed to elicit many Esperanto transitives. It appears that the comprehension and production components of the priming activity acted independently, in that the participants' mean SVO sentence production was nearly identical regardless of whether participants correctly interpreted prime sentences. When considered at the individual level, 2/7 participants who misinterpreted all of the OVS prime sentences produced an SVO transitive during the priming activity, while 6/12 of the participants who correctly interpreted an OVS prime sentence produced an SVO transitive. A Fischer's Exact test indicated that there was no significant relationship between the accurate interpretation of OVS prime sentences and the production of SVO transitives during the priming activity [$\chi 2$ (1, 19) = .83, p = .34]. In other words, either the comprehension or the production component of structural priming activities may be sufficient to drive production of novel constructions, albeit at very low rates.

3.4 Post-priming production

For the final analysis, we considered whether experience with Esperanto transitives during the priming activity carried over to the participants' picture descriptions during the post-priming activity. Similar to the baseline production task, they described pictures that were previously unseen and whose sentences had been previously unheard. To capture their different experiences during the priming activity, we classified participants into four groups based on whether they had interpreted OVS items correctly or produced any SVO sentences during the priming activity. Since none of the participants produced an OVS transitive in the post-priming phase, we focus on their production of SVO transitives only. As shown in Table 4, the five participants with no correct OVS interpretations or SVO picture descriptions did not produce any SVO sentences during the post-priming activity. Similarly, the six participants who correctly interpreted an OVS prime sentence but did not produce any SVO sentences also failed to produce any SVO sentences during the post-priming activities. However, the participants who produced SVO sentences during the priming activity (n = 2) or both correctly interpreted OVS and produced SVO sentences (n = 6) did produce SVO post-priming sentences, at a mean rate of 2.5 and 1.2 sentences, respectively. Due to the small expected values in every cell, it was not possible to calculate a *chi*-square test of the relationship between priming activity performance and post-priming production.

Table 4: Post-priming Production of SVO by Priming Activity Performance

n	Interpreted OVS prime correctly	Produced SVO transitive	Post-priming production of SVO transitives			
			Sum (%)	M	SD	CI
5	No	No	0/50	–	–	–
6	Yes	No	0/60	–	–	–
2	No	Yes	5/20 (25)	2.5	2.1	1.8, 3.3
6	Yes	Yes	7/60 (12)	1.2	1.2	.3, 2.2

In summary, the overall findings indicate that structural priming was not a particularly effective mechanism for promoting the acquisition of the Esperanto transitive construction. The participants had no knowledge of the key features of the Esperanto transitive construction prior to undertaking the priming activity, and few of them were able to correctly interpret OVS prime sentences or produce SVO Esperanto transitives. Participants who produced Esperanto transitives during the priming activity were only able to generate SVO sentences. However, most of the participants (6/8) who generated an SVO sentence during the priming activity also produced an SVO sentence in the post-priming activity, which provides some evidence of the impact of priming on subsequent production.

4 Discussion

The goal of this study was to examine whether structural priming facilitated acquisition of the novel Esperanto transitive construction, on the assumption that the input or output components of structural priming might be sufficient to help learners detect and subsequently use a novel cue to assigning argument roles (Pickering and Ferreira 2008). Based on the analysis of the response patterns for 19 participants who did not detect either the word order or morphological features of the Esperanto transitive construction prior to carrying out a structural priming activity, we found little evidence that structural priming alone drove the learning of a new construction. The ostensibly harder OVS transitive structure, which combines an unfamiliar word order with a novel morphological marking, was detected at very low rates (approximately one sentence in 10) by 12 of the 19 participants, and was never produced. The SVO transitive structure, based on a familiar word order and a novel morphological marking, accounted for only 4 % of the sentences produced in the structural priming activity and

6 % of the sentences in the post-exposure production phase. This learning challenge was similar across the two L1 groups (Thai, Farsi), despite the fact that Farsi, unlike Thai, marks transitivity morphologically based on definiteness and animacy features and that all participants had experience with morphological marking in English, their L2. In essence, the experience with structural priming in the current study was insufficient to enable the participants to replace one cue (word order) with another (morphology) as the key functional element for assigning argument roles in transitives (Ferreira 2003; MacWhinney 2012; Van Patten 1996, 2004).

As was discussed earlier, one learning challenge for L2 learners, compared to child L1 speakers, is to acquire the ability to express potentially familiar meanings using new forms. The findings of previous L2 research (Hopp 2010; Jiang 2004, 2007; Papadopoulou et al. 2011), including research on novel construction learning (Fulga and McDonough in press; McDonough, Trofimovich, & Fulga in press; McDonough and Trofimovich 2013), suggest that it might be difficult for L2 learners to detect and use a novel morphological cue for sentence interpretation. The current set of findings further qualifies this challenge by suggesting that structural priming, in the absence of any other input, feedback, or output learning opportunities, provides little evidence to help learners abandon a familiar cue in favor of a new one. Put differently, structural priming, with its focus on positive evidence (i.e. models of target language), does not seem to trigger the kind of learning that would enable L2 speakers to depart from their predominant language strategies. This finding is compatible with linguistic arguments about the insufficiency of positive evidence in L2 learning (e.g. White 1991) and with cognitive phenomena of overshadowing and blocking, proposed within emergentist, usage-based approaches to language learning, which inhibit L2 speakers' ability to adopt novel linguistic cues (Ellis, Hafeez, Martin, Chen, Boland and Sagarra 2012; MacWhinney 2012).

Based on the results of this case study and the companion large-scale project (McDonough, Trofimovich, & Fulga in press), it appears that structural priming activities might be more useful for the extension of existing knowledge of a target structure, rather than for the acquisition of new construction. Priming may be beneficial only for L2 speakers who have successfully detected the structure, which highlights the importance of input tasks in early stages of novel L2 construction learning. However, given relatively low uptake of novel structures by learners in input tasks, with only 23 % of the Thai speakers and 50 % of the Farsi speakers in the larger study successfully detecting the novel structure, input tasks might need to be enhanced by explicit instructions, feedback, textual highlighting, or auditory emphasis, in order to maximize learners' chances of detecting the target structure through input (see McDonough and Trofimovich 2013), or

through the use of instructional techniques associated with processing instruction (VanPatten, 1996, 2004). And with respect to structural priming, L2 researchers might need to explore other design and methodological tools to make it more useful during an initial stage of acquisition when learners have not yet formed mental representations of the target construction. Such tools might include increasing lexical and semantic overlap between primes and prompts to highlight the target structure (Goldwater et al. 2011; Kim and McDonough 2008), using repetition to make prime sentences more salient (Shimpi et al. 2007), manipulating lexical properties, such as providing learners with low-type frequency input distributions or prompts (McDonough and Nekrasova-Becker 2014; McDonough and DeVleeschauwer 2012; Year and Gordon 2009), and overall orienting learners towards language form rather than meaning as part of priming tasks (Bock, Loebell and Morey 1992; Marsden, Altmann and St Claire 2013).

The current set of findings also speaks to the relative importance of the comprehension and production components of structural priming. In this dataset, only the participants who produced SVO transitive structures in Esperanto during the priming activities ($n = 12$), regardless of how accurately they interpreted novel morphology in prime sentences, were able to subsequently produce SVO structures with the -*n* inflection in the post-exposure phase. This finding supports earlier L2 research showing that the production component of structural priming is associated with subsequent production (McDonough and Chaikitmongkol 2010). Put differently, while the input component of priming might drive at least some detection of target structures *within* a priming activity (see Table 1), it is the production component of priming that appears to determine whether or not the structure will emerge subsequently in unprimed production. These findings thus highlight the potential value of structural priming as output activities which extend and consolidate existing structural knowledge through a gradual tuning of the language production system as a result of production experience (see Ferreira and Bock 2006).

Finally, the current findings highlight the overall complexity of morphological learning by adult L2 speakers, even those who have had some previous experience with case marking in their L1 (Farsi) and to a lesser extent in their L2 (English). What emerges from our data is that learning L2 morphology is an incremental process, initially driven by learners' reliance on a single salient or familiar cue (SVO word order, in this case). It is therefore not surprising that novel morphology (-*n* affix in Esperanto) emerged for the current set of participants in production only in SVO sentences. This developmental pattern is consistent with previous research demonstrating that learners initially rely on a single cue in language learning (e.g. MacWhinney and Bates 1989; Matessa and Anderson 2000; McDonald 1986). This pattern is also predicted by theoretical views which

suggest that in early stages of L2 learning, comprehension and production are initially determined by a single, familiar, and statistically robust functional element for assigning argument roles (e.g. Ellis et al. 2012; MacWhinney 2012; VanPatten 1996, 2004). Although structural priming activities might not be most efficient for the establishment of novel constructions, they may facilitate the incorporation of a novel morphological feature (e.g. -*n* affix) into a familiar word order. Developing more complex kinds of knowledge (pairings of novel morphology with unfamiliar word orders) might require more extensive input and output practice than those made available through structural priming.

5 Conclusion

Although structural priming did not play a major role in the development of new form-meaning mappings involving morphology, it may have other benefits for L2 learning and use. One possibility is that, in line with Pickering and Ferreira's (2008) original proposal, structural priming may facilitate the detection of novel constructions which involve a word order cue, rather than a morphological one. Secondly, structural priming may be most beneficial for helping L2 speakers extend and consolidate their existing knowledge, particularly for constructions that have already been detected and can be interpreted correctly. In fact, there is a growing body of literature supporting the value of structural priming activities for helping L2 speakers produce target structures that are developmentally more advanced or less frequently used (e.g., McDonough and Chaikitmongkol 2010; McDonough, Neumann, & Trofimovich in review), as opposed to completely novel forms. Thirdly, structural priming might help learners strengthen form-meaning connections or facilitate automatic retrieval of structures, consistent with the view of priming as a vehicle for developing cognitive fluency (Smith and Wheeldon 2001). Finally, structural priming may help L2 speakers extend low-scope structural patterns and adopt more abstract representations (McDonough and De Vleeschauwer 2010; McDonough and Kim 2009). Put differently, structural priming might enable speakers to produce a target construction with greater lexical variety, resulting in structural knowledge that is not specific to individual lexical items or exemplars. All these possibilities need to be examined in future research, with the overall goal of extending our knowledge of how input and output learning opportunities interact to determine the time course and outcomes of L2 learning.

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