＜論文＞

Pronoun Frames, Metalinguistic Awareness and Cognitive Abilities in Usage-Based Adult Second Language Construction Learning : A Fast-Mapping Experiment

NAKAMURA Daisuke

Bulletin of Japan Women's College of Physical Education, 2024, 54, 13-27

Linguistic input becomes consistent if the same items appear repeatedly in some slots in constructions. In particular, if pronouns appear in the noun slots of argument-structure constructions repeatedly (called pronoun frames), they make input more consistent than concrete nouns do since they can occur in different exemplars of the same argument-structure construction. Caregivers scaffold their children's generalisations of argument-structure constructions by employing pronoun frames. The aim of the present study is to determine whether such facilitative effects of pronoun frames are available for adult second language (L2) learners. In particular, this paper addresses the following research questions : a) whether providing pronouns in noun slots of argument-structure constructions facilitates the generalisation of argument-structure constructions in L2s, and b) what types of cognitive abilities are responsible for such inductive learning. Thirty-nine adult Japanese learners of English participated in psycholinguistic experiments in which they watched a set of pictures and were exposed to training sentences of previously unknown target constructions (the APPEARANCE and the Samoan ergative constructions) with the noun slots filled with one of three experimental conditions : 1) noun-only : only concrete nouns were provided, 2) pronoun-only : only pronouns were provided, and 3) noun-pronoun : both concrete nouns and pronouns were provided. The comprehension and production of the target constructions were tested, as well as the participants' linguistic processing (repetition and semantic priming), intelligence, statistical learning, and metalinguistic understanding, which were included to provide measures of individual differences. The results showed that ; a) both the concrete-noun only group and the noun-pronoun group showed above chance performance for the comprehension of the APPEARANCE construction, b) metalinguistic understanding was correlated positively with the production of the Samoan ergative construction, and c) repetition priming was correlated positively with the comprehension of the Samoan ergative construction.

Keywords : argument-structure constructions, pronoun frames, individual differences, adult second language learners

Introduction

Cognitive linguistics posits that languages are constructed based on concrete language usages (usage-based models) with the assistance of cognitive abilities such as attention sharing with caregivers, and the imitation of and analogical reasoning about the linguistic input provided in child-directed speech (Goldberg, 2006 ; Tomasello, 2003). Both monolingual and bilingual children, as well as adult second language (L2) learners, are argued to first acquire first language (L1) and L2 constructions from whole phrases, then via fixed frames with open slots (e.g., *More X*.), and finally produce adult-like abstract constructions (Ellis, 2003 ; Quick et al., 2021). Acquisition is assumed to be inductive in nature ; that is, accumulations, automatisation and the entrenchment of knowledge occur due to repeated exposure to each construction token, and the subsequent, gradual schematisation of stored construction tokens supported by construction types then takes place. Therefore, the input type and the token frequency play prominent roles in the entrenchment and generalisation of L1 and L2 constructional knowledge (Lieven, 2010) ; specifically, providing pronouns in the argument slots of constructions (high token frequency) with variability in the verb slots (high type frequency) has been found to be facilitative both for the production and for the comprehension of the English transitive construction in the literature on chil-

日本女子体育大学（講師）

dren's language acquisition (Childers & Tomasello, 2001 ; Ibbotson et al., 2011). This paper discusses whether such promotive effects of pronoun frames could also be applicable for the acquisition of L2 constructions and which, if any, are the optimal degrees of consistency and variability in the slots of the L2 constructions for the adult L2 learner population.

Input Consistency and Pronoun Frames

If children begin to acquire L1 constructions by imitating whole phrases, how can they proceed to acquire more abstract and adult–like constructions? Extensive experimental and observational studies that have included corpora have shown that earlier productivity in parents' and children's utterances are restricted in some slots, such as invariant items with variant slots. For example, Cameron–Falkner, Lieven, and Tomasello (2003) showed that the majority of parental speech directed towards children aged from one to two years in the CHILDES corpora were not canonical SVO word orders, but were item –based constructions that included fragments such as *More X* and question forms. Particularly interesting is the fact that 45% of the parental input began with one of 17 words, such as *what*, *that*, and *it*, and that most of the subject slots in the intransitive and transitive constructions were occupied by pronouns such as *you*, *I*, and *it*. Children were also found to imitate such fixed items via slot patterns (e.g., *There's X* and *That's X*) in their productions.

In an experimental study, Childers and Tomasello (2001) compared the effects of verb familiarity to those of consistency and variability in the noun slots on the comprehension and production of the English transitive construction by two–year olds. The consistency and variability of the noun slots was operationalised as provisions of only concrete nouns (e.g., *Look! The dog's hurtling the chair. See? The dog's hurtling the chair.* p.74]) or of both concrete nouns and pronouns (e.g., Look! *The bear's striking the tree.* See? *He's striking it.* Ibid.). The results showed that those who were presented with both nouns and pronouns outperformed those who only received concrete nouns, while verb familiarity had no effect (see also Ibbotson et al., 2011). Lieven and Tomasello (2008) suggested that

> [p]ronouns are a highly limited set of consistent forms with very abstract meanings, …they may therefore act as a kind of "stepping stone" to the formation of more abstract argument slots since they play precisely the role of a consistent form followed by a variable slot.
>
> (p.178)

However, contradictory results were obtained by Horvath and Arunachalam (2021) ; with regard to verb learning in the English transitive construction, Horvath and Arunachalam compared the effects of repeated provisions of concrete nouns to those of concrete nouns and pronouns, as in Childers and Tomasello's (2001) study involving two–year olds' acquisition of English transitive verbs. In the experiment, the children were exposed to the transitive construction twice, either with the noun slots filled with the same concrete nouns twice (called the "consistent" condition)[1] or with concrete nouns in the first and pronouns in the second exposure (called the "varied" condition). The result showed that two–year olds learned English transitive verbs more efficiently in the consistent condition than they did in the varied condition. Horvath and Arunachalam pointed out the role of repetition in memory consolidation. In terms of processing, pronouns require the resolution of their referents, and such additional processing "burdens" are much more cognitively demanding, while the children did not need to solve such problems in the case of concrete nouns repeated in the same context, and thus experienced reduced processing burdens ; they were also supported to construct robust representations of novel transitive verbs in their memories. In turn, robust memory representations provide high accessibility (e.g., ease of retrieval) of the verbs in a test. However, the authors admitted that, at later stages of acquisition, the "[s]ubsequent extension of that verb (an initially learned verb) into new contexts, once a sufficiently robust

representation is established, may be dependent on variability in both the linguistic and visual contexts in which it occurs" (p.4245).

In summary, Childers and Tomasello (2001) showed that *variability in the noun slots* (as well as in the verb slots) by the provision of concrete nouns and subsequent *consistency in the constructional frame* provided by pronoun frames in the noun slots facilitated children's construction learning, while Horvath and Arunachalam showed that *consistency in the noun slots* via repeated provisions of the same concrete nouns were more important for verb learning in the initial phase.

In contrast to the L1 acquisition research on children, there has been little research on the effects of input consistency provided via frequent (pronoun) frames during adults' acquisition of L2 constructions. Nakamura (2012a) investigated whether input consistency instantiated by the pronoun frames facilitated adults' comprehension and production of the previously unknown L2 constructions, the APPEARANCE construction (Casenhiser & Goldberg, 2005) and the Samoan ergative construction (Robinson, 2002). During the training of the participants, who were Japanese learners of English, the subjects watched training films or were shown pictures with sentences in which the noun slots were filled either with proforms (such as *He* and *there*) or with concrete nouns (e.g., *the rabbit* and *the hat*). Since different nouns were provided in the noun slots in the latter manipulation, the input became less consistent. The result showed that the participants in the latter (–consistent) group outperformed the former (+consistent input) group in the guided production of the APPEARANCE and in the comprehension of the Samoan ergative constructions ; thus, the frequent pronoun frames had negative effects on the acquisition of L2 constructions. Unlike Childers and Tomasello's (2001) experiment, in which both concrete nouns and pronouns were provided, L2 learners in the (+consistent) group were given the noun slots of both the target L2 constructions that were filled only with proforms (e.g., *He*, *it* and *there*) due to the binary operationalisation of the input consistency with the aim of replicating the work of Casenhiser and Goldberg (2005). Nakamura (2012a) argued that such restricted variability might hinder the generalisation of constructional knowledge that should be applied to new exemplars of the same constructions. Childers and Tomasello (2001) pointed out that the extensively restricted consistency of the same pronouns would simply lead to the entrenchment of these pronoun frames and that optimal consistency and variability would be needed for effective constructional generalisation, either via the provision of both nouns and pronouns, or of different pronouns in the noun slots. However, this did not appear to be confirmed in the work of Horvath and Arunachalam (2021) described above, as the participants who only received same concrete nouns (thus less variability) in the noun slots in the transitive constructions with nonce verbs outperformed those who received nouns and pronouns (more variability), although Horvath and Arunachalam admitted that the repetition of the same pronouns (unlike concrete nouns) was less effective than was the provision of both pronouns and concrete nouns for two–year olds. The optimal level of input consistency is still under discussion ; thus, one aim of the present study is to examine this by providing only concrete nouns or proforms, or both, for an adult L2 learner population.

Individual Differences as Mediating Factors

Another possibility for the null positive effects of the pronoun frames in adults' learning of L2 constructions is individual differences (IDs) in cognitive abilities. Adults' L2 learning generally demonstrates greater variability in terms of cognitive abilities such as intelligence, which results in greater variability in learning outcomes (e.g., Robinson, 2002).

As stated above, the nature of learning in usage–based models is inductive ; accumulations of constructional exemplars and generalisations thereof are required irrespective of the items (pronouns or concrete nouns or both) that fill the noun slots in argument structure constructions. Another research

question therefore pertains to the mediating factors for inductive adult L2 construction learning. One candidate is priming, which "refers to performance facilitation that can be attributed to a specific prior processing event" (Woltz, 2013, p.97). Woltz (2003) differentiated between repetition priming, in which the facilitation in processing an upcoming event (called a "target" ; e.g., *doctor*) is promoted by exposure to the same, or an almost identical prior event (called a "prime" ; e.g., *doctor*) and semantic priming, in which the facilitation is promoted by exposure to a prime (e.g., *doctor*) that has a semantic relationship with the target (e.g., *nurse*). Although little research on the effects of priming on adults' L2 construction learning has been published, and the proposal is thus speculative, Robinson (2004) proposed semantic priming as a basic cognitive ability for initial input–based learning, particularly the aptitude for complex "deep semantic processing", which is responsible for incidental learning during input processing for meaning. The rationales underlying this are that priming promotes greater activation of the prime and spreads the activation to other items related to the prime (the targets) in the memory ; Robinson argued that IDs in priming represented abilities for the strength of maintaining and spreading activation. Perceptual repetition priming is also included as a candidate ability in the present study because it taps orthographic and phonological coding abilities (Yap et al., 2015) and a construction entails form–meaning mapping ; therefore, learning it should also involve acquiring perceptual aspects (linguistic forms).

Another candidate is statistical learning abilities. Statistical learning, originally derived from word segmentation studies, concerns the ability to extract word boundaries from continuous speech (Saffran et al., 1996), and has now been extended to other domains, such as finding grammatical categories based on statistical properties like transitional probabilities and contingencies (Gomez, 2002). Some research has shown that IDs are responsible for many aspects of language acquisition in such implicit statistical learning, including argument structure constructions (e.g., Kidd, 2012 ; Kidd & Arciuli, 2015). For example, Kidd (2012) showed that implicit statistical learning operationalised as scores on serial reaction time (SRT) tasks (see the procedure below) promoted the production of passive constructions by five–year olds.

Moreover, we should consider the effects of awareness during learning in the case of adult L2 learning ; specifically, the *noticing* of surface linguistic forms of and the *metalinguistic understanding* of grammatical rules underlying L2 constructions have been claimed to be necessary and facilitative for adults' L2 acquisition (Schmidt, 1990). Nakamura (2012b) showed that those who could develop and verbalise the word order rules of the Samoan ergative construction during training without grammar teaching outperformed those who only *claimed to notice* the rules.

Finally, nonverbal intelligence (the Cattell Culture Free Intelligence test) is also included here as a measure of general cognitive ability. Some studies have included it to confirm that the results obtained in the studies were not attributable to such general abilities (Kidd, 2012 ; Kidd & Arciuli, 2015), while other studies have shown that intelligence is also an ID factor for L2 grammar learning under an inductive and incidental learning condition (Brooks & Kempe, 2013 ; but see Nakamura (2015) ; Robinson, 2002).

The Present Study

Research Questions (RQs)

RQ1 : Does providing pronoun frames facilitate adults' inductive learning of L2 constructions and, if so, what degrees of consistency and variability in the noun slots are optimal for maximising learning effects?

RQ2 : What cognitive abilities are responsible for the successful usage–based inductive learning of L2 constructions by adult learners?

Target Constructions

Following Nakamura (2012a), two constructions were used in this experiment.

The APPEARANCE construction (Casenhiser & Goldberg, 2005)

The first construction consisted of English nouns and nonce verbs with the subject noun + the locative noun + the nonce verb + the morpheme (–o) order, as shown in the following example. The construction describes the sudden appearance of the subject in the location denoted by the locative noun, and English does not have constructions with this meaning.

(1) *The rabbit the hat moopoed.*
"The rabbit appears on a hat."
(Casenhiser & Goldberg, 2005, p.503)

All the exemplars were taken from or were constructed by consulting the works of Brooks and Tomasello (1999), Casenhiser and Goldberg (2005), Goldberg et al. (2007), Robinson (1997), Robinson and Ha (1993), Pinker (1989), and Seidenberg and Hoeffner (1998).

The Samoan ergative construction (Robinson, 2002)

The second construction was the Samoan ergative construction (Robinson, 2002). Samoan is an ergative language (Ochs, 1988) ; in ergative languages, the subject of the transitive verb is differentiated from the object of the transitive verb and the subject of the intransitive verb. In Samoan, the subject of the transitive verb is marked by the ergative case marker *e* when it follows the transitive verb, as in (2). Although other word orders are allowed, the canonical word orders are either VSO or VOS (see Ochs, 1988).

(2) *ave e le tama le taavale*
drove ergative the boy the car
"The boy drove the car."
(Robinson, 2002, p.224)

All the Samoan exemplars were simplified to allocate relevant words to these word orders to ensure that the participants' L1 (Japanese SOV) or L2 (English SVO) word orders did not affect the results, and to mitigate the processing burdens of memorising all the necessary nouns in order for the results to be comparable to those of the first APPEARANCE construction in which the participants did not need to memorise any words in advance. All the sentences were constructed by consulting the work of Milner (1993), Ochs (1988), Pratt (1839/2007) and Robinson (2002).

Participants

Thirty–nine Japanese college students (all female : mean age=18.77) were recruited to participate in this experiment, and were paid 4,725 yen for their four and a half hours of participation. Before the respondents participated in the study, the experimental procedures, including the ethical standards (e.g., voluntary participation, no impact on their grades for their classes, anonymity of the data and so forth) were explained to them, and they completed the consent forms. All the participants completed two construction learning tasks and four cognitive ability tasks over three separate days. These tasks were grouped according to

1) Samoan ergative construction learning + repetition priming,
2) APPEARANCE construction learning + semantic priming + SRT, and
3) CFIT.

Each session was normally completed within 90 minutes. Six task sequences were created (e.g., 1, –2, –3), and the participants were randomly allocated to one of them.

Construction Learning Tasks

All the learning experiments were similar to those in Nakamura (2012a) study, which aimed to replicate Casenhiser and Goldberg's (2005) fast–mapping experiment. See Nakamura (2012a) for detailed information, including a list of some of the training and test sets. The construction learning programmes were operated using SuperLab 5 (Cedrus).

1. The APPEARANCE construction

1.1 Training

The participants were asked to look at two consecutive pictures that depicted a subject's sudden appearance in a particular location with a corresponding sentence on the screen in one of the following four conditions to which they were randomly assigned. The first picture introduced one subject and a location, while the second picture presented the subject's sudden appearance. Eight different events with corresponding sentences were presented in total, and each was repeated twice (thus 16 times). The order of presentation was randomised for each participant.

1.1.1 The noun-only group.

All the noun slots were filled with concrete nouns, as in "*The rabbit the hat moopo*" and "*The rabbit the hat moopoed*".

1.1.2 The noun-pronoun group.

The noun slots were filled with concrete nouns in the first presentation and with the proforms (*He* and *there*), as in "*The rabbit the hat moopo*" and "*He there moopoed*".

1.1.3 The pronoun-only group.

All the noun slots were filled with preforms, as in "*He there moopo*" and "*He there moopoed*".

1.1.4 Vocabulary-only group.

The participants in this group were assumed to only have vocabulary knowledge about concrete nouns and proforms.[2] No training was provided.

1.2 Forced-choice comprehension test

After training, the participants were shown three pictures and a test sentence on a screen. The first picture introduced one subject (e.g., a bee) and one location (e.g., a flower) ; soon afterwards, the participants were shown two pictures (e.g., the bee is suddenly landing on the flower and the bee is stinging the flower) and were presented with one test sentence (e.g., *The bee the flower dirko.*). The participants were asked to choose the corresponding picture denoted by the test sentence by pressing a key as quickly and as accurately as possible. The test set consisted of eight sentences. An additional eight distractor sentences were created in the typical SVO word order with transitive meanings. In this "filler" set, the participants were required to choose a picture denoting a transitive scene (e.g., A tiger attacks strawberries) and to distinguish it from an appearance scene (A tiger suddenly appears behind strawberries) by reading a distractor sentence (e.g., *The tiger calimodo the flower*). The rationale for including the filler set was that, if the participants had acquired the target construction, they should have been able to differentiate between a new exemplar of the novel construction and the familiar construction (Goldberg et al., 2007, pp.77-78). The order of presentation was randomised for each participant.

1.3 The guided production task

Following the comprehension task, the participants were given pieces of paper with a word written on each of them. After watching an appearance scene depicted in two consecutive pictures, they were asked to construct a sentence that matched the scene by placing each word in the correct word order on the table, as in the work of Nakamura (2012a) and Robinson (2002). The test set consisted of eight sentences in total. The presentation of the test sets was randomised for each participant, and the accuracy of the alignments (maximum eight points) was taken as a dependent measure for this task.

2. The Samoan ergative construction

Before engaging in the study, the participants were asked to memorise sixteen concrete nouns, as well as two proforms (*oia* "he" and *olea* "that"), and were tested until they obtained a perfect score for the vocabulary quiz. The training procedure was almost the same as in the APPEARANCE construction learning, except for the following : The training set was only provided in the verb + ergative case maker *e* + subject + object word order with the prototypical animate subject/inanimate object. Eight training sentences were presented in any one of the four conditions, as in the APPEARANCE construction.

2.1 The forced-choice comprehension test

The transfer set consisted of two types. The first set consisted of eight test sentences in the same verb+e+subject+object word order as in the training set, but animate entities functioned as a subject and as an object (e.g., *moto e le tama le leoleo* "the boy punches the police") in half of them ; the same prototypical animate subject and inanimate object combination was used in the other half. The second set (called the generalisation set) consisted of eight sentences in the new verb + object + *e* + subject word order that was not included in the training. Half of them contained animate subjects/inanimate objects, and the other half contained animate subject/animate object combinations. These two orders were the first preference (Ochs, 1988, p.68), and correct performances for the latter generalisation set meant that the participants had acquired knowledge about ergativity that exceeded the input ; that is, ergativity is marked by the case marker *e* irrespective of the word order (VSO or VOS). Since the latter order did not appear during the training, this also functioned as a distractor set. The presentation of both test sets were randomised for each participant.

2.2 The guided production test

The procedure was the same as in the guided production of the APPEARANCE construction.

3. Post-hoc awareness and difficulty questionnaire

After each construction learning task, the participants' levels of awareness were measured using a post-hoc awareness questionnaire, as in Nakamura's (2012a) work. The questionnaire consisted of

1) background information (a history of foreign-language learning and having studied abroad experience),
2) perceived difficulty of the target constructions scored using a five-point Likert scale,
3) rule search : whether they had attempted to search for grammar rules (Yes or No),
4) notice : whether they claimed to have noticed grammar rules (Yes or No), and
5) rule verbalisation : write any grammatical rules freely.

Positive answers for the subsections 3), 4) and 5) were scored one point each.[3]

Cognitive Ability Measures

1. Repetition priming

Three types of word pairs were constructed for this task, namely repeated words, unrepeated words and non-words. All the words were taken from the work of Sugishima, Iwahara, and Gasyu (1996) who investigated the familiarity ratings of 4,160 four-letter Japanese Hiragana words. Ninety words (30 for the prime in the repeated word pair and 60 for the prime and target in the unrepeated word pairs) were taken from their list, with one from each frequency category (bands 1.95 to 5.0). One hundred and twenty non-words were created by switching the second mora and the third mora of the words in the same frequency categories.

Repetition priming effects were measured via a lexical decision task. In the training session, after a fixation mark (+) was briefly presented for 500 ms, the first word (called a prime) appeared on the screen for 150 ms. After 50 ms of a blank white screen, the second word (called a target) was presented on the screen, and the participants were instructed to judge whether the target word was a real Japanese word by pressing a blue (for yes) or a red (for no) button on the response pads RB-740 as quickly and as accurately as possible. Ten training and 120 test trials were supplied, and each trial accompanied 1500 ms of a blank white screen to provide an inter-trial break. Reaction times (RTs) and accuracy were recorded, and priming effects were measured by subtracting the average RTs and error rates for the targets in the unrepeated word pairs from those in the repeated pairs.

2. Semantic priming

Three types of word pairs were created for this task, namely related words, unrelated words and non-words. First, two sets of 30 Hiragana word pairs were extracted from Mizuno (2011), with both sets having equal associative strength on average. The

first set was used for the related word pairs ; the second set was used to create unrelated word pairs by swopping the target of one word pair and that of another pair while ensuring that the word pairs did not have high associative strength. One hundred and twenty non–words (60 pairs) were taken from Kawakami (1996, 2009). All the non–words consisted of three letters and three moras, and were paired with no letter overlaps between the prime and the target. The procedure was the same as in the repetition priming task.

3. Statistical Learning

Statistical learning was measured via an SRT task. Four different coloured squares (yellow, green, red and blue) appeared on a screen one by one after a fixation mark (+) had been presented in the centre of the screen for 700 ms, and the participants were instructed to press a corresponding colour button on the response pads RB–740 (Cedrus) as quickly and as accurately as possible.

The experiment consisted of the training session and the test session, which were separated by a break. The training set consisted of 48 colour sequences, the lengths of which varied from three to eight colour sequences. The length of each length consisted of eight exemplars (thus six colour sequence types x eight exemplars). The order of colour sequence was generated by and thus constrained by underlying rules, which were concealed from the participants. The test session began after the break, and the participants could resume the task by pressing any key. The test set consisted of 20 new grammatical colour sequences that followed the same underlying rules but which did not appear during the training, and 20 ungrammatical colour sequences. The length of both test sequences varied from four to eight colour sequences, and the length of each length consisted of four exemplars. The training and test sequences were taken from the work of Conway et al. (2010 ; see Appendix A). If the participants had learned the statistical patterns underlying the possible colour sequences during the training, their responses on the grammatical test items should have been much faster and more accurate than for the ungrammatical counterparts ; thus, the dependent variables were both the differences in the RTs and the amount of errors for the grammatical and the ungrammatical test items.

4. Nonverbal Intelligence

The Japanese translation of the Cattell Culture Fair Intelligence Test scale 3 (Takei Scientific Instruments Co.) was employed as a test of the participants' general cognitive abilities. The participants completed both Form A (50 items) and Form B (50 items) of Scale 3. This nonverbal intelligence test employed abstract geometric figures as stimuli and consisted of four subtests :

1) Series,
2) Classification,
3) Matrices, and
4) Topology.

In the Series subtest, the participants should choose the appropriate figure that completed the series, while they were required to identify two figures that differed from the other three in the Classification subtest. In the Matrices subtest, a matrix should be completed by selecting an appropriate figure. In the Topology subtest, the participants were required to choose the figure that followed the same topological condition as the test stimulus. Only the total scores were used for the analyses in the present study.

Results

Since the data set in the present study was small, nonparametric statistical analyses of the data were conducted.

RQ1 : Roles of pronouns

Figure 1 shows the median scores for each construction learning task as a function of the experimental groups. Overall, only the noun–only group appeared to acquire receptive (comprehension) knowledge of both the target constructions, while none of the groups gained productive knowledge. A

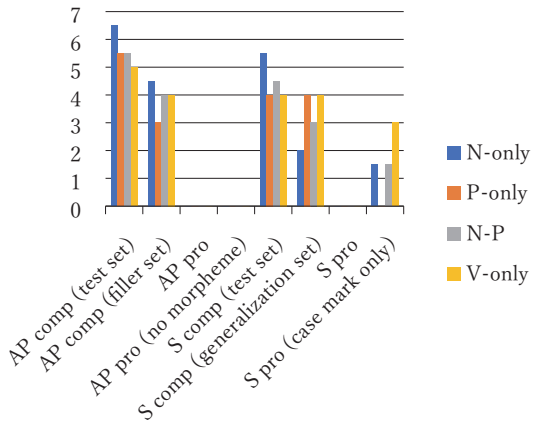

Figure 1 *Median Scores for Each Learning Task as a Function of the Experimental Groups*

Notes. N–only : Noun–only group, P–only : Pronoun–only group, N–P : Noun–Pronoun group, V–only : Vocabulary only group. AP : APPEARANCE, S : Samoan, comp : comprehension, pro : production

series of nonparametric statistics partially supported this interpretation.

The Kruskal–Wallis test showed that there were no significant differences in the comprehension of the APPEARANCE construction, H(3)=6.351, p=.096, nor its filler SVO set, H(3)=4.165, p=.244. For the production tasks for both target constructions, the differences in the input did not make a difference in the learning scores ; H(3)=0, ps>.1 since none of the participants produced correct sentences with the morpheme –o or the ergative case maker *e*. There were no main effects of input in the comprehension of the Samoan ergative construction, H=3.779, p=－.286, but there was an effect in the comprehension of the subset, the generalisation set of the Samoan ergative construction, H(3)=9.981, p=.019. Follow–up Jonckheere's tests with adjusted p–values showed that the pronoun–only and the vocabulary–only groups tended to outperformed the noun–only group, J=83.5, Z=2.573, p=.03, and J=78.0. Z=2.780, p=.016.

To understand some of the unexpected results, each group's comprehension scores for both the target constructions were compared to chance performance levels (50%, since they needed to choose one of two pictures on the screen eight times) using one–sample Kolmogorov–Smirnov tests, and the results revealed that only the noun–only and the noun–pronoun groups showed significant, above–chance performances for the comprehension of the APPEARANCE construction, Z=1.85, p=.002, Z=1.371, p=.047, respectively. The other performances were all below chance (ps>.05). Thus, learning effects were only obtained in the comprehension of the APPEARANCE construction by the noun–only and the noun–pronoun groups, and the magnitude did not differ between the groups.

For the guided production tasks, additional "less strict" coding was applied to the data. Since none of the participants in Nakamura's (2012a) work noticed the morpheme –o in the APPEARANCE construction, a performance was judged to be correct when the word order (that is, subject–locative noun–verb) was followed irrespective of the morpheme –o. For the Samoan ergative construction, the participants received one point if they attached the ergative case marker *e* to the subject noun due to the fact that the participants had seen the test sets in both the verb–e–subject–object and the verb–object–e–subject word order, and because word order is flexible in Samoan (see Ochs, 1988). The results showed that no group differences were found in the production of the APPEARANCE construction, U (3)=2.591, p=.459. For the production of the Samoan ergative construction, input had significant main effects, U (3)=7.936, p=.047 ; however, no significant differences were found in any of the pairs of groups, as Jonckheere's tests with adjusted p–values showed : J=326.500, Z=1.077, p=.282. In summary, no significant group differences were observed in the production data.

RQ2 : IDs

Prior to the correlational analyses of these cognitive abilities and of the awareness and perceived difficulty measures for construction learning, we first checked whether these four cognitive ability tasks tapped into the expected abilities in a series of Friedman's ANOVAs and subsequent multiple comparisons (all the p–values in the comparisons were Bonferroni–corrected values). For the SRT task, al-

though the participants pressed the three types of colour sequences with different speeds and accuracy rates, they did not do so in an expected way, $X^2(2)=45.267$ (RTs) and $X^2(2)=25.08$ (accuracy), ps=.00 ; they showed faster RTs (Ts=1.433 and 1.567, ps=.000, respectively) and greater accuracy (Ts=1.233 and .817, ps<.01) in the old training sequences in comparison to the new grammatical and ungrammatical ones. However, there were no differences between the latter two in terms of speed (T =.133, p>.05) and accuracy (T=.417, p>.05). Therefore, the SRT task in the present study did not capture IDs in implicit statistical learning ability. The data for the SRT task were omitted in the subsequent analyses.

In the repetition priming task, ($X^2(2)$=, p=.00), the participants judged the lexicality of the targets in the repeated pairs compared to those in the unrepeated ones and the non-words with greater speed (T=.633, p=.043, T=1.267, p=.000, respectively). In terms of the accuracy of the responses, they demonstrated better performances for the targets in the repeated pairs compared to the targets in the unrepeated pairs (T=.95, p=.001) : The differences did not reach statistical significance for the non-words, T =.15, p>.05. The participants also judged the lexicality of the targets in the unrepeated pairs more quickly (T=.633, p=.043) and with greater accuracy (T=1.100, p=.000) compared to the targets in the non -word pairs. Therefore, the repetition priming task demonstrated reliable priming effects. Similarly, in the semantic priming task ($X^2(2)=24.867$, p=.000), the participants judged the lexicality of the targets in the related pairs more rapidly than they did those in unrelated ones (T=1.267, p=.000) and in non-words (T=.833, p=.004). Differences between the unrelated pairs and the non-words did not reach significance, T=.433, p>.05. In terms of accuracy ($X^2(2)=9.956$, p=.007), the participants demonstrated greater accuracy for the related pairs compared to the unrelated ones (T=.700, p=.020), but no other comparisons reached statistical significance (ps>.05). Therefore, the semantic priming task showed reliable priming effects.

Since some of the learners did not show the expected differences (e.g., slower RTs for the repeated stimuli than for the unrepeated ones in the repetition priming task), these learners' data were excluded from the analyses. With regard to awareness and perceived difficulty, significant correlations were only available for the Samoan ergative construction : Awareness had significant and positive correlations with both the production data for the Samoan ergative construction under normal (τ=.334) and less strict (τ=.431) coding conditions. Surprisingly, the scores for the perceived difficulty showed positive correlations with filler items (VOeS generalisation items ; τ=.322) ; other correlations did not reach statistical significance. For the cognitive ability measures, only repetition priming effects showed positive correlations with the comprehension of the Samoan ergative construction in terms of accuracy (τ=.302) ; other correlations did not reach statistical significance.

Discussion

RQ1 : Roles of pronouns

The present study found that learning effects were only observed in the comprehension performance of the APPEARANCE construction in the noun-only group and the noun-and-pronoun group, and that the effects did not differ in magnitude. Differences in the linguistic input had no effects on the comprehension of the Samoan ergative construction, nor on the production of either construction. First, since both the noun-only group and the noun-and-pronoun group showed learning effects but did not differ, the present study cannot lend support to Childers and Tomasello (2001), who showed that consistent constructional frames with pronouns and variability in argument slots with concrete nouns promoted construction learning, or for Horvath and Arunachalam (2021), who demonstrated that less variability in argument slots with repetitions of the same concrete nouns outperformed the combinatorial effects of pronoun and nouns in Childers and Tomasello's (2001) work. However, the present study provided additional evidence for the claim that ex-

cessive repetitions of pronouns in the arguments and the resultant limited variability in the constructions hindered generalisations of constructional knowledge ; these claims were made by both Childers and Tomasello (2001) and by Horvath and Arunachalam (2021), and were supported empirically by Nakamura (2012a) with and adult L2 learner population.

The present study also found that input manipulation had no effect on the production of either of the target constructions. These findings are consistent with Nakamura (2012a), who revealed that consistent input had negative effects on the production of the APPEARANCE construction. As Goldberg and Casenhiser (2008), Childers and Tomasello (2001), and Nakamura (2012a) argued, production requires more robust representation of form–meaning mappings and resultant stronger generalisations of the constructional knowledge. Thus, exposure to a limited number of constructional exemplars (eight x two times) may not have provided adequate opportunities for constructing such representations. Therefore, in order to consider the effects of consistency and variability in the constructional frames on the productive aspects of construction processing, a greater amount of constructional input should be taken into consideration in the future.

RQ2 : IDs

First, awareness showed positive correlations with the production of the Samoan ergative construction. As described above, this is in line with the arguments that, compared to comprehension, production requires stronger representations of constructional form–meaning mappings, and this stronger representation that was exemplified by the explicit metalinguistic understanding of word order or word order plus the ergative case marker *e* promoted generalisations of the constructional knowledge required for its production. The findings generally supported those of Nakamura (2012b) in that metalinguistic awareness promoted the production of the target construction. Unlike the production of the Samoan ergative construction in the present study and that of the APPEARANCE construction in Nakamura (2012b), awareness was not correlated with the production of the APPEARANCE construction since no participant in the present study demonstrated an appropriate alignment of constructional elements even under less strict coding conditions (see Figure 1). Why did such differences between both target constructions in terms of their noticing and metalinguistic understanding arise? The key is the nature of the filler sets.

In the APPEARANCE construction, the filler set was provided in a canonical SVO English sentence during the comprehension tests, which might have evoked knowledge of English and hindered production performance, particularly for less proficient participants who majored in sports sciences and thus generally had fewer opportunities for grammatical analyses. By contrast, the participants in Nakamura (2012a) study majored in English linguistics or literature, and had numerous opportunities for grammatical analyses, which may have resulted in a superior grammatical ability to differentiate between the filler set and the test set. Similarly, in the Samoan data, subject nouns appeared both before and after the object nouns. Thus, even if the participants only saw the former verb–*e*–subject–object word order during the training, they saw both types of word orders during the comprehension test. In this case, the ergative case marker *e* leading a subject noun achieved prominence and could have become noticeable even for less proficient participants. In other words, the filler sets in the comprehension tasks might have had a negative effect on the production of the APPEARANCE construction, but improved that of the Samoan ergative construction.

Repetition priming effects in terms of error rates were found to have positive correlations with the comprehension of the Samoan ergative construction. Since repetition priming taps into the processing of formal aspects of linguistic stimuli (Yap et al., 2015), this was expected. Due to the lack of semantic priming effects, the training instruction in the present study may not have promoted the deeper semantic processing of the language input. In the present

study, learners were asked to look at and comprehend pictures and constructional exemplars, unlike in Robinson's (2002) study, in which they were asked a comprehension question after each training sentence was presented in the incidental learning condition. Deeper semantic processing of the training input could only be guaranteed in the latter case ; thus, semantic priming was responsible for such processing.

The learners did not demonstrate the expected implicit statistical learning ability due to the lack of significant differences between the grammatical and the ungrammatical sequences, which could have been due to methodological reasons. In the original study (Conway et al. 2010), the total number of correct responses for the given length of a sequence (e.g., five) was multiplied by that length, and the multiplied scores for all length levels were added. These "weighted" scores were calculated separately for both grammatical and ungrammatical sequences, and learning was calculated by subtracting the weighted scores for the ungrammatical sequences from those for the grammatical ones. By contrast, the present study employed raw scores, as in Kidd (2012), who employed an adapted version of the implicit SRT task (Nissen & Bullemer, 1987).

Finally, Intelligence, as measured by a nonverbal measure (CFIT), did not show observable effects on construction learning. The null effects were inconsistent with Brooks and Kempe's (2013) work, but were consistent with Robinson's (2002) study, in which intelligence as measured by the WAIS-R had positive correlations with explicit problem solving and negative correlations with the implicit learning of alphabetical stimuli, but had no correlations with the incidental learning of Samoan constructions. In Brooks and Kempe's (2013) study, intelligence as measured by the CFIT was correlated significantly with the generalisation of case marking to new exemplars. However, adding metalinguistic understanding as a predictor of the Russian gender and case marking system in further regression analyses cancelled out the effects of the CFIT, thus demonstrating that nonverbal intelligence itself had no direct relationship with the knowledge generalisation of constructions, but did have indirect ones through explicit metalinguistic understanding, as revealed by the positive relationships between the CFIT and metalinguistic understanding and between metalinguistic understanding and the scores for case generalisation. Therefore, the effect of intelligence observed in the present study might have been due to similar reasons.

Conclusion

The present study found that consistently providing pronouns in the argument slots of constructions hindered the learning thereof because the lack of variability may facilitate the entrenchment but prevent the generalisation of the constructions. Both balanced consistency and variability (the noun-and-pronoun group) and variability without consistency (the noun-only group) showed equal learning effects, which requires further studies to clarify the reasons. A greater amount of input may be necessary to construct the robust constructional representations that are required for production, which could be one of the subjects in further research.

Some rudimentary findings regarding the mediating factors were also identified. Awareness in the form of noticing and metalinguistic understanding clearly facilitated the production of the Samoan ergative construction, which requires the appropriate alignment of constituent elements. The knowledge required for production should be deeply entrenched in the memory and metalinguistic understanding demonstrates such robust representations. By contrast, repetition priming only showed positive correlations with the comprehension of the Samoan ergative construction. Shallower representations or 'tentative generalizations' that are sufficient for differentiating between new and known constructions (Goldberg & Cansenhiser, 2008, p.204) may have been sufficient for comprehension in the present study, and repetition priming that taps into the processing of formal aspects of linguistic stimuli (e.g., holding and activating forms of the training and test exemplars, but not necessarily the extended abstract

alignments in the memory) can promote the development of such shallower representations. In other words, there might be ability differentiation in terms of processing skills (e.g., productive versus receptive skills), which could be another topic for future research.

Acknowledgements

This research was supported by the 2019 *Nikaido Shourei Kenkyuhi* (the Nikaido Grant-in-Aid for Encouragement of Scientists) and was approved by the Japan Women's College of Physical Education Research Ethical Review Committee (No. 2019-7).

Notes

1. In terms of consistency at the construction frame level, this "concrete noun-only" condition provides less consistent input than does providing both nouns and pronouns or pronouns only, since different nouns should occupy the noun slots whenever different characters appear in an event.
2. Vocabulary knowledge was assumed because all the concrete nouns and proforms were familiar to the students (e.g., *rabbit*, *monster*, *king*, *chair*, *doctor*, *hospital*, and so on), even though this was not tested explicitly.
3. The post-hoc awareness questionnaire was originally supplemented with a more sensitive measure, namely the confidence interval (see Nakamura, 2013a, b). The participants' input levels of confidence were rated using a five-point Likert scale by asking them to press a key (from 1 "not confident" to 5 "most confident") after each judgement in the production and the comprehension tasks for both target constructions. However, the participants sometimes claimed to have pressed the incorrect keys by pressing the space bar consecutively without inputting their confidence levels ; therefore, the confidence interval was removed from the data analyses.

References

Brooks, P.J., & Kempe, V. (2013). Individual differences in adult foreign language learning : The mediating effect of metalinguistic awareness. *Memory & Cognition*, 41, 281-296.

Brooks, P., & Tomasello, M. (1999). Young children learn to produce passives with nonce verbs. *Developmental Psychology,* 35(1), 29-44.

Cameron-Faulkner, T., Lieven, E., & Tomasello, M. (2003). A construction-based analysis of child-directed speech. *Cognitive Science*, 27, 843-873.

Casenhiser, D., & Goldberg, A.E. (2005). Fast mapping between a phrasal form and meaning. *Developmental Science*, 8, 500-508.

Childers, J.B. & Tomasello, M. (2001). The role of pronouns in young children's acquisition of the English transitive construction. *Developmental Psychology*, 37(6), 739-748.

Conway, C.M., Bauernschmidt, A., Huang, S.S., Pisoni, D.B. (2010). Implicit statistical learning in language processing : Word predictability is the key. *Cognition*, 356-371.

Ellis, N.C. (2003). Constructions, chunking, and connectionism : The emergence of second language structure. In C. Doughty & M. Long (Eds.), *Handbook of Second Language Acquisition* (pp.66-103). Blackwell.

Goldberg, A.E. (2006). *Constructions at work : The nature of argument structure generalisations*. Oxford University Press.

Goldberg, A.E. & Casenhiser, D. (2008). Construction learning and second language acquisition. In P. Robinson & N.C. Ellis (Eds.), *Handbook of Cognitive Linguistics and Second Language Acquisition* (pp.197-215). Routledge.

Goldberg, A.E., Casenhiser, D., & White, T. (2007). Constructions as categories of language : The role of order on construction learning. *New Ideas in Psychology*, 25, 70-86.

Gomez, R. (2002). Variability and detection of invariant structure. *Psychological Science*, 13, 431-436.

Horvath, S., & Arunachalam, S. (2021). Repetition versus variability in verb learning : Sometimes less is more. *Journal of Speech, Language, and Hearing Research*, 64, 4235-4249.

Ibbotson, P., Theakston, A., Lieven, E., & Tomasello, M. (2011). The role of pronoun frames in early comprehension of transition constructions in English. *Language Learning and Development*, 7, 24-39.

Kawakami, M. (1996). Kana 3moji de hyooki sareru hitango no ruijigosuuhyoo (Tables of Japanese 3-letter Nonwords with Neighborhood size). *Bulletin of the School of Education, Nagoya University* (*Educational Psychology*), 43, 187-220.

Kawakami, M. (2009). Hitangokiokukai ni okeru seisainin to kyosainin ni taisuru ruijigosuu no kouka (*The effect of neighborhood size on hit and false alarm of nonword recognition task*). *The Human Science Research Bulletin* 8, 53-60.

Kidd, E. (2012). Implicit statistical learning is directly associated with the acquisition of syntax. *Developmental Psychology*, 48, 171-184.

Kidd, E., & Arciuli, J. (2015). Individual differences in statistical learning predict children's comprehension of

syntax. *Child Development,* 87(1), 184–193.
Lieven, E. (2010). Input and first language acquisition : Evaluating the role of frequency. *Lingua*, 120, 2546–2556.
Lieven, E., & Tomasello, M. (2008). Children's first language acquisition from a usage–based perspective. In P. Robinson & N.C. Ellis (Eds.), *Handbook of Cognitive Linguistics and Second Language Acquisition* (pp.168–196). Routledge.
Milner, G.B. (1993). *Samoan Dictionary : Samoan–English English–Samoan*. Polynesian Press.
Mizuno, R. (2011). (Ed.). *Rensouhindohyo : 3–mora Kanji, Hiragana, and Katakana hyookigo* (*Association frequency tables : Three–mora Kanji, Hiragana, and Katakana words*). Nakanishiya Shuppan.
Nakamura, D. (2012a). Input skewedness, consistency, order of frequent verbs in frequency–driven second language construction learning : A replication and extension of Casenhiser and Goldberg (2005) to adult second language acquisition. *International Review of Applied Linguistics in Language Teaching*, 50(1), 1–37.
Nakamura, D. (2012b). Noticing and metalinguistic understanding in second language construction learning. *Papers from the 12th National Conference of the Japanese Cognitive Linguistics Association* (pp.399–412).
Nakamura, D. (2013a). Methodological considerations in studying awareness during learning. Part 1 : implicit learning. *Polish Psychological Bulletin*, 44(1), 102–117.
Nakamura, D. (2013b). Methodological considerations in studying awareness during learning. Part 2 : Second language acquisition. *Polish Psychological Bulletin*, 44(3), 337–353.
Nakamura, D. (2015). Individual differences in implicit learning : Current problems and issues for research. In Z. Jin (ed.). *Exploring implicit cognition : Learning, memory, and social–cognitive processes* (pp.61–85). Harshey, PA : IGI Global.
Nissen, M.J., & Bullemer, P. (1987). Attentional requirements of learning : Evidence from performance measures. *Cognitive Psychology,* 19, 1–32.
Ochs, E. (1988). *Culture and language development : Language acquisition and language socialization in a Samoan village*. Cambridge University Press.
Pinker, S. (1989). *Learnability and cognition*. MIT Press.
Pratt, G. (1839/2007). *Samoan Dictionary : English and Samoan, and Samoan and English with a Short Grammar of the Samoan Dialect. A Reprinted Version*. Kessinger Publication.
Quick, A.E., Gaskins, D., & Frick, M. (2021). Priming of frames and slots in bilingual children's code–mixing : A usage–based approach. *Frontiers in Psychology*, 12, 1–9.
Robinson, P. (1997) Individual differences and the fundamental similarity of implicit and explicit second language learning. *Language Learning*, 47, 45–99.
Robinson, P. (2002). Effects of individual differences in intelligence, aptitude and working memory on adult incidental SLA : A replication of Reber, Waklenfeld, and Hernstadt (1991). In P. Robinson (Ed.), *Individual Differences and Instructed Language Learning* (pp.211–266). Benjamins.
Robinson, P. (2004). A multidimensional, developmental framework for aptitude research—Aptitude complexes for input processing, task aptitudes for production and complex task performance, and aptitude for real–world transfer. An unpublished draft presented for CASL, August.
Robinson, P., & Ha, M.A. (1993). Instance theory and second language rule learning under explicit condition. *Studies in Second Language Acquisition,* 15, 413–438.
Saffran, J.R., Aslin, R.N., & Newport, E.L. (1996). Statistical learning by 8–month–old infants. *Science*, 274, 1926–1928.
Schmidt, R. (1990). The role of consciousness in second language learning. *Applied Linguistics*, 11, 129–158.
Seidenberg, M., & Hoeffner, J. (1998). Evaluating behavioral and neuroimaging data on past tense Processing. *Language*, 74, 104–123.
Sugishima, I., Iwahara, A., & Gasyu, H. (1996). Hiragana seion 4moji meishi 4160go no jyukuchika. (Familiarity ratings of 4160 Hiragana 4 letter nouns.). *Jinbunronkyu*, 46(1), 53–75.
Tomasello, M. (2003). *Constructing a Language : A Usage–Based Theory of Language Acquisition*. Harvard University Press.
Woltz, D.J. (2003). Implicit cognitive processes as aptitudes for learning. *Educational Psychologist*, 38(2), 95–104.
Yap, M.J., Hutchinson, K., & Tan, L.C. (2015). Individual differences in semantic priming performance : Insights from the Semantic Priming Project. In M.N. Jones (Ed.), *Big Data in Cognitive Science : From Methods to Insights*. Psychology Press.

（令和５年９月12日受付
令和５年12月７日受理）

日本女子体育大学紀要，2024，54，13-27
＜論文＞

代名詞フレーム，メタ言語的理解，認知能力における個人差が大人の第二言語構文習得に及ぼす影響

中　村　大　輔

代名詞を項構造構文の名詞句の位置に使用した場合，登場人物の性・数が一致すれば同じ代名詞を使用できるため，主語や目的語といった文法役割を担う名詞句の位置が固定され，語順の視認性が高まる．結果，幼児の母語の構文獲得が促進されることが知られている．本研究では１）代名詞が持つ促進効果が大人の第二言語構文習得にも見られるか，２）言語インプットに基づく第二言語構文習得に必要になる能力とは何かを検討した．39名の日本人英語学習者が実験に参加し，英語名詞と新規動詞を用いて作成した「出現構文」と「サモア語能格構文」の２つの未習言語構文を習得対象とし，その理解と産出をテストした．個人差要因として，語順に関する「メタ言語的理解」，「言語処理能力（反復・意味プイライミング効果）」，「知性」，「統計学習」を検討した．結果は１）トレーニング文の名詞句の位置に普通名詞のみを提示した群と普通名詞と代名詞ともに提示した群が出現構文に関してchance levelを超える理解，２）メタ言語的理解はサモア語能格構文の産出と正の相関，３）言語形式の処置能力を測定する反復プライミング効果はサモア語能格構文の理解と正の相関，を示した．

キーワード：第二言語構文習得，代名詞フレーム，個人差