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Effects of input frequency on awareness and perceived difficulty of second language constructions.

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Awareness, or consciousness has been widely studied in the implicit cognition literature (e.g., Litman & Reber, 2005). Specifically, with relation to both implicit learning and second language acquisition (SLA), there has been extensive discussion of the possibility of learning abstract regularities underlying trained items without conscious awareness. In this paper, firstly we review studies of implicit artificial and natural language learning, focusing on the awareness issue. Then we connect focus on form, which aims at leading learners' attention to relevant linguistic code without dispersing attention to meaning, with current usage-based models of language and language acquisition. Subsequently the results from laboratory studies where second language (L2) learners learned previously unknown L2 constructions under different manipulations of input frequency are reported.

Awareness in implicit artificial grammar learning

Implicit learning is learning abstract regularities of patterns of co-occurrences underlying stimuli, thus extending beyond stimuli presented during a training session, and without conscious awareness of such abstract patterns. Implicit learning has been studied in various paradigms including artificial grammar learning (Reber, 1989), sequence learning (Nicessen, & Bullemer, 1987), and dynamic system control (Berry & Broadbent, 1984). Here we deal with artificial grammar learning (AGL) where digit sequences (e.g.,

XXVX) are generated by a finite state Markov grammar. Subjects are assumed to be able to judge the grammaticality of the new sequence presented during the transfer session by just memorizing digit sequences presented during a training session without explicit instruction in the artificial grammar. Since they cannot explicitly verbalize the underlying rule but nevertheless can indicate correct grammaticality judgment at an above chance level, the acquired complex knowledge is argued to result from implicit learning and to be tacit, i.e. unavailable to conscious awareness (see Reber, 1989). In addition, implicit learning processes are assumed to be robust in the face of neuropsychological disorders (e.g., amnesic patients can learn grammar implicitly, Knowlton & Squire, 1996), to be unrelated to individual differences in Intelligence Quotient, to show less individual variance (Reber, Walkenfeld, & Hernstadt, 1991), and to evolve early (Reber & Allen, 2000), compared with explicit learning counterparts.

Since the first demonstration of implicit learning by Reber (1967), largely to say, two issues have been addressed: (1) the nature of acquired knowledge, (2) methodological issues in assessing subjects' awareness (see e.g., Cleeremans, Destrebecqz, & Boyer, 1998; DeKeyser, 2003; Perruchet & Vinter, 2002; Pothos, 2007; Schmidt, 1994, 1995; Shanks & St. John, 1994). In this paper our main concern is to examine the second of these issues.

Perruchet and Pacteau (1990) argue that what subjects in AGL learn is not abstract knowledge but fragmentary, specifically bigram (a two digit sequence such as XV) knowledge consciously memorized during a training session. They found that those who had been presented with only these bigrams during the training session judged the grammaticality of the new transfer sentences at the same above chance level as learners in a typical implicit learning condition. Subsequently they tested recognition of these bigrams and found that subjects could distinguish previously presented bigrams from new bigrams. Knowlton and Squire (1996), on the other hand, compared both normal and amnesic patients who were argued to have impaired declarative memory and found that both groups could judge the correctness of the new transfer sequences. Since amnesics' recognition of the chunks (tri- or bigrams) was marginally above chance ($p = .06$), they concluded that amnesic patients could not rely on impaired recognition memory for the chunks. However, "impairment" does not guarantee total "lack" of recognition memory and explicit learning processes. Moreover, while demonstrating recognition and producing a verbal report are evidence for explicit learning, absence of them is not necessarily evidence for implicit learning. Since consciousness is in some accounts a graded phenomenon (Overgaard, Rote, Mouridsen, & Ramsoy, 2006), it is also likely that potentially more sensitive measures of awareness such as a self report with scales (Overgaard et al. 2006) and remember/know judgments (Rajaram & Roediger, 1997) may capture more subtle states of conscious minds. Perruchet and Vinter (2002) develop a framework called the self-organizing consciousness and argue that all learned knowledge is initially explicit which results from conscious registration of new (fragmentary) input. Subsequently unconscious associative processes gradually create abstract knowledge by reformulating this "old" fragmentary knowledge.

Overall, while implicit learning continues to be investigated widely, there is still a considerable measure of disagreement about learning without awareness (see reviews referred to above). In particular, Shanks and St. John (1994) identified two criteria that must be met by studies claiming to demonstrate learning without awareness: (1) the information criterion, i.e., whether awareness assessed by tests is indeed responsible for task performance, and (2) the sensitivity criterion, i.e., whether tests of awareness are indeed sensitive to all necessary relevant explicit knowledge. Since the assessment of awareness itself may interfere with task performance and since awareness will decrease soon without rehearsal of attended information in memory (Robinson, 2003), assessing awareness "at" and "after" learning is difficult, though various methods have been used to do this (see Seth, Dienes, Cleeremans, Overgaard, & Pessoa, 2008).

Awareness in second language acquisition

The findings from implicit "artificial" grammar learning cannot be automatically assumed to transfer to "natural" second language acquisition. Artificial grammar lacks syntactic properties such as movement restrictions and semantic content that natural languages have (Van Patten, 1994). While Reber himself (Winter & Reber, 1994) occasionally concedes this point, with relation to child natural language acquisition, he claims that:

> [f]ormal instruction is essentially irrelevant, explicit cognitive processes are absent, learning is essentially unintentional, individual differences in the basic skill are minimal, language users have virtually no access to the rules of their language, and the end product of the acquisition process is a rich, complex, and abstract representation that mirrors that of the structure of the linguistic corpus. (Reber, 1997,p.139)

Similarly, Krashen (1981, 2003) distinguishes "subconscious" (second) language acquisition and "conscious" (second) language learning and claims that explicitly learned knowledge via error corrections cannot turn into acquired knowledge; it functions as a monitor for speech production only if students focus on form, have planning time, and have prior knowledge of the pedagogic rule.

Krashen's claim for the superiority of the subconscious acquisition process over the conscious learning process raised a number of counterarguments (Barasch & Vaughan James, 1994). For instance, MacLaughlin (1990) argues that it is difficult to define and distinguish conscious from unconscious processes empirically since both terms are used with different meanings in various contexts and thus the terms are not helpful for SLA theories.

Schmidt (1990, 1995a) also points out insufficiency in the definition of consciousness and distinguishes three levels of consciousness in learning: (1) learning without attention, (2) learning without intention, and (3) learning without (metalinguistic) understanding.

Intention to learn, Schmidt argues, may facilitate learning. Nevertheless intention itself has no causal role for SLA. This could be exemplified by studies of incidental vocabulary learning (i.e., learning vocabulary while reading a book. see Hulstijn, 2001, 2003). Concerning metalinguistic understanding, again it may facilitate learning but it is not necessary for learning as can be seen by the fact that in an implicit learning experiment subjects typically cannot verbalize the underlying rule (Schmidt, 1995) although they often demonstrate above chance performance in tests of learning.

However, Schmidt has claimed that attention at the level of 'noticing', or subjective awareness of a surface element in input is a necessary condition for SLA. Robinson (1995, 2003) argues that focal attention to and subsequent elaborative and maintenance rehearsal of input within working memory lead to awareness at the level of noticing.

This consciousness controversy, as in the case of implicit artificial grammar learning, has been tackled within both theoretical and laboratory SLA (Ellis, 1994; Hulstijn & DeKeyser, 1997; Hulstijn & Ellis, 2005; Hulstijn & Schmidt, 1994; Schmidt, 1995b). A laboratory study directly relevant to this paper is Robinson (1997) who investigated the relation between different levels of awareness and learning conditions. He found that learners in explicit learning conditions, where they were either instructed to search for or taught the rule underlying training L2 constructions, claimed to look for rules more than learners in an implicit learning condition where learners were instructed to memorize the training constructions. Although it was not statistically significant, learners in the instructed condition were twice as likely as learners in other conditions to verbalize rules. Robinson (1997) also found that there were significant main effects for rule verbalizability on learning L2 constructions, that is, those who developed metalinguistic awareness during the training session scored better on transfer test measures of learning than those who did not.

Focus on form, input flood, and frequency effects

Focus on form (Doughty & Williams, 1998a) is a technique which aims to raise learners' awareness of linguistic features of a target language without dispersing their attention to meaningful activities; primary focus is meaning. Long and Robinson (1998) define focus on form as follows:

> [f]ocus on form refers to how focal attentional resources are allocated. Although there are degrees of attention, and although attention to forms and attention to meaning are not always mutually exclusive, during an otherwise meaning-focused classroom lesson, focus on form often consists of an occasional shift of attention to linguistic code features... triggered by perceived problems with comprehension or production. (p.23)

There are many issues concerned with timing, target linguistic features, classroom settings, and curricular design of focus on form (Doughty & Williams, 1998b). In addition, focus on form can be operationalized in different ways: from the least obtrusive *input flood* to the most obtrusive *garden path technique* (Doughty & Williams, 1998c). Relevant here is input flooding, or extensive provision of target input. However, an important issue now arises: What kinds of input should be flooded? Recent usage-based models of language and language acquisition (Barlow & Kemmer, 2000; Robinson & Ellis, 2008a) provide clues for this.

Usage-based models assume that we develop adult-like abstract constructions by gradually schematizing or generalizing early learned concrete item-based constructions based on type-token input frequency (Ellis, 2002; Tomasello, 2003). Three frequency manipulations of input are described here.

Firstly, Casenhiser and Goldberg (2005) investigated an effect of skewed input, that is, providing an item with high token frequency, on children's learning of the novel construction. They found that children under the skewed input condition outperformed children under the balanced input condition where each item was provided with low token frequency on comprehension of the novel construction. Second, Childers and Tomasello (2001) studied the effect of input consistency on children's acquisition of English transitive construction. The results showed that providing pronouns and nouns in subject and object slots promoted more efficient generalization of the transitive construction than just providing various nouns in the slots. This study shows that consistency of a surrounding syntactic frame with variability within a main verb facilitates awareness of form-meaning mappings of the construction. Finally, Goldberg, Casenhiser, and White (2007) found that learners who were provided skewed input initially outperformed those who were provided skewed input randomly.

None of the above studies directly measured learners' awareness of the construction mappings. However, these manipulations of input and their effects on learners' awareness explicitly assessed by the test will provide an important evidence for the un/consciousness controversy within/outside of SLA in general. Moreover they will also provide an important implication for focus on form, specifically in the form of input floods. Thus the aims of the present study are twofold. First, by manipulating input skewedness and consistency, and order of skewed input as three independent variables, the relative effectiveness of awareness and perceived difficulty of L2 constructional mappings are considered. Second, effects of different levels of awareness on comprehension and production of the L2 constructions are investigated.

Target Second Language Constructions

The first construction to be investigated is the same as in Casenhiser and Goldberg (2005), the novel APPEARANCE construction which consists of subject noun phrase + locative noun phrase + nonce verb + morpheme -o (+ed). This construction depicts the scene where the animate entity suddenly appeared in the location denoted by the locative phrase. Except for the nonce verbs taken from Casenhiser and Goldberg (2005), Pinker (1989), and Robinson and Ha (1993), all words are actual English. As Casenhiser and Goldberg (2005) state, English does not have this construction with this meaning. An example is given below.

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

The second construction is a Samoan ergative construction (Robinson, 2005a). Samoan, an ergative VSO language, marks the subject of the transitive construction with an absolute case marker e. Thus the constituent order is verb + case marker e + subject noun phrase + object noun phrase. An example is given below.

(2) ave e le tama le taavale. (the boy drove the car.)
drove ergative the boy the car
(Robinson, 2005a: 245)

Research Questions

Research Question (1): Do skewed input, input consistency, and order of skewed input differently affect development of awareness of L2 constructions?

Though Casenhiser & Goldberg (2005), Goldberg et al. (2007), and Childers and Tomasello (2001) did not directly examine learners' awareness, it is expected that there will be a significant main effect of input skewedness, input consistency, and forward skewing. A 2 (+/- skewed) x (+/-consistent) x (+/-forward skewing), three-way ANOVA is used to analyze the data.

Research Question (2): Do skewed input, input consistency, and order of skewed input differently affect perceived difficulty of L2 constructions?

No prior studies motivate this research question. A 2 (+/- skewed) x (+/-consistent) x (+/-forward skewing), three-way ANOVA is used to analyze the data.

Research Question (3): Do different levels of awareness developed during learning affect task performances?

This question, inspired by Robinson (1997), is addressed by a one-way ANOVA and Kruskal-Wallis tests, taking four levels of awareness (unaware, noticing, metalinguistic word order awareness, and metalinguistic word order + morphology awareness) as independent variables. Following Schmidt (1990, 1995, 2001) who has claimed awareness at the level of noticing to be necessary and metalinguistic awareness to be facilitative for learning, it is hypothesized that those who developed metalinguistic awareness will comprehend and produce target constructions better than whose who did not.

Method

Participants. Participants were 137 undergraduate and graduate students, aged 18-65 (M = 23.4). Of these, 21 were exchange students (12 Korean, 5 Chinese, 3 American, 1 Thai). The Korean and Chinese participants were skilled Japanese speakers. Most Japanese were English majors although some were education and psychology majors. No subjects had any difficulty with instruction in English and they were allowed to ask questions in Japanese only during the instructional delivery. All participants agreed to participate in the experiments as volunteers and were paid 1,500 Yen (about 12 dollars).

Experimental groups. Eight experimental groups were created in terms of the [+/-skewed, +/-consistent, +/- forward skewing] combination. Participants were randomly assigned to one of eight experimental groups (see Table 1, 2, &3 for mean performance of each groups on three tasks). The [+skewed, +/-consistent, +/- forward skewing] groups received one nonce verb with high token frequency while the other verbs occurred two times (thus, 4-1-1-1-1) during the training session. On the other hand, the [-skewed, +/-consistent, +/- forward skewing] groups received each nonce verb with balanced frequency (1-1-2-2-2). The proforms were allocated to the subject and the locative noun slots in the [+/-skewed, +consistent, +/-forward skewing] groups while the concrete nouns were used in the [+/- skewed, -consistent, +/- forward skewing] groups. The [+/- skewed, +/- consistent, + forward skewing] groups received the verb with high token frequency initially while the [+/- skewed, +/- consistent, - forward skewing] groups received the verb with high token frequency last.

Measures and Procedures

Apparatus. Two forced-choice comprehension tasks run by the SuperLab software loaded on a Macintosh Mac Book Intel Core 2 duo.

Learning Task Sequences. Before engaging in the experiment, all participants were required to memorize 41 Samoan words and were tested until they got a perfect score. They individually engaged in three experimental tasks. The first task is the same as Casenhiser and Goldberg (2005) except that input was provided in the form of written stimuli not oral stimuli. After the training block, they were required to do a forced-choice comprehension task, and then a guided production task was conducted. After filling in a biographical form, they participated in a forced-choice comprehension task of the Samoan ergative construction. Finally a three-point awareness scale questionnaire and a five-point perceived constructional difficulty scale questionnaire were filled out.

Forced-choice APPEARANCE construction comprehension task. During the training session, participants watched the eight video clips where an animate drawing suddenly appeared in a specific location with a corresponding sentence. Each video clip with the construction was presented twice. Then participants were presented with two new video clips with one new APPEARANCE construction and were required to indicate the correct video clip by pressing a key. All experimental groups received these transfer set constructions filled with concrete nouns. The transfer set constructions consisted of six new transfer and six filler constructions which were made from the SVO transitive constructions. A dependent measure was the total number of correct choices.

Guided construction production task. After the forced-choice APPEARANCE construction comprehension task, the participant watched one video clip then received one paper packet which contained words on small pieces of paper. S/he was required to construct an appropriate construction matched with the video clip by aligning words in the correct order. Six packets were presented. The dependent measure was the total number of correct alignments. Since scores on the guided production task did not show normal distribution, nonparametric Kruskal-Wallis tests were used for statistical analyses.

<u>*Forced-choice Samoan ergative construction comprehension task.*</u> The procedure is the same as the APPEARANCE construction comprehension task except that only actual verbs were provided. Again scores on this task did not show normal distribution, nonparametric Kruskal-Wallis tests were used for statistical analyses.

For results of effects of skewed input, input consistency, and forward skewing on comprehension and production of the target constructions and correlations among these manipulations of input frequency, awareness and perceived difficulty of the target constructions, see Nakamura (submitted).

Results

Table, 1, 2, 3, and 4 present descriptive statistics for awareness and perceived difficulty scores as a function of experimental learning groups.

Table. 1 Mean awareness scores of the APPEARANCE construction

Group	N	M	SD
+S, -C, +F	19	1.316	.749
+S, -C, -F	20	.750	.851
-S, +C, +F	20	.400	.681
-S, +C, -F	17	.412	.618
+S, +C, +F	13	.308	.480
+S, +C, -F	16	.125	.342
-S, -C, +F	16	1.188	.981
-S, -C, -F	16	.875	.885

S = skewed, C = consistent, F = forward skewing

Table. 2 Mean awareness scores of the Samoan ergative construction

Group	N	M	SD
+S, -C, +F	19	2.000	.577
+S, -C, -F	20	1.950	.686
-S, +C, +F	20	1.700	.923
-S, +C, -F	17	1.412	.795
+S, +C, +F	13	1.154	.689
+S, +C, -F	16	2.000	.730
-S, -C, +F	16	2.125	.619
-S, -C, -F	16	1.812	.911

S = skewed, C = consistent, F = forward skewing

Table. 3 Mean perceived difficulty scores of the APPEARANCE construction

Group	N	M	SD
+S, -C, +F	19	3.57	1.170
+S, -C, -F	20	3.900	1.071
-S, +C, +F	20	4.250	.786
-S, +C, -	17	3.76	1.091
+S, +C, +F	13	4.231	.599
+S, +C, -F	16	4.000	1.211
-S, -C, +F	16	3.938	.929
-S, -C, -F	16	4.250	.856

S = skewed, C = consistent, F = forward skewing

Table. 4 Mean perceived difficulty scores of the Samoan ergative construction

Group	N	M	SD
+S, -C, +F	19	2.632	1.535
+S, -C, -F	20	2.750	1.293
-S, +C, +F	20	2.250	1.020
-S, +C, -F	17	2.529	.874
+S, +C, +F	13	2.692	.947
+S, +C, -F	16	3.000	1.549
-S, -C, +F	16	2.562	1.094
-S, -C, -F	16	2.750	1.125

S = skewed, C = consistent, F = forward skewing

RQ (1): Do skewed input, input consistency, and order of skewed input differently affect development of awareness of L2 constructions?

There was a significant main effect of input consistency for awareness scores of the APPEARANCE construction, F (1, 136) = 32.447, $p < .0001$. Scheffe tests showed that the [-consistent] groups together outperformed the [+consistent] groups (Mean difference = .710, $p <. 0001$. see Table. 5). There was also a significant main effect of forward skewing for awareness scores of the APPEARANCE construction, F (1, 136) = 4.295, $p = .0402$. Scheffe tests revealed that the [+ forward skewing] groups together outperformed the [-forward skewing] groups (Mean difference = .273, $p = .0314$. see Table 6).

Table 5 Mean awareness scores of the APPEARANCE construction for the [+consistent] and [-consistent] groups

	N	M	SD
+ Consistent	66	.318	.559
- Consistent	71	1.028	.878

Table 6 Mean awareness scores of the APPEARANCE construction for the [+forward skewing] and [-forward skewing] groups

	N	M	SD
+ Forward skewing	68	.824	.863
- Forward skewing	69	.551	.758

There was no main effect of skewed input for awareness scores of the APPEARANCE construction, F (1, 136) = 1.377, p = .2428. There were no significant interactions, skewed x consistent [F (1, 136) = .570, p = .4515], skewed x forward skewing [F (1, 136) = .782, p = .3781], consistent x forward skewing [F (1, 136) = 1.952, p = .1648], skewed x consistent x forward skewing [F = (1, 136) = .014, p = 9.077].

There was a significant main effect of input consistency for awareness scores of the Samoan ergative construction, F (1, 136) = 9.748, p = .0022. Scheffe tests showed that the [-consistent] groups together outperformed the [+ consistent] groups (Mean difference = .381, p = .0037. see Table. 7). There was also a significant interaction of skewed x forward skewing, F (1, 136) = 7.231, p = .0081.

Table 7 Mean awareness scores of the Samoan ergative construction for the [+consistent] and [-consistent] groups

	N	M	SD
+ Consistent	66	1.591	.841
- Consistent	71	1.972	.696

There were no significant main effects of skewed input and forward skewing for awareness scores of the Samoan ergative construction, F (1, 136) = .011, p = .9165, and F (1, 136) = .142, p = .7074, respectively. There were no significant interactions of skewed x consistent [F (1, 136) = .003, p = .9547], consistent x forward skewing [F (1, 136) = 3.140, p = .0788], and skewed x consistent x forward skewing [F (1, 136) = 2.817, p = .0957].

RQ (2): Do skewed input, input consistency, and order of skewed input differently affect perceived difficulty of L2 constructions?

A 2 (+/- skewed) x 2 (+/-consistent) x 2 (+/-forward skewing), three-way ANOVA showed that there were no significant main effects of skewed input, input consistency, and forward skewing for perceived difficulty scores of the APPEARANCE construction, F (1, 136) = .516, p = .4740, F (1, 136) = .713, p = .400, and F (1, 136) = .014, p = .9044. There were no significant interactions, skewed x consistent [F (1, 136) = 1.818, p = .1799], skewed x forward skewing, [F (1, 136) = .147, p = .7019], consistent x forward skewing, [F (1, 136) = 3.873, p = .0512], and skewed x consistent x forward skewing, [F (1, 136) = .129, p = 7204].

A 2 (+/- skewed) x 2 (+/-consistent) x 2 (+/-forward skewing), three-way ANOVA also showed that there were no significant main effects of skewed input, input consistency, and forward skewing for perceived difficulty scores of the Samoan ergative construction, F (1, 136) = 1.377, p = .2428, F (1, 136) = .071, p = .7909, and F (1, 136) = 1.139, p = .2879. There were no significant interactions, skewed x consistent [F (1, 136) = 1.017, p = .3152], skewed x forward skewing, [F (1, 136) = .002, p = .9612], consistent x forward skewing, [F (1, 136) = .113, p = .7374], and skewed x consistent x forward skewing, [F (1, 136) = .014, p = 9076].

RQ (3): Do different levels of awareness developed during learning affect task performances?

A one-way (unaware, noticing, metalinguistic word order awareness) ANOVA showed there was no main effect of levels of awareness on comprehension of the APPEARANCE construction, F (2, 135) = .544, p = .5814. Kruskal-Wallis tests showed that there were significant differences in production of the APPEARANCE construction, H = 4.514, p = .0058. Scheffe tests revealed that those who developed metalinguistic word order awareness outperformed those who did not (p = .0270. see Table. 8). Kruskal-Wallis tests also showed that there were significant differences in comprehension of the Samoan ergative construction, H = 4.454, p = 0520. Scheffe tests showed that those who developed metalinguistic word order + morphology awareness outperformed those who claimed to notice the rule (p = .0089), and that those who developed metalinguistic word order awareness outperformed those who claimed to notice the rule (p = .0025. see Table 9)

Table 8 Mean Rank orders of the production scores of the APPEARANCE construction as a function of levels of awareness.

	N	Mean Rank
Unaware	74	62.527
Notice	32	74.219
Metalinguistic word order	31	79.065

Note: no one developed metalinguistic word order + morphology awareness

Table 9 Mean Rank orders of the comprehension scores of the Samoan ergative construction as a function of levels of awareness.

	N	Mean Rank
Unaware	10	55.400
Notice	30	49.033
Metalinguistic word order	76	75.539
Metalinguistic word order + morphology	21	80.333

Discussion

Do skewed input, input consistency, and order of skewed input differently affect development of awareness of L2 constructions?

There were no significant main effect of skewed input but significant negative main effects of input consistency for awareness of both the APPEARANCE and the Samoan ergative construction. One possible interpretation is that unlike children L2 learners feel difficulty in ambiguity resolution of pronouns, that is, identifying referents of pronouns. In naturalistic conversation in L2, it will be the case; referents sometimes appear in there and then. However, the mapping between pronouns and referents was clear in the present experimental setting; concrete entities and locative objects appeared on the screen with a sentence. Indeed Nakamura (submitted) reported that there was a significant positive effect of input consistency on comprehension of the Samoan ergative construction but a negative effect on production of the APPEARANCE construction. This tension between the positive effect on comprehension of the Samoan ergative construction and negative effects on production of the APPEARANCE construction and on awareness of both target constructions cannot be fully resolved here. Since no one study has addressed the relation among input consistency, comprehension, production, and awareness of L2 constructions, we need further research on this issue.

In the case of input skewedness, the result is consistent with Nakamura (submitted) who reported that skewed input did not facilitate comprehension and production of the target constructions. This lack of significant positive effects clearly indicates that skewed input is not necessary for developing awareness of L2 constructional mappings.

The present study also revealed that forward skewing had a significant positive effect on awareness of the APPEARANCE construction. This is in a line with Goldberg and Casenhiser (2008) who suggested that providing items with high token frequency initially results in efficient constructional categorization, but with a modification; flooding input with a relatively high token frequency initially, whether it is skewed or not, facilitates awareness of constructional mappings and thus leads to better comprehension.

Do skewed input, input consistency, and order of skewed input differently affect perceived difficulty of L2 constructions?

As a three-way ANOVA showed, none of manipulations of input frequency affected learners' perceived difficulty of the target constructions. Thus it is likely that a way of delivering input does not affect perception of constructional difficulty. However there remain important issues for further research to address concerning this claim. We did not define constructional complexity and difficulty independently. With relation to analyzing learners' speech production, Robinson and Ellis (2008b) point out the necessity of theoretically motivated measurement. This is also applied to the definitional problem of constructional difficulty and complexity. How do we define constructional complexity and difficulty in a psycholinguistically motivated way beyond descriptive terms? In addition to this, Robinson (2005b) also argues that learners' individual differences such as aptitude contribute to perception of task difficulty. Clarifying these two issues will provide a clearer picture of relations among constructional difficulty, complexity, and learners' perception of these.

Do different levels of awareness developed during learning affect task performances?

Kruskal-Wallis tests revealed that those who developed metalinguistic awareness produced the APPEARANCE construction and comprehended the Samoan ergative construction better than those who claimed to notice the rule. Nakamura (submitted) also reported that there were significant positive correlations between production and awareness of the APPEARANCE construction and between comprehension and awareness of the Samoan ergative construction. These results together clearly confirm the necessity of awareness for learning that Schmidt (1990, 1995, 2001) has argued. Specifically, metalinguistic awareness beyond the level of noticing clearly facilitates learning (but cf. Roehr, 2008).

Furthermore, those who developed metalinguistic word order + morpheme e of the Samoan ergative construction outperformed those who claimed to notice the rule. There was no one who could develop metalinguistic knowledge of word order + morpheme -o of the APPEARANCE construction, compared with the morpheme e (N = 21, see Table. 10 and 11). This is understandable since the morpheme -o was attached to the main nonce verb and embedded between the main verb and the past morpheme -ed in a second presentation (note each picture with sentences were repeated twice during a training session). In other words, learners might misconstrue the morpheme -o to be a part of the main verb (e.g., moopo). On the other hand, the morpheme e stands as one word on its own. Casenhiser and Goldberg (2005) reported that the morpheme -o was not a helpful cue for children's acquisition of the constructional mappings. Goldschneider and DeKeyser (2001) in their meta-analysis show that perceptual saliency is one factor for accounting morpheme acquisition orders. Thus, this contrast of the perceptual saliency of the two morphemes clearly affected the development of metalinguistic awareness of word order + morphology, and in such a case more obtrusive focus on form techniques such as input enhancement will likely be needed to facilitate learning.

It should be added that individual differences in learners' cognitive abilities would play a significant role for developing metalinguistic awareness as well as input characteristics (e.g. saliency). Roehr (2008) speculates that learners' learning, aptitude, working memory, and analytic learning style are important for use of metalinguistic L2 knowledge, especially when a metalinguistic description of L2 constructions is difficult and thus is not easily amenable to explicit learning. Also important is learners' executive or attentional control of L1/L2 knowledge since focal attention is a prerequisite for awareness (Robinson, 2008; Schmidt, 2001).

Table. 10 Individual differences in awareness of the APPEARANCE construction as a function of experimental groups

	Unaware	Notice	Word order	Total
[+S, -C, +F]	3 (.16)	7 (.37)	9 (.47)	19
[+S, -C, -F]	9 (.47)	5 (.26)	5 (.26)	19
[-S, +C, +F]	14 (.7)	4 (.21)	2(.1)	20
[-S, +C, -F]	12 (.67)	5 (.28)	1 (.06)	18
[+S, +C, +F]	9 (.69)	4 (.31)	0	13
[+S, +C, -F]	14 (.88)	2 (.13)	0	16
[-S, -C, +F]	6 (.38)	1 (.06)	9 (.56)	16
[+S, -C, -F]	7 (.44)	4 (.25)	5 (.31)	16
Total	74 (.54)	32 (.23)	31 (.23)	137

Note 1: S = skewed, C = consistent, F = Forward skewing

Note 2: Since the number of subjects in each group is different, frequency ratios are provided in a bracket.

Table. 11 Individual differences in awareness of the Samoan ergative construction as a function of experimental groups

	Unaware	Notice	Word order	+Morphology	Total
[+S, -C, +F]	0	3 (.16)	13 (.68)	3 (.16)	19
[+S, -C, -F]	1 (.05)	2 (.11)	14 (.73)	2 (.11)	19
[-S, +C, +F]	2 (.1)	6 (.3)	8 (.4)	4 (.2)	20
[-S, +C, -F]	2 (.11)	7 (.39)	7 (.39)	2 (.11)	18
[+S, +C, +F]	2 (.15)	7 (.54)	4 (.31)	0	13
[+S, +C, -F]	1 (.06)	1 (.06)	11 (.69)	3 (.19)	16
[-S, -C, +F]	0	2 (.13)	10 (.63)	4 (.25)	16
[+S, -C, -F]	2 (.13)	2 (.13)	9 (.56)	3 (.19)	16
Total	10 (.07)	30 (.22)	76 (.55)	21 (.15)	137

Note 1: S = skewed, C = consistent, F = Forward skewing

Note 2: Since the number of subjects in each group is different, frequency ratios are provided in a bracket.

Conclusion

This paper addressed the relation among manipulations of input frequency, awareness, and perceived difficulty in the domain of second language construction learning, specifically focusing on learners' awareness. Metalinguistic awareness of an L2 construction was actually facilitative for L2 construction learning, which is in a line with Schmidt's claim that awareness is necessary for SLA. On the other hand, results of the effects of input frequency manipulations on learners' development of awareness were unexpected. Especially input consistency posed an awkward problem: it has both positive and negative effects on learning and developing awareness of L2 constructions. Since no other empirical study of this issue is available yet, further investigations of the role of input consistency as well as learners' individual differences in relevant cognitive abilities are clearly needed to clarify second language construction learning processes by input flooding.

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