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Learning without Awareness Reconsidered: A Replication of Williams (2005)

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1. Introduction

Researchers in the field of Second Language Acquisition (SLA) disagree as to whether or not learning can take place in the absence of awareness (e.g. Leow, 2000; Tomlin & Villa, 1994; Robinson, 1995b; Schmidt, 1990, 1993; Williams, 2004, 2005). On one hand, many researchers have found that some level of attention or awareness is necessary for linguistic development to occur (e.g. Leow 1997, 2000; Robinson, 1995a; Rosa & Leow, 2004; Schmidt, 1990, 1993). On the other hand, research has found evidence of implicit language learning, or learning in the absence of awareness (e.g. Williams, 2004, 2005). Hama and Leow (2010) performed an extension of Williams (2005), with various modifications to the methodology and participant inclusion criteria, and failed to find evidence of implicit learning of the form and meaning connections examined by Williams (2005). Thus, the question of whether the results of the Williams (2005) study can be generalized to other learner groups remains. The present study aimed to replicate Williams (2005) with the goal of gaining a more profound understanding of implicit learning by (1) examining learning in a group of learners with specific linguistic backgrounds and (2) utilizing a more fine grained analysis of awareness level.

2. Review of Literature

Current research indicates that a learner's conscious mental processes, or awareness, may play an important role in SLA (e.g. Leow, 1997, 2000; Robinson, 1995a; Rosa & Leow, 2004; Rosa & O'Neill, 1999; Schmidt, 1990, 1993). From a theoretical perspective, Schmidt (1995) defined two levels of awareness: awareness at the level of *noticing*, which entails attention with subjective awareness, and awareness at the level of *understanding*, which entails the ability to analyze, compare, or test hypotheses. Critically, according to Schmidt's Noticing Hypothesis (1990, 1995) awareness at the level of *noticing* is required for initial processing of input. Tomlin and Villa (1994) agreed that attention was needed for input to be processed, but objected to the need for subjective awareness. They posited three components that comprise attention: alertness, orientation, and detection, and argued that detection, the "cognitive registration of stimuli" (p. 190) that takes place outside of awareness, is the attentional level required for input to be processed. Robinson (1995b) addressed these opposing theoretical viewpoints, and put forward a new view of the role of awareness in second language (L2) processing. According to Robinson (1995b), detection occurs prior to noticing in the language acquisition process, but it is at the level of noticing that data in linguistic input can be made available for further processing. As with the theoretical perspectives of awareness in SLA, results from empirical research that addresses this issue are also divided. Many researchers have found that some level of awareness must be present in order for learning to take place (e.g. Leow, 1997, 2000; Robinson, 1995a; Rosa & Leow, 2004; Schmidt, 1990, 1993), but learning has also been evidenced among learners who did not report awareness (e.g. Williams, 2004, 2005).

Recent empirical work conducted by Williams has focused on whether development takes place among learners who are unaware (Williams, 2004, 2005). In his 2004 studies, Williams examined the possibility of learning form and meaning connections without awareness. In Experiment 1, participants

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learned eight novel nouns as translations of common English words, as well as eight novel determiners, learned as translations of the English words *the, a,* and *some*. The distribution of these determiners, which depended on the animacy of the object as well as on noun definiteness and number, was not explained to participants. Training was designed to encourage focus on both form and meaning. During the testing phase, participants were required to select between two determiner plus noun options to match a given English translation, one of which violated the animacy rules of the determiner. Responses to a post exposure interview revealed that 30 of the 37 participants did not become explicitly aware of the relationship between determiner choice and animacy. The analysis on data from only these unaware participants showed performance above chance on untrained items, providing evidence of generalizable implicit learning. Examination of individual differences, including linguistic background, revealed that generalization item performance was significantly better than chance among participants whose native language (L1) encoded grammatical gender, but not among participants whose L1 did not encode grammatical gender. There was also a correlation with implicit learning and the overall number of gendered languages known, suggesting an important role for language background in implicit learning, but leaving the question of the relative importance of L1 vs. L2 knowledge open for further research. The researcher offered three possible interpretations for the lack of learning among the learners with relatively little experience with gendered languages, stating that these data may indicate (a) that there are limitations of the implicit learning mechanism, (b) that the training task (translation) failed to encourage the depth of processing needed to learn form and meaning associations, or (c) that the target system was too complex for implicit learning. In order to test these possible interpretations, a second experiment was designed.

In Experiment 2, Williams (2004) attempted to reduce the potential impact of prior knowledge of gendered languages by minimizing similarities between gendered languages and the novel system. The target system was less complex, and the training task was designed to be more in depth and engaging. Participants were taught four novel determiners (translated as English *near* and *far*) and were informed that each word functioned like the English definite article, in addition to indicating distance. As in Experiment 1, determiner choice also depended on the animacy of the object. Based on responses to post exposure questioning, only three of the 17 participants became aware of the relevance of animacy, and all claimed to have developed this awareness during the testing phase. For the remaining 14 unaware participants, only performance on trained items was above chance level, with no evidence that the participant's L1 had an effect on performance. Implicit learning, the researcher posited, may be subject to influence from the size of the training set or language sample – relatively small in the (2004) experiments. In order for generalizations to emerge, a larger language sample may be needed. Williams also concluded that the implicit learning of form and meaning connections likely depends on prior knowledge and its potentially facilitative role.

Williams (2005) further examined the influence of prior knowledge and the nature of the target system on implicit learning. For these (2005) experiments, the same miniature noun class system employed in the previously described (2004) Experiment 2 was used, but the training task was altered in order to facilitate focus on meaning without increasing processing demands. In Williams (2005) Experiment 1, 41 participants with various language backgrounds were explicitly taught the *near* and *far* distinction between the determiners, but were not told that determiner choice also depended on the animacy of the object noun. Participants listened to sentences containing the novel determiners, and were asked indicate whether the novel word meant *near* or *far*. They were directed to repeat the sentence aloud and to form a mental image of the situation described by the sentence. After training, participants began the first testing phase, in which a written sentence context was provided, and participants were required to choose between two possible determiner options (presented with the same noun) to complete the sentence. After the testing phase, participants were asked what criteria they had used to make their decisions. If participants mentioned animacy, they were asked at what point during the study they had become aware of the relevance of animacy. If animacy was not mentioned, the participant completed a second testing phase, with instructions to try to "work out" the rules governing the use of the determiners. Both testing phases included trained and generalization items; the inclusion of the second testing phase was designed to provide a more accurate measure of when awareness was developed (e.g. during training or testing). At the end of the second testing phase, participants were asked to state the rule, or provide a guess of the rule.

Based on responses to questioning after the first testing phase, Williams determined that in Experiment 1, 33 of the 41 participants involved in the study remained unaware of the relationship between animacy and determiner choice. Five of the six participants who became aware during the training phase in Experiment 1 were native speakers of English, possibly reflecting different processing demands for native and nonnative speakers. In order to address this, a second experiment was conducted including only nonnative speakers of English. An additional modification from Experiment 1 was that each noun occurred in both singular and plural form with only one determiner during training. In Experiment 2, 17 of 24 participants remained unaware. In both experiments, although these unaware participants could not state the rule, they were able to choose the determiner that was appropriate for the noun's animacy at levels significantly above chance when faced with novel combinations of determiners and nouns. Successful generalization among the unaware participants in this study provided evidence of implicit learning of form and meaning connections. As in Williams (2004) Experiment 1, there was a correlation between test performance on these novel combinations (generalization items) and knowledge of languages (L1 and L2) that encode grammatical gender. This finding was interpreted as an indication of the importance of prior knowledge in implicit learning, with the suggestion that further research examine this variable more closely.

Hama and Leow (2010) performed an extension of Williams (2005) in which awareness was assessed at the encoding/training stage. The purpose of this study was to address the lack of corroboration between Leow (2000), which found no evidence of L2 development in unaware learners, and Williams (2005), which provided empirical evidence of unaware learning. In order to assess awareness, Hama and Leow (2010) administered a post exposure debriefing questionnaire as was used in the Williams studies and also asked participants to "think aloud" during the training and testing phases, in order to obtain a concurrent measure of awareness. These awareness measures were used to categorize learners into three awareness groups: (a) noticing, if some aspect of animacy was mentioned or commented upon; (b) understanding, when correct rules related to animacy were mentioned; and (c) no report, when the report did not fall under the coding categories of noticing or understanding.

Other methodological changes were made, including a revised testing phase that included a multiple choice task and a production task. Also, both training and testing tasks were presented aurally, in order to maintain a consistent modality. Furthermore, participants with backgrounds in a field related to language or linguistics were excluded. Results revealed that unaware learners did not demonstrate any significant animacy bias, but rather relied on distance information in both the multiple choice and production assessment tasks. Data from assessments gathered across different stages of learning indicated that unaware learners were unable to select or produce correct determiner and noun combinations at a level of above chance. As the focus of the study was on the role of awareness at different stages of learning and not on individual differences that may affect implicit learning, language background information was not analyzed.

In sum, although previous research in the field of SLA has supported the view that greater levels of awareness lead to greater L2 development (e.g. Leow 1997; Rosa & Leow, 2004; Schmidt, Rosa & O'Neill, 1999), recent research has also provided empirical evidence for unaware learning (e.g. Williams 2004, 2005). An extension of this work failed to find evidence of linguistic development among unaware learners (Hama & Leow, 2010). However, as suggested by Williams (2004, 2005), the role of learners' previous language experience may play an important role in implicit learning, and this factor this was not considered in Hama & Leow (2010). Thus, an important question remains: can the results of Williams (2005) be evidenced among new sets of learners?

3. Study Motivation and Research Questions

The overall goal of the present study was to replicate Williams (2005) and to further contribute to the field's understanding of the nature of unaware learning and of the importance of particular individual differences in successful L2 learning. In addition, the study aimed to address the call for a more fine grained approach to assessing learner awareness (Williams, 2005) by categorizing awareness at different levels, i.e., noticing, understanding, and no report, which were established based on the classification systems used by Rosa and O'Neill (1999) and Hama and Leow (2010). Our first research question parallels that of Williams (2005), with the addition of a more fine grained assessment of awareness:

RQ1: a. Will unaware learners show evidence of acquisition of form and meaning connections?
b. Will learners with awareness at the level of noticing show evidence of acquisition of form and meaning connections?
c. How will performance compare among unaware learners and learners at different levels of awareness?

Based on findings from Williams (2005), we hypothesize that learners who are unaware of the target rule (animacy) will perform above chance level on animacy based decisions, providing evidence of implicit learning – although this may be affected by language background (see Research Question 2). Previous research that has separated learners into the categories of no report of awareness, awareness at the level of noticing, and awareness at the level of understanding has found evidence of development among learners who show awareness at the level of noticing only, and increased development among learners who show higher levels of awareness (e.g. Leow, 1997; Rosa & Leow, 2004; Rosa & O'Neill, 1999). Following these studies, we predict that learners who demonstrate awareness at the level of noticing will perform above chance levels. It is further expected that learners with greater levels of awareness (understanding) will outperform learners who report lower levels of awareness (noticing) of the target rule.

The second research question addresses the role of language experience and other individual differences in linguistic development, thereby contributing to the discussion on the role for prior knowledge in implicit learning (Williams 2004, 2005) as well as to the exploration of broader questions about other external factors and their relationship with implicit and explicit learning.

RQ2: a. Is language background, specifically knowledge of languages that encode grammatical gender, related to successful unaware learning of form and meaning connections?
b. Are other external factors, specifically years of education, related to successful learning of form and meaning connections?

As was found in Williams (2004, 2005), a positive relationship between knowledge of languages that encode grammatical gender and implicit learning is expected. Piloting for the current study suggested that participants who had higher levels of education tended to search for rules more than participants with less education. Thus, for the present study, we also examined this variable in order to contribute to the discussion of individual differences and L2 learning.

4. Methods

4.1. Participants

Thirty participants (20 female) completed the study. All were undergraduate students (mean age = 18.93 years, *SD* = 0.14) at a large university, and were enrolled in an introductory psychology course. Participants received research participation credits for their psychology course for completing the study. In contrast to the parent study, which included both native and nonnative speakers of English in Experiment 1 and only nonnative speakers in Experiment 2, all participants in the present study were native speakers of English. This decision was made in order to provide a strict control for processing demands, given that all of the experimental tasks were conducted in English. Fifteen participants also reported a second native language, 11 of which encoded grammatical gender; these participants considered themselves fully bilingual. When asked to report L2 experience, 14 participants (7 bilingual) reported speaking an L2 at an intermediate level or better. The L2s reported were all gendered languages. The overall mean number of gendered languages (L1 and L2) spoken to an intermediate level or better among participants in the study was 0.80 (*SD* = 0.66), as none of the participants reported speaking more than one L2. An additional exclusion condition also differentiates the current participant pool from that of the parent study. Williams (2005) found a correlation between number of gendered languages known and implicit learning, but also a correlation between study of linguistics and number of gendered languages known, making it difficult to draw conclusions about which factor may be more relevant to successful implicit learning. Those studying language related disciplines were excluded from the present participant pool in order to examine the role of language knowledge independent of linguistic study.

4.2. Materials and Procedure

All materials and procedures followed those of Williams (2005) as closely as possible. Four novel determiners and their appropriate use, based on the distance and animacy of the object of the sentence, comprised the target structure: *gi* (near, animate), *ro* (near, inanimate), *ul* (far, animate), and *ne* (far, inanimate). Example sentences are provided below; see Williams (2005) for a complete list of stimuli:

> The little boy patted *gi tiger* in the zoo.
> We all admired *ne pictures* from the other side of the gallery.

After receiving general information about the study and giving consent to participate, participants completed a background questionnaire with the researcher. The questionnaire included information regarding participant age, years of education, native language, and experience with second languages. Participants then began the vocabulary pre training phase. Each participant was presented with four flashcards that had one of the four novel words printed on one side (e.g. *gi*), and the corresponding English word (either *near* or *far*) printed on the other. The English words were printed in different colors (red, blue, gray, and green for *gi, ro, ul,* and *ne*, respectively) in order to distinguish alternate forms for each meaning. The participants were asked to study the cards until they felt they had memorized the associations between the English word/color and the novel word.

After participants finished studying the cards, the task of producing a novel word when presented with the corresponding English word and color was practiced using a computerized version of the flashcards until participants could perform without error. Participants then completed a comprehension task with the new words, in which a recording of the researcher saying one of the novel words was played on the computer and the participant indicated whether the word meant *near* or *far*. When an error was made during this task, participants received feedback indicating that their response was incorrect. This portion of the vocabulary pre training phase included 12 repetitions of each item, presented in random order.

Vocabulary pre training was followed by the training phase. Participants read instructions for the task on the computer screen with the researcher and were able to ask clarification questions if necessary. During the task, participants heard recorded sentences, each of which contained one of the four novel words. The stimuli sentences were presented in two alternating sets of 24, repeated three times each, with the presentation order of the stimuli altered. Participants were instructed to listen to each sentence and repeat it exactly aloud. They were further instructed to state whether the object was *near* or *far* from the subject of the sentence, based on context and the previously learned meaning of the novel word, and to form a mental image of the general situation described by the sentence. The participants were told that there would be a memory test afterward that would require them to understand the context and general idea of each sentence.

After training, participants were told that before beginning the memory test, they would perform an exercise with new sentences; this was the first testing phase. For each test item, the sentence context was first displayed on the computer screen (e.g., *The lady spent many hours sewing…*). Participants clicked to continue, and were presented with alternative noun phrases to complete the sentence (e.g. *gi cushions / ro cushions*), both of which meant either *near* or *far.* The correct selection depended solely on the animacy characteristics of the object, a distinction that participants had not been taught. Participants were asked to select the noun phrase that seemed "more familiar, better, or more appropriate" based on the sentences they had heard during training. Stimuli sentences included two sets of generalization items, Generalization 1 (*N*=8) and Generalization 2 (*N*=8) that were preceded by sets of trained items, Trained 1(*N*=2) and Trained 2 (*N*=8). The sentences were pseudo randomized based on animacy in order to reduce the possibility of making comparisons between successive items (e.g. a $\text{far}_{\text{animate}}$ followed by a $\text{far}_{\text{inanimate}}$). Participant responses for each item were recorded by a researcher.

A yes/no recognition memory test was then provided to each participant. The test contained 10 sentences from the training phase, and 10 new sentences. Participants simply indicated whether they had seen or heard each sentence during the study. After completing the memory test, a debriefing questionnaire and interview was administered by the researcher. Participants were first asked what criteria they had used to make their decisions during the testing phase, then, more specifically, how or when they knew to use each of the four novel words. If animacy was mentioned, the participant was asked at what point in the study they became aware of the relevance of animacy. When animacy was not mentioned, the researcher asked whether the participant had looked for rules regarding the use of any of the four novel words at any point in the study. Finally, the participant was told that there was a rule used to govern the use of the determiners, and asked to provide a guess as to what that rule could be. This questionnaire provided awareness information that determined whether or not the participant would move on to the second testing phase. Participants who had mentioned animacy or who provided a correct rule were finished with the study; participants who provided no rule or an incorrect rule completed the second testing phase.

At the onset of the second testing phase, participants were asked to try to complete the sentences again, but this time with the goal of trying to work out the rule that dictates the appropriate word to end the sentence. Participants were told that they would first see items that should seem more familiar (trained items), and that they could use their responses to these items as a basis for detecting with some possible rules. First, all 10 trained items were presented, followed by 16 generalization items (Generalization 3). The second testing phase was then followed by another set of debriefing questions, in which participants were asked to state the rule governing usage of the novel words. If they did not mention animacy, the researcher asked if the participant had ever considered that some words were used with living objects, while others were used with nonliving objects. Responses were recorded and coded for awareness information. The entire procedure took around 90 minutes.

4.3. Analysis

Awareness was initially assessed using participant responses to the first debriefing questionnaire and interview. Two awareness classifications were used: The first followed Williams (2005) in order to ensure that results could be directly compared between the present study and the parent study. Under this classification protocol, any mention of animacy resulted in a classification as Aware and failure to mention animacy resulted in a classification as Unaware. The second classification protocol, adapted from Rosa and O'Neill (1999) and Hama and Leow (2010), split participants into three awareness groups (No Report, Noticing, and Understanding) in order to provide a more fine grained analysis of awareness. For this classification protocol, participants who did not report having looked for or having noticed rules and who could not state a rule were categorized as No Report. Participants who reported having looked for and/or noticed rules, and/or provided a partial or incorrect rule were classified as Noticing. Finally, participants were placed in the Understanding group if they stated a full, correct rule regarding animacy and distance.

In order to address research questions 1a and 1b, *will unaware learners and learners with awareness at the level of noticing show evidence of acquisition of form and meaning connections?*, one sample *t* tests were run to determine whether each awareness group (as determined by both classification protocols) performed at better than chance level. Research question 1c asked *how will performance compare among unaware learners and learners at different levels of awareness?* For the first classification protocol, this question was addressed using paired samples *t* tests to compare the accuracy of participants in the Aware and Unaware groups on each set of items from the first testing phase (Trained, Generalization 1, and Generalization 2, as well as Mean Generalization score). For the second classification protocol, a repeated measures ANOVA was used to compare accuracy among the No Report, Noticing, and Understanding groups across testing phase item sets. Learner performance in the second testing phase was also examined.

The second research question addressed individual differences, i.e., knowledge of languages that encode grammatical gender and years of education, and their relevance to successful learning. To address these questions, a paired samples *t* test was used (following Williams, 2005) in order to determine if generalization scores were significantly higher for participants who spoke a gendered L1 compared to those that did not within the Unaware group. In addition, correlations were run to examine the relationship between scores on generalization and trained items with (1) the number of gendered L2 languages spoken to an intermediate level or better and the overall number of gendered languages (L2 and L1) spoken to an intermediate level or better (also following Williams, 2005), and (2) the years of education. These correlations were run independently for each awareness group from both classification protocols in order to determine whether the relationship plays out differently at different levels of awareness.

5. Results

Our first research question examined the relationship between awareness and the acquisition of form and meaning connections. First, this question was examined in regard to the first classification protocol, i.e., Aware and Unaware learners. The results showed that a number of learners, 9 out of 30, became aware of the relevance of animacy by the end of the first testing phase. In general, these Aware learners were more accurate during testing compared to Unaware learners for both trained and generalization items. Analysis of this data revealed that the Unaware participants performed above chance level on trained items only. Surprisingly, the Aware participants, who mentioned animacy as a criterion for selecting the appropriate determiner after the first testing phase, also failed to perform above chance on generalization items (see Table 1 for descriptive statistics and *t* test results). In the present study, no significant differences were found between the Aware and Unaware groups, although a trend to a difference favoring the Aware group was found for trained items ($t(28) = 1.92$, $p = .065$).

Table 1

Mean percentage correct, standard deviations, and t values for deviation from chance for Unaware and Aware participants at the first testing phase

Group	Generalization 1	Trained 1	Generalization 2	Mean Generalization
Unaware				
M	52.98	62.38	54.76	53.87
SD	24.01	18.14	19.15	18.06
t(20)	0.57	3.13**	1.14	0.98
Aware				
M	52.78	76.67	63.89	58.30
SD	24.83	20.00	23.75	22.75
t(8)	0.34	4.00**	1.75	1.10

** $p < .01$

The relationship between learning and acquisition of form and meaning connections was also examined in regard to the second classification protocol, i.e., learners grouped as No Report, Noticing or Understanding. The data showed that (a) learners with awareness at the level of understanding ($N = 4$) are generally more accurate than learners with awareness at the noticing ($N = 13$) and no report levels ($N = 13$), and (b) all learners are generally more accurate on trained items than on untrained items. Statistical analysis showed that participants in the No Report group performed significantly above chance on trained items only. Participants in the Noticing group did not perform significantly above chance for any items, although there was a trend toward a significant difference from chance for trained items. Finally, within the Understanding group, scores were significantly above chance for both trained items and the second set of generalization items. (See Table 2 for descriptive statistics and *t* test results). The repeated measures ANOVA comparing performance of the three awareness groups revealed a main effect of Set ($F(2, 54) = 6.00$, $p = .004$) but only trend for Group ($F(2, 27) = 3.00$, $p = .067$). No interaction between Set and Group was found ($F(4, 54) = 1.06$, $p = .388$). These results indicated that learners performed better on the trained items ($M = 66.67\%$, $SD = 23.83$) compared to the generalization item sets (Generalization 1: $M = 52.92\%$, $SD = 23.83$; Generalization 2: $M =$

57.50%, *SD* = 20.66), but that there were no significant differences among the three awareness groups (*p*s > .068).

Learner performance at the second testing phase was also examined. After the second testing phase, as all participants were directed to look for rules and all provided a guess of the rule, the No Report group was eliminated, resulting in two groups: Aware, which at this second testing phase was the same as Understanding, and Unaware, which was the same as Noticing. Only two of 21 participants became aware of the relevance of animacy during the second testing phase, and only one of these could state a full, correct rule. Because only two participants became aware during the second testing phase, statistical analysis of performance was impractical for this group. Descriptively, however, on both trained and generalization items presented during the second testing phase, Aware participants performed better than Unaware participants (Trained - Aware: *M* = 65.00%, *SD* = 35.36, Unaware: *M* = 53.20%, *SD* = 17.34; Generalization - Aware: *M* = 84.40%, *SD* = 22.10, Unaware: *M* = 49.34%, *SD* = 13.65). For the Unaware group, the analysis showed that performance was not significantly above chance level for trained ($t(18) = .794$, $p = .438$) or generalization items ($t(18) = 0.210$, $p = .836$) seen during the second testing phase.

Table 2

Mean percentage correct, standard deviations, and t values for deviation from chance for No Report, Noticing and Understanding participants at the first testing phase

Group	Generalization 1	Trained 1	Generalization 2	Mean Generalization
No Report				
M	48.08	64.62	52.88	50.48
SD	22.73	17.61	18.51	16.03
t(12)	-0.31	2.99*	0.56	0.11
Noticing				
M	55.77	60.77	56.73	56.25
SD	28.80	18.47	23.17	22.24
t(12)	0.84	2.10^	1.05	1.01
Understanding				
M	59.38	92.50	75.0	67.19
SD	27.72	5.00	10.21	17.21
t(12)	0.68	17.00***	4.90*	2.00

^ $p < .1$
* $p < .05$
*** $p < .001$

Our second research question asked whether particular individual differences, specifically, knowledge of languages that encode grammatical gender and years of education, were relevant to successful unaware and aware learning of form and meaning connections. First, in regard to speaking gendered languages, the comparative analysis showed that Unaware participants who spoke a gendered L1 did not outperform Unaware participants who did not (Gendered L1: *N* = 6, *M* = 54.17%, *SD* = 0.50; Genderless L1: *N* = 15, *M* = 53.87%, *SD* = 0.50; $t(21) = -0.047$, $p = .963$). The planned correlational analysis for the number of gendered L2s spoken could not be performed because none of the participants spoke more than one L2 at an intermediate level or better, and the correlation between the total number of gendered languages spoken (including L1 and L2) did not significantly correlate with mean generalization performance during the first testing phase in the present study (Unaware: $r = 0.165$, $p = .237$; Aware: $r = 0.275$, $p = .237$). Second, in regard to years of education, a significant correlation was revealed only for Aware learners between years of education and performance on generalization items (Generalization 1: $r = 0.823$, $p < .003$; Generalization 2, $r = 0.680$, $p < .022$; Mean

Generalization: $r = 0.804$, $p < .005$) and a trend for trained items ($r = 0.553$, $p < .061$). No other significant correlations were found with either number of gendered languages spoken or years of education for the Unaware group or for the No Report, Noticing or Understanding groups.

6. Discussion

The current study examined the possibility of learning form and meaning connections without awareness, as evidenced in Williams (2004, 2005), within a new learner group, as well as the relationship between linguistic and educational background and L2 learning. Our first research question (RQ1a) asked whether unaware learners would show evidence of acquisition of form and meaning connections. As we aimed to carry out a faithful replication of Williams (2005) in order to determine whether the findings were generalizable to other groups of learners, we provide a detailed discussion of our results in light of the results reported in Williams (2005).

During the first testing phase, Williams (2005) found that learners who were unaware of the target rule performed significantly above chance on both sets of generalization items, as well as on trained items. In the present study, when using the Aware and Unaware classifications employed by Williams (2005), there was no evidence of implicit learning: Unaware participants performed above chance level on trained items only. Interestingly, Aware participants, who mentioned animacy after the first testing phase, also failed to perform above chance on generalization items. Williams (2005) found a significant difference between scores for Aware and Unaware learners on trained items and both sets of generalization items, with Aware learners outperforming Unaware learners. In the present study, no significant differences were found between these groups, although a trend to a difference favoring the Aware group was found for trained items.

Williams (2005) also looked into awareness after the second testing phase and its relationship to accuracy. In the original study, Experiment 1, 11 of 33 participants became aware during the second testing phase. Participants who were aware of the rule after the second testing phase significantly outperformed those who remained unaware of the target rule on both trained and generalization items presented during this phase. In the present study, given that only 2 of 21 participants became aware of the relevance of animacy during the second testing phase, and only one of these could state a full, correct rule, statistical analyses comparing Aware and Unaware learners were impractical. Descriptive differences between the two groups, however, parallel the results of Williams (2005): On both trained and generalization items presented during the second testing phase, Aware participants outperformed Unaware participants.

Theoretical claims (e.g. Schmidt 1990, 1995) and empirical evidence (e.g. Leow, 1997; Rosa & Leow, 2004) indicate that awareness at the level of noticing is meaningfully distinct from no report of awareness and from awareness at the level of understanding. Taking into consideration this theoretical and empirical framework, research question 1b motivated a more fine grained analysis of awareness level using the levels of understanding, noticing, and no report, adapted from Rosa and O'Neill (1999) and Hama and Leow (2010). The analysis revealed that participants aware at the level of understanding did perform above chance on generalization items. No evidence of learning was found for participants classified as Noticing or No Report, although generalization item scores were descriptively higher within the Noticing group than the No Report group. In all, the current study did not find evidence for learning without awareness, or of learning with awareness at the level of noticing. The only learners who were able to perform at levels significantly above chance on generalization items were those who had reached awareness at the level of understanding.

Hama & Leow's (2010) extension of Williams (2005) also failed to find evidence of learning without awareness. As the authors point out, however, significant methodological modifications in the 2010 study make direct comparison between the two studies complicated. The present study, however, made no methodological changes from Williams (2005), and, even when using the same awareness classification system as Williams, failed to find above chance performance for unaware learners on generalization items. The discrepancy in the results between the current study and Williams (2005) leads to the question: What makes these participants different from the Williams (2005) participants? Our second research question addressed this issue.

Williams (2004, 2005) concluded that implicit learning of form and meaning connections likely depends on the nature of participants' prior knowledge as well as on the nature of the system being learned. In light of the inconsistent results of Williams (2005) and Hama and Leow (2010), among others, we aimed to contribute information regarding which individual differences are relevant to successful unaware and aware learning of form and meaning connections. Williams (2005) found a significant correlation between number of gendered languages known at an intermediate level or better and scores on generalization items among participants who were unaware of the target rule. The current study did not find evidence for a relationship between knowledge of gendered languages and performance in Aware or Unaware learners. However, this null result may have been affected by the fact that (a) accuracy scores on generalization items among the Unaware participants were not significantly higher than chance and (b) there was little variation among participants in terms of number of gendered languages known. Williams (2005) also found that unaware subjects who studied language related disciplines (linguists) significantly outperformed nonlinguists. In the original study, the linguists were also the participants who knew the greatest number of gendered languages (2.17 vs. 1.48 among nonlinguists), making it difficult to determine which factor was more important for implicit learning.

The difference between linguists and nonlinguists in Williams (2005) is particularly of interest in view of the fact that linguists were excluded from the participant pools in both Hama and Leow (2010) and in the present study, both of which failed to find evidence of implicit learning. It is important to note, however, that the relevance of knowledge of gendered languages vs. the study of language related disciplines still remains unclear based on the findings of the present study. Due to a lower mean number of gendered languages known among participants in the present study (0.80) in comparison with participants in Williams (2005) (1.68), it is still not possible to determine whether the study of language related disciplines or knowledge of gendered languages is more relevant to implicit learning of the determiner system under investigation. Further study is needed in order to better understand the role of experience with speaking, studying and learning languages in subsequent implicit language learning.

Although the findings of the present study cannot directly address which individual differences are associated with successful unaware learning, the data do indicate a relationship between years of education and successful *aware* learning. A significant and large correlation was found between years of education and accuracy on generalization items for the Aware participants. Participants in the present study differ from the participants of Williams (2005) in terms of education (all undergraduate students vs. 88% undergraduate or graduate students) and age (mean age of 18.9 vs. 24.9). These background differences may also have contributed to learning disparities between the two groups. Future studies interested in individual differences and learning may wish to consider these variables in addition to linguistic factors.

The present study was unable to replicate the findings of Williams (2005). Failure to find learning without awareness among participants in the current study is consistent with previous research (e.g. Hama & Leow, 2010; Leow 1997, 2000; Robinson, 1995a; Rosa & Leow, 2004; Schmidt, 1990, 1993) as well as with theoretical perspectives that claim there is a role for awareness in L2 learning (e.g. Schmidt, 1990, 1995; Robinson, 1995b). Failure to corroborate the results of the parent study may be due to the fact that the background of participants, including linguistic knowledge, fields of study, years of education, and age, in the present study was quite distinct from that of participants in Williams (2005). Furthermore, whereas Williams (2005) included nonnative speakers of English, participants in the present study were all native speakers of English. It is very possible that this difference had an impact on the processing load of the training task, potentially affecting implicit learning levels. It is difficult to pinpoint the exact cause for inconsistent results between the present study and Williams (2005), although given the demonstrated relevance of language experience in learning of this system, linguistic and educational differences between the two participant groups provide a credible explanation.

7. Conclusion

The present study sought to replicate the findings of Williams (2005) with regard to the unaware learning of form and meaning connections. Two modifications were made to the participant pool in that (1) participants who were not native speakers of English and (2) participants who were studying language related disciplines were excluded. The present study failed to find evidence of learning without awareness among this modified participant group. Further investigation into the individual differences that may affect learning, both with and without awareness, is clearly warranted. The incongruity between the findings of Williams (2005), where evidence of implicit learning was found, and those of Hama and Leow (2010) and the present study, where no evidence of implicit learning was attained, further illustrates the need for careful consideration and examination of individual differences in studies of implicit learning, and throughout second language acquisition research.

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