The Effects of First Language on Learning an Artificial Language

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This research investigates adult learning of a miniature artificial language focused on nominal morphology and the effects that first language (English vs. Japanese) have on such learning. By including two groups of participants in the research, native speakers of English and Japanese — languages that differ radically with respect both to each other and to the properties of the artificial language to be acquired — the research contributes to understanding the relative importance to learning of internal factors such as L1 knowledge, a matter of continuing debate (Luk & Shirai, 2009). By focusing on nominal morphology, the research hopes to extend findings that have been established to date primarily by studies of the learning of verbal morphology, argument structure, and individual constructions to the relatively less studied domain of nominal morphology (e.g. singular-plural) and to noun classes (e.g., count-mass) rather than isolated constructions.

By incorporating into the learning task semantic features that are grounded in comparative studies of nominal morphology in the world’s languages, the research also aims to address a bias in the established SLA literature to date towards viewing the acquisition of morphology as primarily a matter of acquiring linguistic forms, with little attention to semantics. In these various ways, the research reported here is intended to contribute new knowledge to our understanding of the processes of second language acquisition, especially with respect to the learning of functional morphology, which has been viewed as a major theoretical challenge by researchers working within such diverse perspectives as the processing-instructional paradigm (DeKeyser, 2005; VanPatten, 2002) and generative SLA

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Studies in the Humanities vol.99

(Hawkins & Chan, 1997; Lardiere, 2007; Prévost & White, 2000; Slabakova, 2008).

Learning second language morphology is difficult

English is not particularly rich in inflectional morphology. For instance, English does not mark nominal case (as do German and the Slavic languages) or grammatical gender (as do all the Romance languages) and does not have either a large number of noun classes, such as those found in Swahili and many Niger-Congo languages (Pinker, 1994) or an elaborate system of classifiers as is found in Chinese, Japanese, Korean and Persian. English verbal inflections are also limited, compared to many languages. For example, although many languages require verbs to agree with their subjects in terms of person, number and gender in all tenses, English marks only the present tense verb and only for third singular subjects. Nevertheless, English inflectional morphology — including nominal morphology — poses serious challenges for the L2 learner. The possessive morpheme -s, for example, has frequently been found to be as difficult as the notoriously late acquired 3rd person singular -s in verbal morphology (Krashen, 1977; Goldschneider & DeKeyser, 2001). The English article system (and the count: mass distinction that interacts with it) is another notorious problem area, particularly for speakers whose first languages do not have articles.

In this respect, first and second language learning differ. Early work in the first language acquisition of English grammatical morphology by such scholars as Cazden (1968) and Brown (1973) established the widely held view that English morphology is mastered early in L1 by age four for normal children. For example, Brown demonstrates that English-speaking children are likely to go through similar developmental stages when acquiring the English plural morpheme, one of the first inflectional morphemes to be acquired by English speaking monolingual children. Up to 20 months of age, the regular plural morpheme rarely appears in their utterances, although irregular plurals may be used correctly. During the transitional stage, children make various types of errors (Brown,
The most common type of error is failing to supply a plural morpheme to regular plural nouns, or failing to transform irregular nouns into their plural forms in required contexts. Children also make several types of overgeneralization errors (Brown, 1973; Mervis & Johnson, 1991). In obligatory plural contexts, children may add the regular form of the plural morpheme to roots that have irregular plurals (e.g., mans* instead of men), or may add the regular form to the irregular plurals (e.g., mens* instead of men). Children may also add the plural morpheme to mass nouns (e.g., waters* instead of water), to singular objects (e.g., cups instead of a cup), or to adjectives or quantifiers (e.g., purples* instead of purple). In spite of these errors, most normal children reach the 90% accuracy criterion for the plural morpheme quickly, between 25-34 months of age.

Equivalent research in second language acquisition shows quite different outcomes, indicating that mastering English morphology is a daunting task for L2 learners. In particular, speakers of classifier languages (i.e., Mandarin Chinese, Japanese, Vietnamese) frequently exhibit incorrect use of the plural morpheme in English, even at advanced levels of proficiency. Lardiere (2007) observed one adult learner of English. Her subject "Patty" had been living in the United States for more than 25 years by the time Lardiere interviewed her. While Patty is a native speaker of Chinese, her everyday language environment at the time was nearly exclusively English. In her analysis, Lardiere points out that Patty's knowledge of English syntax was mostly native-like, but her use of morphology, including the past tense in verbal morphology and the plural morpheme in nominal morphology, was not. The data demonstrate that Patty achieved less than 60% accuracy of plural morpheme use in obligatory contexts, even though she had favorable acquisition circumstances over a long period of time in terms of immersion, education level, and success in her target language community. The contrast between Patty's target-like use of English syntax and non-target-like use of plural morphology suggests that morphology is
both more difficult than syntax and more susceptible to fossilization. Slabakova (2008) also points out that L2 learners are often accurate in the acquisition of syntactic and semantic categories while they consistently fail to produce accurate morphology, arguing that acquisition of L2 morphology is "the bottleneck in the flow of acquisition" (p. 100).

Within generative theory, several hypotheses have been advanced to account for the special difficulty of acquiring inflectional morphology, not only for L2 learning but also in individuals with specific language impairment (SLI) (Marchman, Wulfeck, & Weismer 1999; Oetting & Rice, 1993) and in heritage language learners who acquired a language in childhood and either incompletely acquired their first language or acquired it but experienced later attrition (Polinsky, 2008). Klein & Perdue (1997) have proposed that uninstructed adult language learners universally develop a simple, morphologically impoverished form of language, the so-called “basic variety,” which reflects only the core attributes of the human language capacity. Hawkins and Chan’s (1997) Failed Functional Features Hypothesis proposes that morphosyntactic categories that are not activated in the L1 are inaccessible when learning an L2. In contrast, Prévost and White’s (2000) Missing Surface Inflection Hypothesis claims that the absence of a surface form in production does not mean that the underlying knowledge is lacking from a learner’s grammar. For example, Ladiere (2007) noted that while Patty supplied few instances of the past tense morpheme in speech, she did much better when writing, suggesting that the problem might be phonological transfer (Chinese disallows final consonantal clusters, which are present in many past tense verbs such as *dropped* [pt] and *walked* [kt], as well as plurals such as *dogs* [gz] and *cats* [ts]), rather than lack of a functional feature.

Other acquisition theorists have argued that no special theoretical apparatus is required to explain the difficulties associated with morphology (Tomasello, 2003). DeKeyser (2005) has identified factors that make L2 morphology difficult to learn: complexity of linguistic form, complexity of meaning, complexity of form-meaning relationship, and novelty of linguistic meaning. With respect to plural
marking and number, Corbett (2000) demonstrates that these grammatical categories vary greatly from language to language. Some languages have more sophisticated categories than simple singular: plural or mass: count dichotomies, while other languages do not have such noun classes at all.

Cognitive linguists argue that grammatical categorizations of the mass-count distinction depend on how language users conceptualize experience, and they are often constrained by the cultural conventions to which speakers are accustomed (e.g., Croft, 2001; Shariﬁan & Lotﬁ 2003). Langacker (1987, 2008) and Wierzbicka (1983, 1988) propose that grammatical categories such as noun classes are semantically motivated, challenging the traditional idea that grammar is entirely arbitrary with respect to meaning (e.g., Bloomﬁeld, 1933) but can be conceptualized differently in different languages.

Theoretical accounts of the count-mass distinction also investigate the question of whether the speakers of different languages perceive objects differently (e.g., Imai & Gentner 1997; Inagaki & Barner, 2009). Does L1 affect our conceptual representations of objects? Do all humans share a universal conceptual repertoire, or does language actually supply certain concepts? The answers to these questions are important not only to understanding how humans acquire ontological knowledge, but are also essential to understanding how learners acquire nominal morphology in a second language.

Another important theoretical issue regarding L2 morphological learning concerns the effect of the first language on learning processes. It has generally been assumed that the effect of the first language is not very important in the acquisition of grammatical morphemes (e.g., Ellis, 1994; Mitchell & Myles, 2004). However, as we have seen, the L2 morpheme-order research sometimes alludes to such L1 effects on the acquisition of nominal morphology (e.g., Bialystok & Miller, 1999). In a review of morpheme studies conducted with native speakers of Japanese, Korean, Chinese, and Spanish, Luk and Shirai (2009) found that Spanish L1 learners’ acquisition order generally conforms to the “natural order” found in many studies (Krashen, 1977), but speakers of Asian languages such as Chi-
Chinese, Japanese, Korean, and Vietnamese mostly acquired plural -s much later and possessive earlier than predicted. This suggests that learning L2 morphology can be expedited or hampered by linguistic processing routines established in the first language.

Luk and Shirai (2009) argue that there is strong L1 influence of morpheme acquisition order in L2 English and suggest that L2 morphological learning is much more complex and varied when languages besides well-studied European languages are considered. The aim of their study was to examine whether the proposed L2 morpheme acquisition order is actually impervious to L1 effects. They focused on the morpheme acquisition orders of L2 learners of English whose first languages were Japanese, Korean, Chinese, and Spanish.

In their meta-analytic review, Luk and Shirai showed that Japanese, Korean, and Chinese learners deviate greatly from the morpheme acquisition order proposed by Krashen (1977, 1988), finding that they acquire plural -s and the English articles much later than predicted by the Natural Order Hypothesis, and acquire possessive -s earlier than predicted. Luk and Shirai claim that these obvious deviations can be explained by the L1 effects, specifically the lack of articles and plural morphology in Japanese, Korean, and Chinese. Luk and Shirai suggest that L1 effects are strong enough to discount the proposed morpheme order:

[T]he acquisition order of grammatical morphemes is highly affected by the learner’s L1 such that it is possible to predict, to some extent, what is difficult and what is easy for language learners based on their L1s. Since the study by Dulay and Burt (1974b), the “invariant” acquisition order of grammatical morphemes has been seen as evidence for the claim that language learning goes through universal processes impervious to L1 transfer. However, this article shows that L1 effects are strong, which means that learners are indeed heavily influenced by the previous knowledge of their native languages. (Luk & Shirai, 2009, p. 742)
Luk and Shirai continue:

For example, because Japanese does not have any plural markers, Japanese native speakers are trained to interpret plurality from other sources, such as discourse and context. When they learn the plural -s, the stronger cue (i.e., discourse and context) overshadows the marker -s. This may prevent them from processing the plural marker as an important piece of information. This may explain why the absence of a morpheme in a learner’s L1 will create difficulty for the acquisition of that morpheme in the L2. (Luk & Shirai, 2009, p. 740-741)

Based on these findings, Luk and Shirai speculate that L1 may work as a filter through which the L2 learner processes incoming information of L2 input. They argue that since L2 learning mostly takes place after the network of L1 language representation has been established and deeply entrenched over years of learning and processing in the L1, L2 signals may be scattered, residing with entrenched learned L1 items. L1 representation is highly entrenched because of many years of experience with the language, and it is very difficult to create a new separate system of L2 representation, which becomes even more difficult when learners' experience with their L1 increases. Luk and Shirai conclude that viewing L2 morphological acquisition in this way creates an alternative account, which is not consistent with the view that morpheme acquisition order is impervious to L1 effects. Rather, because L2 learning occurs after the L1 network has been created, there must exist very different morpheme acquisition orders depending on learners’ different L1s, rather than a universal order.

A review of research in L2 morpheme studies summarized here makes it clear that acquisition of morphology is an area of specific difficulty for second language learners. Many theoretical questions emerge from the difficulties of acquiring L2 morphology observed in previous research. What makes the acquisition of morphology in second language such a challenging task? Does a learner’s first language affect their L2 morphological learning? How much provision
of input is sufficient to promote learning of second language morphology? Answers to these questions may shed light on some important theoretical issues in morphological acquisition and have practical implications as well.

Research question and hypothesis

The study investigates adult learning of a miniature artificial language focused on nominal morphology and the effects that L1 knowledge has on such learning. Including two groups of participants, adult native speakers of English and Japanese, the research is intended to contribute to understanding the relative importance L1 knowledge in learning of nominal morphology. By focusing on nominal morphology, the research extends findings that have been established by studies of the learning of verbal morphology, argument structure, and constructions to the domains of nominal morphology (e.g. singular-plural) and noun classes (count-mass).

Research Question: Does learners’ L1 knowledge influence the learning of nominal morphology?

Hypothesis: Japanese native speakers should have difficulty acquiring constructions in a new language that include obligatory morphology for aggregation, especially for inanimate entities, because plural marking is rare overall in Japanese and morphological plurals are only possible with animates. English native speakers should have much less difficulty acquiring nominal constructions that mark plural morphologically. On the other hand, native speakers of English should have more difficulty learning constructions that use morphology to individuate mass entities, because although English has constructions for doing this, individuation is not accomplished morphologically. In this case, Japanese native speakers may have an advantage learning constructions of individuation because individuation of mass nouns is such a central phenomenon in Japanese grammar. The rationale for these hypotheses derives from previous research that point to the fact that the ways language acquirers
learn to aggregate and individuate entities in English and Japanese are quite different and that learners' L1 knowledge may influence the developmental path of morphological learning (Luk & Shirai, 2009).

Method

For the experiment reported here, a miniature artificial grammar was created consisting of 20 nouns falling into two classes based on a semantic distinction that is grounded in real world experience. Noun class 1 consists of nouns referring to physical entities that are typically encountered as individuals. The nouns in this class are unmarked in the singular and appear with an affix in the plural. Noun class 2 consists of nouns referring to entities that are typically encountered as groups, sets, pairs or masses. The nouns in the second class are unmarked in the plural and appear with an affix in the singular.

Participants

A total of 129 participants were recruited for the study: 65 adult native speakers of English and 64 adult native speakers of Japanese. English speaking participants were adult college students and working professionals living in the U.S. Japanese speaking participants were adult college students and working professionals living in Japan. During the experiment, all participants completed a brief, online anonymous questionnaire on their foreign language background and history of exposure to foreign language. The questionnaire includes 9 self-assessment questions for second language proficiency. Because this research investigates the influence of linguistic background (L1 English or Japanese) on the acquisition of nominal morphology, L1 Japanese subjects with intermediate or higher proficiency in English and L1 English speakers with comparable proficiency in Japanese were eliminated from the subject pool on the basis of responses on the questionnaire. L1 Japanese participants who indicated that they received part of their education in English (as a
medium of instruction in subjects such as math or history) at any level of education were eliminated from the pool, as well as all subjects who checked any of the following can-do statements: "I can use formal and casual English"; "I can keep a conversation going in English"; "I can give clear directions and instructions in English"; "I can analyze and compare information in English in order to make decisions"; or "I sometimes dream in English." L1 English speakers with knowledge of Japanese were eliminated according to the same criteria. Five L1 English speakers and 4 Japanese L1 speakers were eliminated according to these criteria.

Materials

A set of nominal constructions was created loosely based on morphological characteristics of noun classes found in the Nilo-Saharan languages (Dimmendaal, 2000), which are well known for the complexity of their nominal morphology. Ladd, Remijsen, & Manyang (2009) report that number marking in nominal constructions in Dinka, like other Nilo-Saharan languages, has some particularly interesting characteristics. According to Ladd et al.:

Nouns referring to things that are typically encountered in masses, sets, or pairs (e.g. grass, ants, fingers, or eyes) are often unmarked in the plural, and in many Nilo-Saharan languages are marked by an affix in the singular. Nouns referring to things that are typically encountered as countable individuals (e.g. chief, river, cattle camp) are often unmarked in the singular, and appear with an affix in the plural. The semantic basis of the system is thus related to the distinction between mass and count nouns found in many other languages. As with noun-class systems everywhere, however, it is not always easy to detect a semantic basis for the morphological treatment of any given noun; moreover, there is a third group of nouns that has affixes for number in BOTH the singular and the plural. This ‘tripartite’ number-marking system is found across the Nilo-Saharan language family... (p. 661)
As Ladd et al. (2009) indicate, noun classes in these Nilo-Saharan languages are similar but not identical to the grammatical categories of "mass" and "count" in English and many other languages. Note that of the examples mentioned of things typically encountered in masses, sets, or pairs, only grass is a mass noun in English, while ants, fingers, and eyes are all count nouns in English. What is especially distinctive about these languages is the morphological treatment of these nouns, which differs significantly from both English and Japanese. In English, while the plural of count nouns is marked by an affix (e.g., car + s > cars), mass nouns are not individuated morphologically. Instead, speakers use “unitizer” or “classifier” constructions (glass of water, grain of rice, strand of hair) to individuate mass nouns (Gentner & Boroditsky, 2001; Langacker, 2008). Japanese, on the other hand, does not use inflectional morphology either to aggregate count nouns or to individuate mass nouns (and lacks the distinction between such noun classes) but uses classifiers when it is necessary to individuate entities in order to count them (Iida, 1999; Martin 2004; Yamamoto & Keil, 2000). Dinka and other Nilo-Saharan languages, in contrast, use inflectional morphology (affixes) for both aggregation and individuation.

Modeled loosely on these Nilo-Saharan languages, the two noun classes devised for the experiments reported in this study were motivated by the semantic distinction, grounded in real world experience, between physical entities that are typically encountered as individuals and those typically encountered as groups, sets, pairs or masses (this is a simpler system that that of Dinka and many other Nilo-Saharan languages, which typically have three noun classes, not two). After consulting a number of linguistic and semantic analyses of noun classes and nominal morphology (Allan, 1980; Croft, 2000; Wierzbicka, 1988), two noun classes were devised for use as an artificial grammar, combining formal structures and semantic features. Noun Class 1 comprises nouns referring to physical entities that are typically encountered as individuals. Table 1 shows the semantic basis, forms and corresponding construals of Noun Class 1. The bare stem of nouns in the Noun Class 1 construes the entity as
a particulate individual, while the inflected form, using the prefix *ku* construes the entity as an aggregate or more than one, i.e. a plural. Thus, in Noun Class 1, there are two related constructions, the barestem construction (with an individual construal) and the *ku*-construction (with an aggregate construal).

Noun Class 2 consists of nouns referring to physical entities that are typically encountered as groups, sets, pairs or masses. Table 2 shows the semantic basis, forms and corresponding construals of Noun Class 2.

The bare stem of nouns in Noun Class 2 construes an entity as an unidividuated whole, while the inflected form, with a *bu* prefix, construes the entity as individuated. Like Noun Class 1, Noun Class 2 consists of two related constructions: the bare-stem construction (with a whole construal) and the *bu*-construction (with an individuated construal).

In order to select entities and create artificial words to populate these two noun classes, a preliminary validation test was conducted. The goal of the preliminary test was to validate the construct of the Dinka-like distinction used as the basis of the categories, to assign membership of nouns and the entities they represent to the two noun classes and to identify prototypical and non-prototypical exemplars of each noun class. Fifteen English and 15 Japanese native
speakers participated in the validation test. In this test, participants saw pictures (for example, of a doll, a US president, a grape, and a snowflake) and were asked to decide whether it belongs to Noun Class 1 (things typically encountered as individuals) or Noun Class 2 (things typically encountered in sets, groups, or masses). The directions used in the first validation test in English and Japanese versions were as follows respectively: “Please decide whether things you see in the pictures belong to Category A (things typically encountered as individuals) or Category B (things typically encountered in sets, groups, or masses). Consulting cross-linguistic analyses of entities and nouns likely to be viewed as individuated or mass (Barner & Inagaki, 2009; Croft, 2000, 2001; Wierzbicka, 1988), physical entities were selected for the validation test, and 20 word meanings (represented by photographs) were selected according to the results of the validation. Artificial words were then created to constitute the lexicon used in the subsequent main experiments. In the lexicon of this artificial language, all word stems consist of two open syllables, i.e. CVCV. The only vowel occurring in stems is /a/ (ア). Only the following consonants, p, k, t, n, w, h, b, g, d, m, y, and s were used to create these words, for two reasons. The first reason is that these consonants exist in both English and Japanese. The second reason is that the resulting artificial words can be easily and unambiguously spelled in both English and Japanese (using katakana script, which is appropriate for words of non-Japanese origin). Therefore, there should be no disadvantage for either group of participants to learn the artificial words. Words were then created with either pa, ka, ta, na, wa, or ha for the first syllable, and either ba, ga, da, ma, ya, or sa for the second syllable. The resulting set of words was then checked to make sure that none of them has associations with real words in English or Japanese, and then these newly created nouns (forms) were randomly assigned to entities and pictures (meanings). Table 3 shows the complete lexicon used in the experiments for Noun Class 1, and Table 4 shows the complete lexicon used in
the experiments for Noun Class 2. Each noun class consists of 10 lexical stems, five representing prototypical entities of the class and five representing non-prototypical members of the class, and 10 matching inflected forms. The 16 items in parentheses (four prototypical and four non-prototypical members of Noun Class 1 in Table 3 and four prototypical and four non-prototypical members of Noun Class 2 in Table 4) were withheld from the training set and reserved for use as generalization items in the testing phase. In half of these cases, subjects saw only one member of the paradigm (either the uninflected singular or the inflected aggregate construal for Noun Class 1 and either the uninflected whole or the inflected individuated construal for Noun Class 2) matched with its picture. In the other half, subjects were not exposed to either form.

Learning phase

All participants took a web-based language training session on a web browser. In the training session, participants saw a series of pictures matched with artificial words on the computer screen. Throughout the training session, the participants' task was to type the word (in alphabetic script for L1 English speakers and katakana

<table>
<thead>
<tr>
<th>Prototypicality</th>
<th>Picture</th>
<th>Singular (Alphabet)</th>
<th>Aggregate (Alphabet)</th>
<th>Singular (Katakana)</th>
<th>Aggregate (Katakana)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototypical</td>
<td>camera</td>
<td>naba</td>
<td>kunaba</td>
<td>ナバ</td>
<td>クナバ</td>
</tr>
<tr>
<td>Prototypical</td>
<td>lion</td>
<td>naya</td>
<td>kunaya</td>
<td>ナヤ</td>
<td>クナヤ</td>
</tr>
<tr>
<td>Prototypical</td>
<td>president</td>
<td>haba</td>
<td>(kuhaba)</td>
<td>ハバ</td>
<td>(クハバ)</td>
</tr>
<tr>
<td>Prototypical</td>
<td>ship</td>
<td>(tada)</td>
<td>kutada</td>
<td>(タダ)</td>
<td>クタダ</td>
</tr>
<tr>
<td>Prototypical</td>
<td>bucket</td>
<td>(paba)</td>
<td>(kupaba)</td>
<td>(ババ)</td>
<td>(クババ)</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>doughnut</td>
<td>kada</td>
<td>kukada</td>
<td>カダ</td>
<td>クダ</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>plate</td>
<td>wama</td>
<td>(kuwama)</td>
<td>ワマ</td>
<td>(クワマ)</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>balloon</td>
<td>(pada)</td>
<td>kupada</td>
<td>(バダ)</td>
<td>クバダ</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>string</td>
<td>paga</td>
<td>kupaga</td>
<td>パガ</td>
<td>クパガ</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>can</td>
<td>(taya)</td>
<td>(kutaya)</td>
<td>(タヤ)</td>
<td>(クタヤ)</td>
</tr>
</tbody>
</table>

Table 3. Complete Lexicon for Noun Class 1: Physical Entities Typically Encountered as Individuals
The Effects of First Language on Learning an Artificial Language (MIYATA) 531

**Table 4. Complete Lexicon for Noun Class 2: Physical Entities Typically Encountered in Groups, Sets, Pairs, or Masses**

<table>
<thead>
<tr>
<th>Prototypicality</th>
<th>Picture</th>
<th>Whole (Alphabet)</th>
<th>Individuated (Alphabet)</th>
<th>Whole (Katakana)</th>
<th>Individuated (Katakana)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototypical</td>
<td>pasta</td>
<td>nasa</td>
<td>bunasa</td>
<td>ナサ</td>
<td>ブナサ</td>
</tr>
<tr>
<td>Prototypical</td>
<td>bean</td>
<td>waya</td>
<td>buwaya</td>
<td>ワヤ</td>
<td>ブワヤ</td>
</tr>
<tr>
<td>Prototypical</td>
<td>ant</td>
<td>pasa</td>
<td>(bupasa)</td>
<td>パサ</td>
<td>(ブパサ)</td>
</tr>
<tr>
<td>Prototypical</td>
<td>tooth</td>
<td>(taha)</td>
<td>butaha</td>
<td>(タハ)</td>
<td>ブタハ</td>
</tr>
<tr>
<td>Prototypical</td>
<td>peanut</td>
<td>(pama)</td>
<td>(bupama)</td>
<td>パマ</td>
<td>(ブパマ)</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>block</td>
<td>waka</td>
<td>buwaka</td>
<td>ワカ</td>
<td>ブワカ</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>key</td>
<td>kama</td>
<td>bukama</td>
<td>カマ</td>
<td>ブカマ</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>finger</td>
<td>haya</td>
<td>(buhaya)</td>
<td>ハヤ</td>
<td>(ブハヤ)</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>pizza</td>
<td>(kaga)</td>
<td>bukaga</td>
<td>カガ</td>
<td>ブカガ</td>
</tr>
<tr>
<td>Non-prototypical</td>
<td>cigarette</td>
<td>(kada)</td>
<td>(bukada)</td>
<td>カダ</td>
<td>(ブカダ)</td>
</tr>
</tbody>
</table>

for L1 Japanese) in a block provided, then click the “next” button. The learning session took approximately 30 minutes to complete. Participants were exposed to a total of 24 unique word forms (72 tokens) during the training. After the training session, each participant took a word recognition test consisting of 32 items. For each item, the participants answered whether the artificial word they saw on the computer screen matched the picture.

**Testing Phase**

In order to ascertain whether or not participants in these experiments successfully learned the target constructions of Noun Class 1 and Noun Class 2, immediately following the training, subjects were presented with 32 pictures and words and asked to judge in each case whether the picture-word match that was shown was correct or incorrect. All of the test items had true-false item format, and they were presented via a computer screen. Each participant was asked to click “yes” button on the computer screen if they saw a correct match between the word form and the picture or “no” button if they saw a mismatch. An example is shown below.
**Figure 1.** An example of test items for trained words


**Figure 2.** An example of test items for untrained words

The dependent test consists of two subtests. The first subtest described above was designed to assess how subjects apply their learned morphological knowledge to the items they had been exposed to. The second subtest was designed to assess how well subjects could generalize the learned knowledge to new words that they did not see in the training. The first and second subtests were administered to each participant consecutively. An example of the second subtest items is shown below.

The 32 pictures presented were evenly balanced between items that were presented during the training and those that were not, between Noun Class 1 and Noun Class 2, between prototypical and non-prototypical members of their respective class, and between entities represented by uninflected forms and those requiring inflections. Of the words matched with these pictures, half were true and half were false: and errors were distributed among four types of er-

**Table 5. Test Items and Error Types for Noun Class 1**

<table>
<thead>
<tr>
<th>Trained/Untrained</th>
<th>True/False</th>
<th>Prototypicality</th>
<th>Picture</th>
<th>Word</th>
<th>Error Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trained</td>
<td>True</td>
<td>Prototypical</td>
<td>lion</td>
<td>naya</td>
<td></td>
</tr>
<tr>
<td>Trained</td>
<td>True</td>
<td>Prototypical</td>
<td>ships</td>
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errors: incorrect stems, incorrect choices of affix, omitted affixes, and over-use of affixes. Table 5 shows the test items and their distribution among these error types for Noun Class 1. Table 6 presents the test items and their distribution among these variables for Noun Class 2.

Analyses

The design of the analysis for the study was one-way factorial analysis of variance. Comparisons were made using L1 knowledge (English vs. Japanese) as a between subject factor. For inferential statistics, four subtests were prepared. The first subtests were used to assess how well subjects learned the items belonging to Noun Class 1 and Noun Class 2 that they had been exposed to in the training phase. The other subtests were used to assess how well...
subjects could generalize their knowledge to new words belonging to these two noun classes that they had not seen in the training. The effect sizes of the independent factor were estimated.

Results

The participants' response accuracy for the test items was coded using 1 for correct and 0 for incorrect responses. These binary data were then transformed into $d'$ prime statistics (Macmillan & Creelman, 1991), calculated using the following formula:

$$d' = (z \text{ transform of correct response rate}) - (z \text{ transform of false alarm rate})$$

$Z$ transforms of these two rates (correct response minus false alarm rates) were calculated using the inverse of the normal distribution function. The statistic $d'$ indicates the distance between the correct response rates and false alarm rates. The larger the difference between correct response and false alarm rates, the better the subject’s response accuracy. When the correct response rates and false alarm rates are the same, $d' = 0$. The highest possible $d'$ (greatest response accuracy) is 6.93, and the lowest possible $d'$ (worst response accuracy) is -6.93. The highest effective limit (using 99% for probability of response accuracy) is 4.65. The lowest effective limit (using 1% for probability of response accuracy) is -4.65. Typical values vary from -2.0 to 2.0. For instance, $d'$ of 1.0 corresponds to 69% correct response accuracy while $d'$ of -1.0 corresponds to 31% correct response accuracy.

For inferential statistics, four subtests were prepared. The first two subtests were used to assess how well subjects learned the items belonging to Noun Class 1 and Noun Class 2 that they had been exposed to in the training phase. The other two subtests were used to assess how well subjects could generalize their knowledge to new words belonging to these two noun classes that they had not seen in the training. As a result, the variables for the experiments had the following 4 independent scores:
1. *d’* prime statistics for the trained items of Noun Class 1
2. *d’* prime statistics for the generalization items of Noun Class 1
3. *d’* prime statistics for the trained items of Noun Class 2
4. *d’* prime statistics for the generalization items of Noun Class 2

The accuracy response data were submitted to a factorial MANOVA. The alpha level for the MANOVA was set to 0.05. The MANOVA results showed that the main effects of L1 language (Wilks’ Lambda = 0.658, *p* < 0.001) were statistically significant on the linearly combined dependent variables (trained items of Noun Class 1, generalization items of Noun Class 1, trained items of Noun Class 2, and generalization items of Noun Class 2) by all participants (the results by English and Japanese participants combined). The effect size of L1 language was 34.2 % of the total variance, and the statistical power (0.98) was also adequate to reject the null hypothesis. Descriptive statistics were also computed with respect to the results of each dependent variable (trained and new words of Noun Class 1 and Noun Class 2).

A follow-up ANOVA was subsequently carried out with respect to

<table>
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<th>Group</th>
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<th>Mean</th>
<th>SD</th>
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<tr>
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</table>

Table 7. *Descriptive Statistics*

*Note.* TNC1 = Trained items of Noun Class 1; TNC2 = Trained items of Noun Class 2; GNC1 = Generalization items of Noun Class 1; GNC2 = Generalization items of Noun Class 2.
the effects of L1 language. The alpha level for the follow-up ANOVA was adjusted using Bonferroni corrections and was set to 0.0125 with respect to the number of planned comparisons. The effects of L1 language on each measure were evident on the generalization items of Noun Class 1, $F(1, 84) = 9.7, p = .003, \eta^2 = 0.1$, the trained items of Noun Class 2, $F(1, 84) = 7.12, p = .009, \eta^2 = 0.08$, and the generalization items of Noun Class 2, $F(1, 84) = 8.85, p = .004, \eta^2 = 0.1$. However, the effect of L1 language was not statistically significant on the trained items of Noun Class 1, $F(1, 84) = 4.14, p = 0.045, \eta^2 = 0.05$.

Discussion

The hypothesis regarding the research question predicts that L1 Japanese speakers should have more difficulty than L1 English speakers in acquiring constructions that include obligatory morphology for aggregation. On the other hand, native speakers of English should have more difficulty than L1 Japanese speakers learning constructions that use morphology to individuate mass entities.

The results indicated that L1 language had a statistically significant effect on the linearly combined dependent variables (trained items of Noun Class 1, generalization items of Noun Class 1, trained items of Noun Class 2, and generalization items of Noun Class 2), showing that English speakers generally performed better on Noun Class 1 and Japanese speakers generally performed better on Noun Class 2.

When focused on L1 effects on each measure, the L1 language effects were statistically significant on the generalization items of Noun Class 1 and on both the trained and generalization items of Noun Class 2. Table 8 summarizes the effects sizes of L1 effects on each subtest scores by all participants.

The results demonstrated that the effects of previous knowledge in L1 were widespread, supporting the finding that L2 morphological learning is affected by the learner’s L1 both in terms of a learner’s ability to learn the words of an artificial language and the ability to construct new schemata for generalization to untrained items. L1
Japanese participants’ difficulty with learning the nouns and constructions of Noun Class 1 were predicted because Japanese does not distinguish between singular and plural. As Luk & Shirai (2009) explain:

Japanese does not have any plural markers [...] When they learn the plural -s, the stronger cue (i.e., discourse and context) overshadows the marker -s. This may prevent them from processing the plural marker as an important piece of information. This may explain why the absence of a morpheme in a learner’s L1 will create difficulty for the acquisition of that morpheme in the L2. (Luk & Shirai, 2009, p. 740-741)

For the trained items of Noun Class 1, there was a tendency that the English group to perform well on generalization items of Noun Class 1 while the Japanese group performed poorly on these items. Noun Class 1 is similar (though not identical) to the category of count nouns in English and the constructions associated with this class are similar to the singular-plural distinction in English (both use the bare stem for singular and an affix for aggregation), but in Japanese, suffixation for aggregation is rare. It can be also surmised that the contrast might have been affected by an additional factor. The English group was more successful in learning the trained exemplars of Noun Class 1. Therefore, they had a richer memory base for analogical extension. Thus, the English group was able to
generalize their L1 knowledge from specific exemplars of Noun Class 1 to new members of the class while the Japanese group was not.

Analysis on the effects of L1 language on each dependent variable showed a tendency that was predicted by the hypothesis posed for the study. The hypothesis predicted that native speakers of English should have more difficulty learning constructions that use morphology to individuate mass entities, while Japanese native speakers would have less difficulty learning constructions of individuation. As expected, the Japanese group performed well on the generalization items of Noun Class 2 while the English group performed poorly on these items. This may have been facilitated by the following facts. First, the Japanese group was more successful in learning the trained exemplars of Noun Class 2, and they had a better memory basis for analogical extension than the English group. Also, English does not have constructions that use morphology to individuate mass entities. Therefore, it can be surmised that the Japanese group was able to generalize their L1 knowledge from specific exemplars of Noun Class 2 to new members of the class while the English group was not.

**Conclusion**

Issues arising from the findings of this study have some implications for theory and research regarding the roles of input and L1 in learning of L2 noun classes and the constructions associated with them. The study findings on L1 language showed that L1 effects were spread across all conditions in the experiment, demonstrating that learning noun classes and the constructions associated with them is likely to be susceptible to learners’ previous knowledge in their L1. This supports the idea that transfer affects all aspects of SLA and contrasts with the frequently repeated claim in that the order and route of acquisition of grammatical morphemes is independent of L1 effects. Especially notable was the finding that L1 English participants were generally successful in learning the exemplars of Noun Class 1 and generalizing the morphology to novel nouns
while the Japanese groups were often unsuccessful in learning the same exemplars of Noun Class 1. Noun Class 1 is similar (though not identical) to the category of count nouns in English and the constructions associated with this class are similar to the singular-plural distinction in English (both use the bare stem for singular and an affix for aggregation). Careful consideration of L1 backgrounds is important when analyzing L2 learning of noun classes and the related constructions since the learning outcomes may greatly differ regarding learners’ L1 backgrounds.

In parallel to the implications for theory and research, the findings of this study have the potential to contribute to pedagogical practice in L2 classrooms. Previous research shows that the acquisition of noun classes in a second language is quite difficult (Bialystok & Miller, 1999; DeKeyser, 2005; Ladiere, 2007; Slabakova, 2008). L2 learners have serious problems producing accurate constructions incorporating such grammatical phenomena as number, gender, and case. In response to these learning problems, language teachers often present purely form-oriented rules for producing accurate constructions in classrooms. For example, a common practice used in many ESL classrooms is to provide metalinguistic explanations of how to apply morphological rules for the singular and plural, such that mass nouns do not form plurals while count nouns usually form plurals by adding -s. However, the research indicates that these problems stem less from ignorance of morphological form than from learners’ difficulties understanding the semantic bases of noun classes with which they are not familiar. The distinction between countable and uncountable nouns is not at all self-explanatory as many teachers assume. What’s more important is perhaps providing appropriate input for advancing the learners’ understanding of the L2 noun class category rather than providing mechanical rules for the singular and plural.

References
The Effects of First Language on Learning an Artificial Language (MIYATA) 541


