

# Phonological and Semantic Consistency as Cues for Learning Morphological Systems

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## 1. Introduction and Background

One of the major issues in linguistics is uncovering how complex morphological systems are learned. The learner must make associations between form and meaning, while fitting each form into a complex system. Languages that mark multiple grammatical features (e.g., both number and gender in a single morpheme) pose a learning problem; the more features marked with a single morpheme, the more morphemes that need to be learned. Natural language morphology, in addition to being fraught with exceptions, contains interactions with frequency and complexity in meaning. For this reason, studying consistency in learning morphological systems in natural languages is problematic. The present study makes use of an artificial grammar learning paradigm to provide support for the hypothesis that phonological and semantic consistencies aid in learning morphological systems. Participants were more accurate in learning morphological systems when provided with consistent phonological cues (Experiment 1) and consistent semantic cues (Experiment 2), suggesting that consistency within either form or meaning may reduce the learning load for complex morphological systems.

The present study explores how adults learn morphologically complex words. Learning the morphological structure of one's native language poses a specific challenge because morphology involves both form and meaning. In addition, morphological structure is heavily integrated with both phonological processes and syntactic structures. Because morphological forms are often bound – attached to the stems of each word in the category, learners must be able to recognize morphemes within complex words (referred to as morpheme segmentation). Previous research has shown that adults and children are adept at learning to segment morphemes without semantic information (Finley and Newport 2010). In these experiments, adults and children were exposed to miniature artificial languages in which affixes were systematically paired with stems, without any reference to meaning. Learners were able to parse stems from suffixes, stems from prefixes, and consonants from vowels in a non-concatenative system despite the lack of semantic cues. These results fall in line with previous infant research that demonstrates that learning morphological cues can occur prior to semantic knowledge (Gomez and Maye 2005; Mintz, Newport, and Bever 2002).

While learners can infer the form of affixes without semantic cues, it is unclear how learners integrate both form and meaning into a formal morphological system. The abstract nature of the rules and principles that govern word formation suggest that morphological systems can be arbitrary. In addition to the arbitrariness of a specific phonological marker there may be no systematic links between semantically related morphemes. For example, the past tense */-ed/* and progressive */-ing/* in English show no phonological overlap, despite similarities in semantics. If morphological patterns are generally arbitrary, there is a question of whether systematicity serves a purpose in learning. Phonological and semantic consistencies may provide a cue to the learner. Previous studies in artificial morphological systems support the idea that learners make use of phonological cues when learning arbitrary morphological classes (Frigo and McDonald 1998; Brooks et al. 1993). For example, Gerken, Wilson and Lewis (2005) showed that infants could only learn a Russian gender paradigm if the gender category was 'double marked' (e.g., marked in the noun as well as the determiner). Brooks, Braine, Catalano and Brody (1993) and Frigo and McDonald (1998) found that participants were only

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able to learn noun subclasses when a phonological cue was present. Seyfarth, Akerman and Malouf (2014) also demonstrated that learners make use of systematic information in learning morphology. It was shown that learners can acquire subclasses of paradigms when the information in the subsets follows allows for systematic implications, suggesting that learners make use of structural information to inform choices about the general morphological system of the language.

While previous research has shown that learners make use of systematic cues for learning morphological categories, it is unclear whether learners make use of the same cues in learning more complex morphological paradigms. For example, learning which nouns belong to which gender is a relatively difficult task, as nouns are open-class categories that could contain any number of items. Any cue to help a learner discern which nouns fall into which noun class would be helpful. Because gender affixes are closed class morphemes, and thus have a limited number of items, learners may not rely as much on cues for markings of closed class items. Finley and Wiemers (2013) extended Finley and Newport's (2010, 2011) findings on morpheme segmentation to morphological paradigms by focusing specifically on systems of form-meaning combinations that can extend to novel words. A morphological paradigm is a set of morphemes that marks specific classes (e.g., three suffixes, each marking a different number, /-bu/ 'singular', /-ke/ 'dual', /-mi/ 'plural'), and therefore require differentiation between various morphemes (cells) within the system. Finley and Wiemers (2013) tested how adults learn either gender or number by presenting visual stimuli that contained both gender and number information, along with an auditory stem+suffix form. Each image showed an animal that was dressed with a purse (feminine), with a bow-tie (masculine) or no clothing (neuter) and were presented in sets of one (singular), two (dual) or five (plural). In one condition, the suffixes that denoted gender, while there was no consistent number information. In an alternative condition, all suffixes denoted number, while there was no consistent gender information. Following training, participants were tested on items that were familiar, items in which the stem and suffix were familiar, but had never been paired together, and items that contained novel stems (animals). Participants were able to learn the gender or the number markers despite the arbitrary nature of the suffix items.

Because the learning task was relatively simple (participants only had to learn three suffixes: singular/dual/plural, or masculine/feminine/neuter), it is possible that additional cues are important when learning multiple morphological categories. In the present study, adult English-speaking participants were exposed to a miniature language in which both gender (masculine, feminine and neuter) and number (singular, dual and plural) were marked via suffixes, creating a more complex system containing nine grammatical markers. In Experiment 1, we tested the role of phonological cues when learning a system that marks both gender and number. There is some evidence that languages with complex systems of gender and number morphology such as French, German, and Hebrew may show signs of systematicity within subcategories (Brooks, Braine, Catalano, and Brody, 1993). For example, German definite articles like /der/, /dem/ and /das/ all start with /d/. If learners make use of these phonological cues, then learners can easily decipher the fact that /dem/ and /das/ are part of the same paradigm. In Experiment 2, we tested the role of semantic cues when learning a system that marks both gender and number. Specifically, we focus on syncretism, when forms of multiple morphemes merge to form a single form. Syncretism has the potential to cause confusion in the learner. For example, the /-s/ morpheme in English can denote either plural or third person singular. Because the form has multiple meanings, the learner must sort out this ambiguity. However, syncretism may actually be helpful to the learner if the syncretism follows a logical organization that reduces the number of categories that need to be learned. For example, if syncretism occurs between across all numbered categories of the feminine, then the learner needs to only learn one morpheme for the feminine, as opposed to separate morphemes for feminine singular and feminine plural. In natural languages, syncretism often follows a logical organization in which semantically related morphemes tend to be merged (Bickel and Nichols 2007). For example, the syncretism found in German determiners tend merge semantically similar categories. For example, [dem] marks dative masculine singular and dative neuter singular, overlapping in two of three semantic features (Müller 2011). If learners make use of this systematicity in learning, then syncretism that follows a logical semantic organization will help learners while syncretism that fails to follow a logical organization will hurt learners.

## 2. Experiment 1: Phonological Consistency

### 2.1. Method

Participants were exposed to a miniature language with nouns (animals) marked for number and gender, in the form of picture-sound pairings. Following exposure, participants were provided with a test in order to determine whether the participant was able to discriminate between the different suffixes and their appropriate meanings.

#### 2.1.1. Participants

All 17 participants were adult native English speakers recruited from Waldorf College psychology community. Participants were given extra credit to participate in the experiment. Some participants may have previously participated in an artificial grammar learning experiment, but no participant had been exposed to the stimuli used during the present experiment.

#### 2.1.2. Design

The present study used an artificial language that contained a large number of stems and fewer suffixes, mirroring the fact that many natural languages have many more open class morphemes (stems) than closed class morphemes (affixes). The experiment was designed to test the ability of adult learners to integrate form and meaning into a complex morphological system. A miniature language was developed for the study that contained only words with stems and suffixes, based on Finley and Wiemers (2013). Stems of the words were paired with a type of animal (e.g., /befa/ denotes a ladybug). Each suffix corresponded to the number of animals as well as the gender, creating nine different suffixes. The nature of the suffix depended upon the specific condition. In the Systematic Condition, all neuter forms contained an /m/, all feminine forms contained a /g/, and all masculine forms contained a /p/. In addition, all singular forms contained an /o/, all dual forms contained an /i/ and all plural forms contained an /e/. In the Random Condition, there were no phonological cues to suffix-meaning pairings, as illustrated in Table 1.

Table 1: Morphemes for Experiment 1

	Random			Systematic			
	Neuter	Fem	Masc	Neuter	Fem	Masc	
Sing	me	go	gi	Sing	mo	go	po
Dual	mi	mo	pi	Dual	mi	gi	pi
Plural	po	ge	pe	Plural	me	ge	pe

Exposure to the language was created via picture-word pairings in which the sound of the word was paired with a picture of the appropriate number of animals. The gender of the animal varied randomly throughout, and served as irrelevant information. The gender of the animal was denoted using a bowtie for males, purses for females and no marking for unmarked gender. Examples of the picture-sound pairings can be found in Table 2. Semantic content was marked using pictures of animals of various numbers and genders. Gender was marked with an accessory on the animal (masculine with bow-ties, feminine with purses, and neuter with no markings), as illustrated in Table 2. Note that pictures were presented in color to participants.

Table 2: Examples of Picture-Meaning Pairings

Meaning	Picture	Meaning	Picture
Singular-Fem		Dual-Masculine	
Dual-Neuter		Plural-Neuter	

All stems were of the form CVCV and all suffixes were of the form CV (/bu/, /ke/ and /mi/). All words were therefore CVCVCV. Consonants were all drawn from the set [b, d, g, k, m, n, p, s, t, v, z] and vowels were from the set [a, e, i, o, u]. No words overlapped with English words, and each consonant and vowel was presented equally often in each position.

Each picture corresponded to a recorded word, spoken by a native English speaker. The training set consisted of 54 items, with each of nine grammatical suffixes appearing with six different stems. The training set was presented five times, each time using a different random order of presentation. Following training, participants were given a two-alternative-forced choice test of their learning of the morphological information. The test consisted of items heard in training, stem-suffix pairs not heard in training, as well as novel stems (animals) not heard in training. In the test, participants matched two spoken words to a single picture. Participants were told one of the words would be from the language they had been listening to and the other word would not be from the language. Participants chose which of two words correctly corresponded to the picture shown. There were twelve items in three different test conditions, described in more detail below, with examples in Tables 3-5.

### 2.1.2.1. Familiar Stem-Familiar Picture Items

The first type of test item specifically tested the learner's ability to match a picture seen in training to its corresponding form. Participants heard two words with the same bi-syllabic stem. One word was heard during training, and the other word was a word not heard in training but contained the same stem as the 'correct' test item. If the participant was able to match the picture to the correct suffix, it demonstrates that the participant had learned the suffix-picture pairings. Because the two options contained the same stems, the options were highly similar, and could thus not rely on the stem to make the correct response. Examples of these test items can be found in Table 3, below.

Table 3: Familiar Stem-Familiar Picture Test Items

Correct Item	Decoy Item	Picture
befami	befago	
kuvomu	kuvomi	
ganupi	ganume	

### 2.1.2.2. Familiar Stem-*Novel* Picture Items

The second type of test item probed the learner's ability to generalize the suffixes to the items that were not heard in training. For every stem, there were three possible suffix pairings, but only two were heard in training. In this test condition, the picture shown corresponded to the stem+suffix pairing that was not heard in training, and the decoy item was a stem+suffix item that was heard during training. Both options had the same stem, meaning that participants had to rely on the suffix to choose the correct response. Because the decoy item was familiar to the participant, if participants chose the item that was most familiar, they would be incorrect. Examples of these test items can be found in Table 4, below.

Table 4: Familiar Stem-*Novel* Picture Test Items

Correct Item	Decoy Item	Picture
befamo	befago	
nidemi	nidege	
ganupe	ganugo	

### 2.1.2.3. *Novel* Word -*Novel* Picture Items

The third type of test item probed the learner's ability to generalize to novel stem items. This served as a comprehension version of a *wug* test (Berko 1958). Participants heard two stem+suffix combinations, in which the stems were identical in both conditions. The picture shown corresponded to one of the suffixes. Participants could only rely on knowledge of the suffix to get these items correct, as the participants had not seen these stem items in training. Examples of these test items can be found in Table 5, below.

Table 5: *Novel* Word-*Novel* Picture Test Items

Correct Item	Decoy Item	Picture
pumupo	pumuge	
sufego	sufegi	
kovemi	kovepo	

There were 12 tokens of each of the three test sets of test items. These items were presented in a random, mixed fashion. The 12 items in each test condition were balanced such that the correct response was singular, plural and dual an equal number of times (four). The items were also balanced such that all possible suffix combinations were heard an equal number of times (e.g., in a test trial

where /bedemi/ was pit against /bedeke/, the two suffix options were /ke/ and /mi/. This suffix combination occurred equally often as /ke/ vs. /bu/ and /mi/ vs. /bu/).

### 2.1.3. Stimuli and Procedure

All stimuli were recorded by an adult female native speaker of English in a sound attenuated booth at 12,000 Hz (though participants were allowed to adjust headphones to a comfortable volume during the experiment). Stress was placed on the first syllable using standard English pronunciation, with the exception that no vowels were reduced, meaning all syllables contained partial stress (as English reduces unstressed syllables). All stimuli items were normalized for intensity (set at 70dB) using Praat (Boersma and Weenink 2005). All phases of the experiment were run in Psyscope X (Cohen et al. 1993). Participants were given both written and verbal instructions. The entire experiment took approximately 20 minutes.

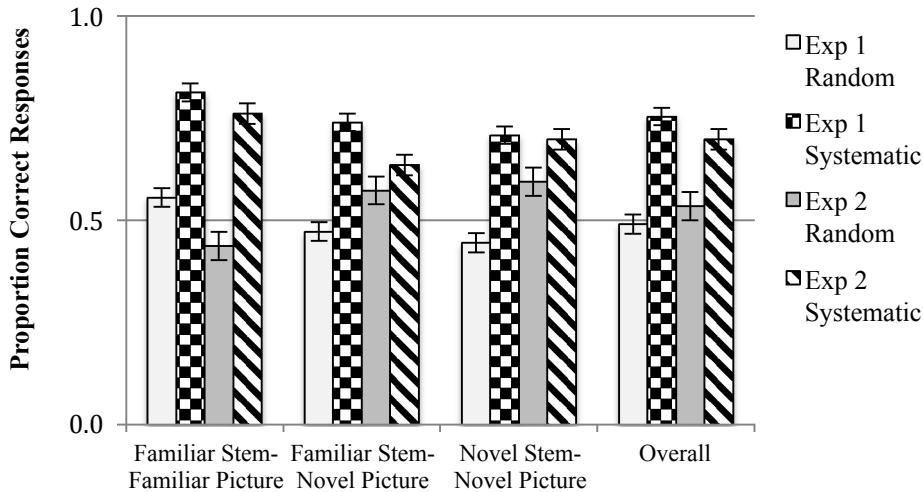
## 2.2. Results

Proportion of correct responses for all three test items are given in Figure 1. We compared each test item to 50% chance via separate one-sample *t*-tests for each type of test item, across each condition. All three types of test items were significantly above chance for the Systematic condition; the Familiar Stem-Familiar Picture test items had a mean of 0.81,  $t(7)=4.71$ ,  $p<0.001$ , the Familiar Stem-Novel Picture test items had a mean of 0.74,  $t(7)=3.21$ ,  $p=0.015$  and the Novel Word-Novel Picture test items had a mean of 0.71,  $t(7)=2.70$ ,  $p=0.031$ , suggesting that the participants learned the suffixation pattern.

In the Random Condition, the Familiar Stem-Familiar Picture test items had a mean of 0.55, which was marginally significantly different from 50% chance  $t(8)=2.00$ ,  $p=0.080$ , the Familiar Stem-Novel Picture test items had a mean of 0.47, and was not significantly different from 50% chance,  $t(8)=0.53$ ,  $p=0.61$  and the Novel Word-Novel Picture test items had a mean of 0.44,  $t(8)=1.41$ ,  $p=0.20$ , which was not significantly different from chance. While the familiar items were marginally different from chance, none of the generalization items were above chance, suggesting that participants in the Random condition failed to learn the suffixation pattern.

We also compared the Random and the Systematic conditions via a generalized linear mixed model fit by the Laplace approximation using the lme4 package in R. A single model was created with random intercepts for both items and subjects. Random slopes were included where appropriate for items (over training condition) and subjects (over test condition). Contrasts were coded to compare Familiar-Stem-Familiar Picture items to each of Familiar-Stem-Novel Picture and Novel Stem-Novel Picture Items. The Familiar-Stem-Familiar Picture items were chosen as a baseline because these items test general familiarity, as participants can score correctly on these items without learning a generalized morphological pattern. There was a significant difference between the Random and the Systematic Conditions,  $\beta = 1.60$ ,  $z = 3.05$ ,  $p = 0.0023$ . There were no differences between Familiar-Stem-Familiar Picture items and Familiar-Stem-Novel Picture,  $\beta = -0.38$ ,  $z = -1.38$ ,  $p = 0.18$  and between the Familiar-Stem-Familiar Picture items and the Novel Stem-Novel Picture Items,  $\beta = -0.45$ ,  $z = -1.59$ ,  $p = 0.11$ . There were no significant interactions between the Random and the Systematic conditions for the differences between the Familiar-Stem-Familiar Picture items and Familiar-Stem-Novel Picture,  $\beta = -0.060$ ,  $z = -0.13$ ,  $p = 0.90$  and between the Familiar-Stem-Familiar Picture items and the Novel Stem-Novel Picture Items,  $\beta = -0.12$ ,  $z = -0.22$ ,  $p = 0.83$ .

Figure 1: Means and Standard Errors for Experiments 1 and 2



### 2.3. Discussion

Experiment 1 demonstrated that adult learners can rapidly acquire complex morphological systems by extending to novel words when there is a systematic phonological regularity governing the various words. Without the systematic phonological cues, learners had to find associations between nine different forms and meanings without any additional cues to link form and meaning. Without these additional cues, participants were less adept at learning the system in the short amount of training time. This supports the hypothesis that phonological consistency within morphological systems serves as a learning cue.

## 3. Experiment 2: Semantic Consistency

Experiment 2 explores the role of semantic consistency in syncretism. Unlike Experiment 1, the nine different semantic forms were marked with three phonological forms. Each morpheme denoted three different semantic classes. As noted in the introduction, syncretism has potential to either add or remove burden from the learner. Syncretism can make learning more confusing by adding ambiguity. Syncretism could ease the burden of learning by reducing the total number of morphemes that the learner has to acquire. We hypothesize that when syncretism follows systematic semantic categorization that syncretism will ease the burden of learning, but when syncretism does not follow any logical semantic category, that learning will diminish.

### 3.1. Method

#### 3.1.1. Participants

All 16 participants were adult native English speakers recruited from Waldorf College psychology community. Participants were given extra credit to participate in the experiment. Some participants may have previously participated in an artificial grammar learning experiment, however no participant had been exposed to the stimuli used during the present experiment, particularly Experiment 1.

#### 3.1.2. Design

The method for Experiment 2 was identical to Experiment 1, except that the nine semantic categories were marked with three morphemes (as opposed to nine), and the distribution of the morphemes varied depending on the condition. In the Systematic-Syncretism Condition, one suffix

consistently marked the plural, while the other two suffixes were randomly distributed (e.g., /-di/ always refers to plural). In the Random-Syncretism Condition, the three meanings of each suffix were assigned randomly without consistency (e.g., /-wa/ denoted plural-neuter, plural-masculine and singular-masculine), illustrated in Table 6.

Table 6: Morphemes for Experiment 2

	Random-Syncretism			Systematic-Syncretism			
	Neuter	Fem	Masc.		Neuter	Fem	Masc.
Sing	me	di	me	Sing	me	me	wa
Dual	di	me	wa	Dual	me	wa	wa
Plural	wa	di	wa	Plural	di	di	di

The test items for Experiment 2 followed the same design as Experiment 1, except that the suffixes were adjusted to reflect the semantic categories.

### 3.1.3. Stimuli and Procedure

The stimuli for Experiment 2 were produced in the same manner as Experiment 1, and the same voice used for Experiment 1 was also used for Experiment 2. The procedure of Experiment 2 was identical to Experiment 1.

## 3.2. Results

Proportion of correct responses for all three types of test items are given in Figure 1, above. We compared each test item to 50% chance via separate one-sample *t*-tests for each type of test item, across each condition. Systematic condition; the Familiar Stem-Familiar Picture test items had a mean of 0.76,  $t(7)=4.51$ ,  $p=0.0028$ , the Familiar Stem-Novel Picture test items had a mean of 0.64,  $t(7)=1.88$ ,  $p=0.10$ , which was marginally significantly different from chance, and the Novel Word-Novel Picture test items had a mean of 0.70,  $t(7)=4.46$ ,  $p=0.0029$ , suggesting that the participants learned the suffixation pattern. None of the three types of test items were significantly above chance for the Random condition; the Familiar Stem-Familiar Picture test items had a mean of 0.44,  $t(7)=0.94$ ,  $p=0.38$ , the Familiar Stem-Novel Picture test items had a mean of 0.57,  $t(7)=1.26$ ,  $p=0.25$  and the Novel Word-Novel Picture test items had a mean of 0.59,  $t(7)=1.47$ ,  $p=0.19$ , suggesting that the participants in the Random condition did not sufficiently learn the pattern.

We also compared the Random and the Systematic conditions via a generalized linear mixed model fit by the Laplace approximation using the lme4 package in R. A single model was created with random intercepts for both items and subjects. Random slopes were included where appropriate for items (over training condition) and subjects (over test condition). Contrasts were coded to compare Familiar-Stem-Familiar Picture items to each of Familiar-Stem-Novel Picture and Novel Stem-Novel Picture Items. The Familiar-Stem-Familiar Picture items were chosen as a baseline because these items test general familiarity, as participants can score correctly on these items without learning a generalized morphological pattern. There was a significant difference between the Random and the Systematic Conditions,  $\beta = 1.52$ ,  $z = 3.45$ ,  $p < 0.001$ . There were significant differences between Familiar-Stem-Familiar Picture items and Familiar-Stem-Novel Picture,  $\beta = 0.67$ ,  $z = 2.42$ ,  $p = 0.025$  and between the Familiar-Stem-Familiar Picture items and the Novel Stem-Novel Picture Items,  $\beta = 0.62$ ,  $z = 0.30$ ,  $p = 0.036$ . There were significant interactions between the Random and the Systematic conditions for the differences between the Familiar-Stem-Familiar Picture items and Familiar-Stem-Novel Picture,  $\beta = -1.31$ ,  $z = -2.96$ ,  $p = 0.0030$  and between the Familiar-Stem-Familiar Picture items and the Novel Stem-Novel Picture Items,  $\beta = -0.97$ ,  $z = -2.15$ ,  $p = 0.032$ .

## 3.3. Discussion

The results of Experiment 2 demonstrate that the burden of ambiguity caused by syncretism is eased when syncretism is systematic across semantic categories. This suggests that systematic syncretism may provide a mechanism for helping learners cope with complex morphological systems.

## 4. General Discussion

The results of the present experiments demonstrate two important cues for learning novel morphological paradigms: phonological consistency and semantic consistency. These results support the hypothesis that languages support structures that are maximally learnable (Finley and Badecker 2008), and that learning biases shape the frequency of structures and patterns found across languages of the world.

One of the reasons that phonological consistency may have helped learners in Experiment 1 was that the phonological consistency allows the learner to break down the morphemes into smaller, systematic components. This would mean that learners in the Systematic condition treated morphemes not as syllables, but individual segments. For example, all neuter items began with an /m/ and all singular items began with an /o/. This means that learners could have parsed the singular neuter morpheme /mo/ as two morphemes (neuter /m/) and singular (/o/). In this case, there would be six pieces to learn (three genders and three numbers) rather than nine different morphemes. In order to test whether learners are aided by breaking down the morphemes into smaller units or through general phonological consistency, one could create an additional condition in which the phonological consistency was systematic without breaking apart the syllable suffixes. For example, if all singular forms were voiceless stops, dual forms were voiced stops, and plural forms were glides and liquids, then the learner could use a rule to formulate the suffixes. Because this rule is more complex than simply including the same consonant /vowel for each form, one might expect that the advantage of the phonological consistency to diminish slightly, but if the advantage persists (as compared to a comparable random condition), then it suggests that the phonological consistency itself does aid learners in acquiring complex morphological systems.

The results of Experiment 2 were not as robust as the results of Experiment 1. Participants in the Systematic condition were only marginally significantly different from chance on the Familiar Stem-*Novel Picture Test Items*, and the overall number of correct responses were numerically weaker compared to Experiment 1. One reason for the weaker statistical results in Experiment 2 may simply be due to a lack of power. With only eight participants in each condition, a lack of significant differences may be resolved with additional participants. In addition, the overall effect sizes in Experiment 2 may be smaller than Experiment 1, due to the fact that the systematicity created in Experiment 2 was not completely uniform. Specifically, syncretism only neutralized the plural category, but otherwise created ambiguity. For example, /-wa/ appeared in both singular and dual forms, creating ambiguity between what the /-wa/ suffix marked.

Experiment 2 demonstrated that morphological syncretism is easier to learn when an entire category is neutralized. While languages tend to use syncretism to neutralize categories, not all neutralization is created equal. Languages tend to neutralize semantically marked categories more often than semantically unmarked categories (Aalberse 2009), with biases towards syncretism in plural over singular (Baerman, Brown, and Corbett 2005; Greenberg 1963), and inanimate over animate (Baerman, Brown, and Corbett 2005). One goal for future research will be to test whether different patterns of syncretism show greater benefits to learning, as well as the role of phonology in producing various patterns of syncretism.

The present study makes use of adult participants. While studying children is often ideal when examining language learning, adult studies are also extremely useful in terms of understanding how learning biases persist into adulthood. The present paradigm is well suited to adapt to child language studies, allowing future research to easily make adult-children comparisons in learning. However, there are many reasons that using adults in the present study has theoretical importance. Throughout life, novel stimuli are presented in a language no matter how long ago the language was learned. New words come into the language (e.g., as each new generation adds to the list of slang words). Adult studies increase the knowledge about continuing language learning in the first language and learning in general. In addition, studying adults in a second language environment will help to understand the biases that adults use in second language learning, which may provide insight into making adult second language learning easier. Because studies of adult second language learning often reveal deficiencies in learning the morphology of the language (Johnson and Newport 1989; Newport 1990), the present research program is particularly relevant to second language learning.

The present study adds to the growing number of studies that demonstrate that learners are able to make use of distributional cues to learn the regular (rule-based) aspects of language. When forms (e.g., suffixes) are paired consistently with a meaning, the learner infers a general rule that can apply to items that have never been seen or heard before. The more systematic the rule is, the easier the rule is to acquire. This may be the reason that, despite the arbitrariness of language, languages of the world readily make use of systematicity.

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