Syntax-induced pattern deafness

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Perceptual systems often force systematically biased interpretations upon sensory input. These interpretations are obligatory, inaccessible to conscious control, and prevent observers from perceiving alternative percepts. Here we report a similarly impenetrable phenomenon in the domain of language, where the syntactic system prevents listeners from detecting a simple perceptual pattern. Healthy human adults listened to three-word sequences conforming to patterns readily learned even by honeybees, rats, and sleeping human neonates. Specifically, sequences either started or ended with two words from the same syntactic category (e.g., noun–noun–verb or verb–verb–noun). Although participants readily processed the categories and learned repetition patterns over nonsyntactic categories (e.g., animal–animal–clothes), they failed to learn the repetition pattern over syntactic categories, even when explicitly instructed to look for it. Further experiments revealed that participants successfully learned the repetition patterns only when they were consistent with syntactically possible structures, irrespective of whether these structures were attested in English or in other languages unknown to the participants. When the repetition patterns did not match such syntactically possible structures, participants failed to learn them. Our results suggest that when human adults hear a string of nouns and verbs, their syntactic system obligatorily attempts an interpretation (e.g., in terms of subjects, objects, and predicates). As a result, subjects fail to perceive the simpler pattern of repetitions—a form of syntax-induced pattern deafness that is reminiscent of how other perceptual systems force specific interpretations upon sensory input.

illusions | language acquisition | modularity | perception | syntax

One of the hallmarks of perceptual systems is to force a limited number of possible percepts on an observer. For example, observers obligatorily see illusory contours, such as Kanizsa triangles, even when perceiving them impairs their performance of a certain task (1). Such percepts reflect statistically predictable regularities about the likely sources of the percepts in the environment (2) and help observers to reconstruct these sources from ambiguous sensory input.

On a more abstract level, language acquisition presents a problem similar to reconstructing the likely sources of sensory input. Although expressed languages differ from one another in many ways, there appears to be a finite number of possible underlying grammars that constrain the form of the expressed languages (3, 4). If particular aspects of the language faculty operate in ways that are similar to perceptual systems, such as vision or audition (5–7), learners might perceive the structures of "sentences" only in certain ways that match one of these possible grammars.

Here, we test the hypothesis that our syntactic system obligatorily operates as soon as listeners hear word sequences, and attempts to force specific interpretations on the sequences to create meaningful structures. Specifically, we ask whether adult native speakers of American English could learn extremely simple rules involving repetitions of syntactic categories (i.e., nouns and verbs) that do not fit syntactic templates. By syntactic templates, we mean syntactic patterns that might be grammatical in some natural language (although not necessarily in the participants' native language). We used repetition-based structures because they are simple enough to be learned by bees, rats, human infants and even sleeping human neonates (8–11) and yet are uncommon in natural language.

In all experiments, participants were told that they would listen to three-word sequences (triplets) and were instructed to memorize them (see Table 1 for a list of all experiments). Then 40 example triplets were played, all conforming to the same repetition pattern. Half of the participants were familiarized with AAB sequences where the first two categories were identical, and half were familiarized with ABB sequences where the last two categories were identical. Following this familiarization, participants were informed that the triplets had conformed to a common structure. The participants were then presented with pairs of new triplets made of new words, one conforming to an AAB pattern and one to an ABB pattern. Participants were asked to indicate which of the two triplets was like the familiarization triplets.

Results and Discussion

In Experiment 1, participants had to learn a repetition pattern over the syntactic categories of nouns (N) and verbs (V); we only selected unambiguous examples of these categories, such that no noun could be interpreted as a verb (e.g., "run," as in "a run" and "to run") and vice versa. We familiarized half of the participants with AAB triplets (i.e., either NNV sequences, such as window-napkin-annoy, or VVN sequences, such as scavenge-listen-camel); the remaining participants were familiarized with ABB triplets (i.e., VNN or NVV). Then they were tested on new triplets with new words that either matched or mismatched the pattern presented during familiarization. In half of the test trials, they had to choose between a NNV triplet (AAB) and a VNN triplet (ABB); in the remaining trials, they had to choose between a VVN triplet (AAB) and a NVV triplet (ABB).

As shown in Fig. 1A, participants in Experiment 1 failed to learn the repetition patterns [percentage correct: $M = 53.0\%$, $SD = 10.7\%$), $t(19) = 1.26$, $P > 0.05$]. There was no difference in performance for *AAB* as opposed to *ABB*; this was also the case for all of the other experiments. Further experiments showed that participants also failed to learn the pattern when using exclusively very high-frequency monosyllabic or bisyllabic words (see Experiments C1 and C2 in *Appendix*: *Main Control Experiments*).

As nouns and verbs are not necessarily salient categories, in Experiment 2, we primed participants on nouns and verbs to facilitate the learning of the repetition pattern. Specifically, Experiment 2 was identical to Experiment 1, except that before listening to the familiarization triplets, participants were presented with 10 words (5 nouns and 5 verbs), and had to decide whether these words were nouns or verbs. Following this, they were informed that they would listen to triplets that conformed to an extremely simple pattern involving nouns and verbs and

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Table 1. Overview of the experiments

Experiment	Motivation	Familiarization	Test	Success
1	Learning of repetition patterns over syntactic categories	AAB: NNV and VNN ABB: NVV and VNN	NNV vs. VNN No	No
2	Learning of repetition patterns over syntactic categories after a word categorization task and with explicit instructions	As in Exp. 1	As in Exp. 1	No
3	Learning of repetition patterns over syntactic categories with Hungarian stimuli and Hungarian speakers	As in Exp. 1	As in Exp. 1	No
4	Learning of repetition patterns over syntactic categories with homogenous input (1)	AAB: NNV only; ABB: VNN only	As in Exp. 1	See main text
5	Learning of repetition patterns over syntactic categories with homogenous input (2)	AAB: NNV only; ABB: VNN only	As in Exp. 1	See main text
6	Learning of repetition patterns over nonsyntactic categories	AAB: AnAnCl and ClClAn ABB: ClAnAn and AnClCl	AnAnCl vs. ClAnAn AnClCl vs. ClClAn	Yes
7	Learning of repetition patterns over syntactic categories consistent with possible grammatical structures	AAB: NNV and AAN ABB: VNN and NAA	NNV vs. VNN AAN vs. NAA	Yes
8	Learning of repetition patterns over syntactic categories consistent with impossible grammatical structures	AAB: VVN and AAV ABB: NVV and VAA	NNV vs. VNN AAV vs. VAA	Yes

N, noun; V, verb; An, animal; Cl, clothing; A, adjective.

were instructed to find the relevant pattern. Then the experiment proceeded as in Experiment 1. At the end of the experiment, participants were informed about the structure of the familiarization triplets and were asked whether they had noticed this structure.

As shown in Fig. 1B, participants were near perfect in their classification of words [($M = 98.0\%$, SD = 5.2%), t (19) = 41.03, $P < 0.00001$, Cohen's $d = 9.2$]. However, although they successfully learned the repetition pattern at the group level [($M = 67.5\%$, SD = 22.4%); see Fig. 1A), t (19) = 3.49, $P < 0.01$, Cohen's $d = 0.78$], Fig. 1C reveals that the group performance was carried by five participants who performed at 100% correct; after removing these participants, the group performance did not differ significantly from chance [($M = 56.7\%$, SD = 13.5%), t (14) = 1.92, $P > 0.05$]. Moreover, even when including the five successful participants, 60% of the participants reported that they had not noticed the repetition pattern—although they were explicitly informed about a pattern before starting the experiment.

It is possible that subjects had difficulty learning the repetition patterns because, as mentioned above, nouns and verbs are ambiguous in English. Although in Experiments 1 and 2 we used nouns and verbs that we believed lacked such ambiguities, Experiment 3 addressed this possibility head on. Specifically, we replicated the design of Experiment 1 but tested native speakers of Hungarian in Hungarian. Unlike in English, nouns are unambiguously nouns, and verbs are unambiguously verbs in Hungarian. Nonetheless, as shown in Fig. 1A, Hungarian participants failed to learn the repetition pattern with Hungarian stimuli [($M = 56.8\%$, SD = 16.5%), t (19) = 1.83, $P > 0.05$].

Although it is clear from Experiment 2 (and, we believe, from everyday experience) that participants can classify nouns and verbs when presented in isolation, perhaps this capacity is suppressed when words are presented in the context of other words, making participants incapable of learning repetition patterns involving these syntactic categories. Experiments 4 and 5 tested this idea by presenting participants with simplified familiarizations. Specifically, in Experiments 1 to 3, AAB sequences were heterogeneous, comprised of both NNV and VVN sequences, whereas ABB sequences consisted of both VNN and NVV sequences. In Experiments 4 and 5, in contrast, all triplets were homogeneous, with the same structure. In Experiment 4, participants were presented with either NNV sequences (for AAB), or with VNN sequences (for ABB). In Experiment 5, the

sequence structures were either VVN (for AAB) or NVV (for ABB).

Fig. 1D shows the results of Experiment 4. Although participants failed to learn the repetition pattern in Experiment 4 [($M = 48.8$, SD = 9.0%), t (19) = 0.6, $P > 0.05$], their performance on the two trial types differed significantly [t (19) = 3.96, $P < 0.001$, Cohen's $d = 0.89$]. When choosing between NNV and VNN triplets, participants performed significantly above chance [($M = 68.0\%$, SD = 24.2%), t (19) = 3.33, $P < 0.01$, Cohen's $d = 0.74$]. When choosing between VVN and NVV triplets, in contrast, they performed significantly below chance [($M = 29.5$, SD = 22.8%), t (19) = 4.02, $P < 0.001$, Cohen's $d = 0.9$], selecting the triplets conforming to the repetition pattern opposite to that heard during familiarization. Likewise, in Experiment 5, participants failed to learn the repetition pattern [($M = 50.5\%$, SD = 10.2%), t (19) = 0.2, $P > 0.05$], but performed differently on the two test trial types [t (19) = 3.27, $P < 0.01$, Cohen's $d = 0.73$]. In contrast to Experiment 6, participant performed above chance for trials pitting VVN triplets against NVV triplets [($M = 66.5\%$, SD = 23.9%), t (19) = 3.1, $P < 0.01$, Cohen's $d = 0.69$], but below chance for trials pitting NNV against VNN triplets [($M = 34.5\%$, SD = 24.4%), t (24) = 2.8, $P = 0.01$, Cohen's $d = 0.69$].

Surprisingly, participants not only failed to learn the repetition patterns, but, for some test trials, they even chose the triplets with the incorrect repetition pattern. These results suggest that participants were able to extract the syntactic categories of verb and noun, and their placement in the first or last position but were incapable of detecting the repetitions of these categories. For example, following familiarization with NNV triplets, participants should (correctly) choose NNV over VNN triplets. However, they should also (incorrectly) choose NVV triplets over VVN triplets because, despite having the opposite repetition pattern, the NVV test items and the NNV familiarization items start and end with the same categories. Similarly, when familiarized with VVN triplets, participants should (correctly) choose VVN triplets over NVV triplets; however, as both VVN triplets and VNN triplets start with a verb and end with a noun (even though they have different repetition patterns), they should (incorrectly) choose VNN triplets over NNV triplets. Hence, if participants only track the first and the last category in triplets, they should exhibit the differential performance on the test trial types found in Experiments 4 and 5.
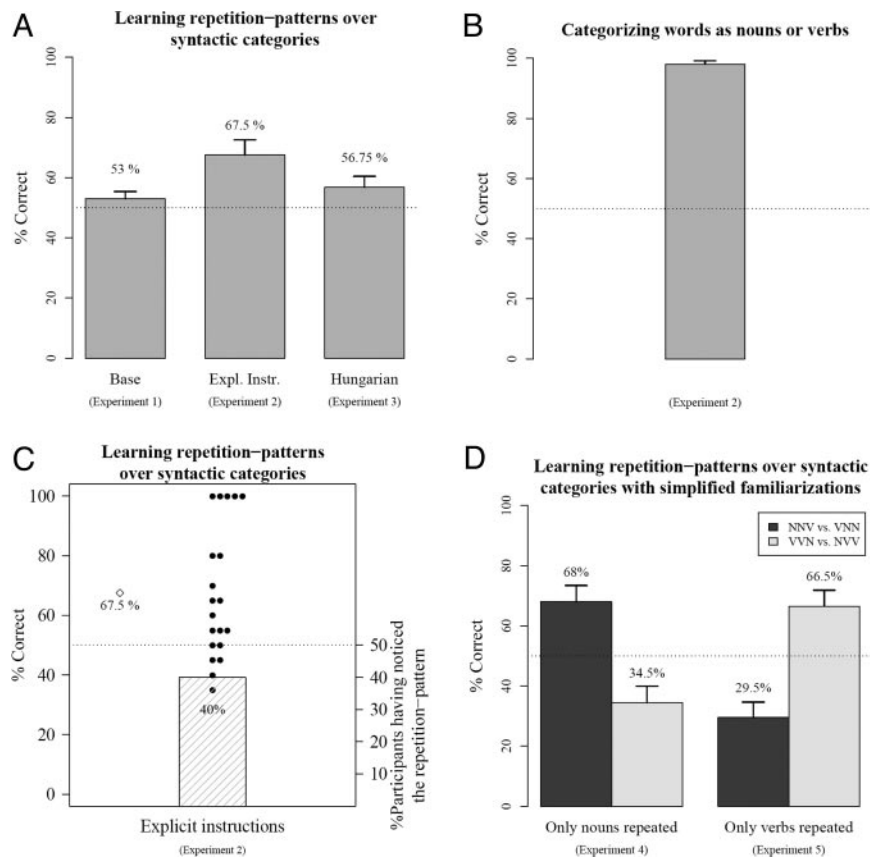
Fig. 1. Results of Experiments 1 to 5. (*A*) When exposed to three-word sequences following a repetition pattern of syntactic categories, participants fail to learn this pattern (Experiment 1). Most participants fail to learn it after being asked to classify words as nouns or verbs and after being explicitly informed about the existence of a pattern involving nouns and verbs (Experiment 2; see also *C*). In addition, Hungarian speakers tested on Hungarian stimuli (where nouns and verbs are unambiguously marked) fail to learn the pattern (Experiment 3). (*B*) Participants are near perfect at classifying words as nouns and verbs in the classification phase of Experiment 2. (*C*) Dots represent averages of individual participants, the diamond represents the sample average, and the bar represents the proportion of participants having noticed the repetition pattern over categories. After being primed on syntactic categories and after being explicitly informed about the existence of a pattern involving nouns and verbs, most participants failed to learn the pattern (Experiment 2). Moreover, only 40% of the participants claimed to have noticed the pattern (Experiment 2). (*D*) In Experiment 4, participants performed above chance when choosing between NNV and VNN triplets but below chance when choosing between VVN and NVV triplets. In Experiment 5, participants performed above chance when choosing between VVN and NVV triplets but below chance when choosing between NNV and VNN triplets. Bars in *A*, *B*, and *D* represent sample averages, and error bars represent standard errors from the average.

A possible explanation that might account for all of the failures reported thus far is that participants are unable to detect repetition patterns that operate over open-ended categories (including syntactic categories). To assess this possibility, we replicated Experiment 1 but with nonsyntactic, open-ended categories, specifically, animals and clothes. Thus, in Experiment 6, AAB triplets had the form animal–animal–clothing (e.g., dog–swan–shirt) or clothing–clothing–animal (e.g., hat–blouse–hawk) whereas ABB sentences had the form clothing–animal–animal (e.g., shirt–dog–swan) or animal–clothing–clothing (e.g., hawk–hat–blouse). Except for the choice of the categories, the experiment proceeded as in Experiment 1.

Fig. 2a reveals that participants successfully learned the repetition patterns [(M = 64.3%, SD = 21.2%), t (19) = 3.0, $P <$ 0.01, Cohen's d = 0.67], suggesting that the prior failures cannot be explained by a general inability to extract repetition patterns over open-ended categories. Moreover, additional experiments show that human adults can also learn repetition patterns over other linguistic categories (e.g., abstract phonological categories, such as different pronunciations of the same syllable by different speakers; see Experiment C10 in *Appendix*: *Main Control Experiments*). The difficulty to learn repetition patterns over categories thus seems to be specific to syntactic categories.

The results presented so far suggest that participants have severe difficulties learning repetition patterns over syntactic categories although all of the requisite processes would seem to be in place: Repetition patterns are simple enough to be learned by a wide variety of other animals, participants can classify words perfectly, they access such categories, and they can learn repetition patterns over open-ended categories. Repetition patterns of syntactic categories thus seem to be blocked by some other computational processes.

One possible explanation of these results is that participants might automatically try to make sense of any word sequence with which they are presented. This, however, requires them to assign some rudimentary syntactic structure to the word sequences, matching them to some sentence template even if it does not fit the word order of their native language, and even if the resulting "sentence" is semantically nonsensical. That is, just as it is possible to make "syntactic sense" of Chomsky's famous sentence "colorless green ideas sleep furiously" (12), participants might automatically try to force the triplets into some syntactic-like sentence template. If such templates are in place, however, it becomes clear why participants cannot learn the repetition patterns: NNV and VVN sequences have the same repetition pattern, but a template with two nouns is necessarily different from a template with two verbs. Participants exposed to NNV
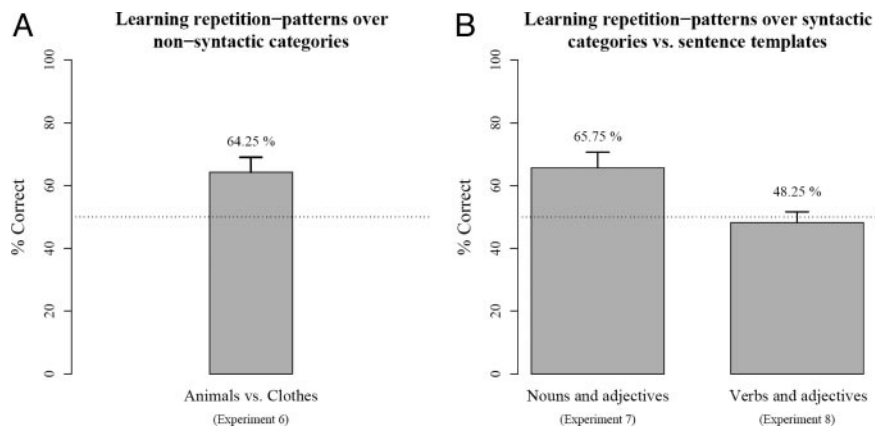
Fig. 2. Results of Experiments 6 to 8. (*A*) When exposed to three-word sequences conforming to a repetition pattern of nonsyntactic categories (i.e., animals and clothes), participants successfully learned this pattern (Experiment 6). (*B*) In Experiment 7, participants were familiarized with three-word sequences of which they could make syntactic sense. Specifically, they were exposed either to NNV and AAN triplets or to VNN and NAA triplets. Participants successfully learned the structure of these triplets. In Experiment 8, it was harder to make syntactic sense of the triplets. Specifically, participants were exposed either to VVN and AAV triplets or to NVV and VAA triplets. They failed to learn their structure.

and VVN sequences would need to learn two distinct sentence templates, which, in turn, might prevent them from noticing that both templates conform to a single AAB repetition pattern.

Experiments 7 and 8 tested this possibility. In Experiment 7, we presented participants with sequences where the repetition patterns were consistent with the syntactic templates of the sequences. Specifically, participants in the AAB group were presented with NNV sequences (e.g., baby–water–juggle) or adjective (A)–adjective–noun (e.g., clever–fragile–water) sequences. In the ABB group, participants heard VNN (e.g., juggle–baby–water) sequences and NAA sequences (e.g., water–clever–fragile). Note that although these sequences are grammatical in some natural languages, most are not grammatical in English. For example, although AAN sequences are grammatical in English, NAA sequences are not. Still, even for English speakers, it might be possible to make syntactic sense of NAA sequences because such sequences are grammatical in some languages (e.g., in French); as a result, such sequences might match a universally available syntactic sentence template.

Following this familiarization, participants had to choose between AAB and ABB sequences. As shown in Fig. 2*B*, they successfully selected the test items conforming to the repetition pattern [($M = 65.8\%$, SD = 21.8%), t (19) = 3.2, $P < 0.01$, Cohen's $d = 0.72$]. Importantly, and as in the other experiments presented here, the participants' performance did not differ depending on whether they were familiarized with AAB or ABB sequences [t (19) = 0.7, $P > 0.05$]; given that AAN sequences are grammatical in English but not NAA sequences, these results suggest that participants did not simply match the triplets to the syntax of their native language but rather that they could make syntactic sense of the triplets even when they did not conform to the word order of their native language. The results of Experiment 7 thus support the hypothesis that when the syntactic sentence templates are consistent with the repetition pattern, participants readily learn the repetition pattern.

However, instead of learning the syntactic templates, participants may have only noticed the first and the last categories in the sequences. Further, our use of three different syntactic categories (nouns, verbs, and adjectives) may have facilitated the task compared with the other experiments where only two categories were used. Experiment 8 controlled for these possibilities.

Experiment 8 was similar to Experiment 7 except that nouns were replaced with verbs; that is, AAB participants heard VVN or AAV sequences, whereas ABB participants heard NVV and VAA sequences. These sequences were chosen because it is not

clear what kind of syntactic structure could be assigned to VVN sequences, such as scavenge–listen–baby, or to AAV sequences, such as fragile–eager–furnish. Therefore, it should be much harder to make syntactic sense of these sequences. In contrast, if participants just noticed initial or final categories, or if the use of three categories made the learning task easier, we would expect successful generalization in Experiment 8.

In contrast to Experiment 7, and as shown in Fig. 2*B*, participants in Experiment 8 failed to learn the repetition pattern [($M = 48.3\%$, SD = 15.2%), t (19) = .5, $P > 0.05$]. Participants performed better in Experiment 7 than in Experiment 8 [F (1, 38) = 8.7, $P < 0.01$, $\eta^2 = 0.186$]. These results further support the hypothesis that participants attempt to force word sequences into a syntactic template to learn their structure.

Together, our results (see also *Appendix: Main Control Experiments*) suggest that people can learn structures over syntactic categories only to the extent that they match available syntactic templates. These templates need not be available in their native language, but they must be within the range of natural grammars. Although the detection of repetitions appears to be an evolutionarily ancient capacity computed even by honey-bees and sleeping neonates, healthy human adults are deaf to patterns of repetition if they perceive items that fall naturally into syntactic categories. This syntax-induced pattern deafness arises even when subjects are primed to look for the pattern, a form of immunity that is reminiscent of how many perceptual processes force specific interpretations upon sensory input (13–15). Our results thus give credence to the proposal that language is akin to perceptual systems such as vision and audition (5–7) and that syntactic processes are just as modular and impenetrable as other perceptual processes.

Materials and Methods

Table 2. Main control experiments

Experiment	Motivation	Familiarization	Test	Success
C1	Replication with high-frequency monosyllabic words	As in Exp. 1	As in Exp. 1	No
C2	Replication with high-frequency bisyllabic words	As in Exp. 1	As in Exp. 1	No
C3	Replication with ABA pattern	As in Exp. C1 but with ABA pattern	NVN vs. NNV; VNV vs. VVN	No
C4	Replication of Exp.1 with categorization phase as in Exp. 2 but without explicit instructions	As in Exp. 1	As in Exp. 1	No
C5	Only categorization phase as in Exp. 2 but with all words used in Exp. 1–8 and C1-C10	NA	NA	Almost perfect
C6	Added third-person plural(s) to stems	As in Exp. 1, but words were inflected	As in Exp. 1	No
C7	Each word was pronounced as an individual question. Prosodically, the words should not be part of the same phrase	As in Exp. 1, but with question intonation	As in Exp. 1	No
C8	Only intransitive verbs used to homogenize the input	As in Exp. 1, but with intransitive verbs only	As in Exp. 1	No
C9	Different nonsyntactic categories	As in Exp. 8, but with animals and body parts as categories	As in Exp. 8, but with animal and boyd parts as categories	Yes
C10	Repetitions over non-syntactic linguistic categories, i.e. phonological categories	AAB: shoy–shoy–pow/ pow–pow–shoy; ABB: shoy–pow–pow/ pow–pow–shoy*	shoy–shoy–pow vs. pow–pow–shoy vs. shoy–pow–pow*	Yes

N, noun; V, verb; NA, not applicable.
*All syllables are uttered by different speakers.

Stimuli. Words were recorded by using a Sennheiser ME67 directional microphone connected to a PC running Audacity (available at http://audacity.sourceforge.net/), and saved in the aiff file format (44.1 kHz, 16 bit, mono). English words were recorded from different female native speakers of American English, and Hungarian words were recorded from a male native speaker of Hungarian. Depending on the difficulty the speaker experienced producing words without list prosody, words were either recorded in isolation or embedded in short sentences, and then excised from these sentences. All words are given in Table S1.

Procedure

Categorization phase (Experiment 2). In Experiment 2, participants were first informed that they would hear words, and were instructed to decide whether they were nouns or verbs. Then, they were presented with 5 nouns and 5 verbs. Words were presented in random order, with the constraint that no more than three nouns or verbs could occur in a row. Following this, participants proceeded to the familiarization phase.

Familiarization Phase (Except Experiment 2). Participants were informed that they would hear a number of three-word sequences, and were instructed to memorize them. Participants then listened to a total of 40 triplets. The triplet types used in the different Experiments are shown in Table S2. Triplets were presented in random order with the constraint that words could not occur in consecutive triplets and that no more than three triplets of the same type could occur in a row.

Familiarization Phase (Experiment 2). In Experiment 2, participants were told that they would listen to sequences conforming to a very simple pattern of nouns and verbs and were instructed to find the relevant pattern. Then the familiarization proceeded as in the other experiments (Table S3).

Test Phase. Before participating in the test phase, participants were informed that the triplets they had listened to conformed to some regularity. They were informed that they would listen to pairs of new triplets and that in each pair, one of the triplets conformed to the regularity of the familiarization triplets. Then they were presented with 20 test pairs. The test pair types are shown in

Table S4. For each test pair type, the correct choice occurred equally often first and second in a test pair.

In Experiment 2, participants were informed about the nature of the regularity after they had completed the test phase and were asked whether they had noticed it.

Appendix: Main Control Experiments. Our most important control conditions, and their motivations, are listed in Table 2. Experiments C1 and C2 were replications of Experiment 1 with different words. We reasoned that participants might find it easier to generalize the repetition patterns with more homogenous input; in Experiments C1 and C2, we thus exclusively used extremely high-frequency monosyllabic and bisyllabic words, respectively. In Experiment C2, an equal number of nouns and verbs had a strong–weak and a weak–strong stress pattern, respectively. Experiment C3 was another replication of Experiment 1, where we used an ABA pattern instead of the AAB and ABB patterns used in the other experiments.

Experiment C4 implemented a more subtle form of priming than in Experiment 2. Specifically, participants first had to categorize 10 words as nouns or verbs (as in Experiment 2). Then, however, they were not explicitly informed about the presence of the pattern; rather, the experiment continued as in Experiment 1. Results showed that participants did not benefit from the priming and failed to generalize the repetition pattern.

The goal of Experiment C5 was to make sure that participants correctly perceived our stimuli as nouns or verbs (Table S5). Participants were presented with all 72 words used in Experiments 1–8 and C1-C10 and had to decide whether they were nouns or verbs. As in the categorization phase of Experiment 2, participants' categorization performance was near perfect, suggesting that they correctly perceived words as nouns or verbs.

In half of the familiarization trials of Experiment C6, we added third-person and plural endings to the words (e.g., guzzles–annoys–churches, churches–windows–brings); by adding inflectional markers, we hoped to make the category membership more salient. Results indicate that these inflectional markers did not help participants identify the repetitions.

In Experiment C7, each word in a triplet was pronounced as an individual question. If participants tried to interpret the word triplets as sentences, prosodically marking each word as a question might have helped participants to consider each word in isolation and thus to detect the repetition pattern.

Results suggest that this prosodic information failed to help our participants, presumably because they ignored it after the first few familiarization triplets.

In Experiment C8, we attempted to facilitate learning of the repetition pattern by making the familiarization phase more homogenous. Specifically, whereas the other experiments used both transitive and intransitive verbs, Experiment C8 presented a repetition pattern over nouns and verbs by using intransitive verbs only. None of these manipulations facilitated learning the repetition pattern.

Experiment C9 was a replication of Experiment 6 with different nonsyntactic categories. In this experiment, participants had to learn a repetition pattern over animals and body parts as nonsyntactic categories. As in Experiment 6, participants successfully learned the repetition pattern over nonsyntactic categories.

The goal of Experiment C10 was to show that participants can learn repetition patterns over linguistic categories. Specifically, all triplets were composed of the same syllables. Participants familiarized to AAB triplets heard the sequences shoy–shoy–pow and pow–pow–shoy, whereas participants familiarized to ABB triplets heard the sequences show–pow–pow and pow–shoy–shoy triplets. Importantly, however, each syllable was uttered by a different speaker. Following this familiarization, participants had to choose between AAB and ABB triplets implemented with the same syllables, uttered by other different speakers. This experiment parallels Experiment 1 in important ways, as both involve repetition patterns over linguistic categories. In Experiment 1, the categories are syntactic (i.e., nouns and verbs); in Experiment C10, the categories are the abstract, speaker-independent phonological representations of the syllables. In both cases, these categories had different realizations in the triplets. In Experiment 1, we used different words as exemplars of nouns and verbs; in Experiment C10, we used different pronunciations as exemplars of the phonological categories. Despite the similarity between these experiments, participants successfully learned the pattern in Experiment C10 but not in Experiment 1.

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