Psychology of Consciousness: Theory, Research, and Practice
2014, Vol. 1, No. 3, 229–242

2326-5523/14/$12.00 http://dx.doi.org/10.1037/cns0000027

Unconscious Sources of Familiarity Can Be Strategically Excluded in Support of Conscious Task Demands

Andy D. Mealor, Zoltan Dienes, and Ryan B. Scott
University of Sussex

What factors contribute to subjective experiences of familiarity, and are these subject to unconscious selection? We investigated the circumstances under which judgments of familiarity are sensitive to task-irrelevant sources using the artificial grammar learning paradigm, a task known to be heavily reliant on familiarity-based responding. In 2 experiments, we manipulated 'free-floating feelings of familiarity' by subliminally priming participants with either a subjectively familiar stimulus (their surname) or unfamiliar stimulus (a random letter string). In Experiment 1, after training on an artificial grammar, participants were required to rate the familiarity of a new set of grammar strings where the subliminal priming manipulation preceded each rating. Under these instructions the manipulation significantly altered ratings of familiarity. In Experiment 2, the training, the request for familiarity ratings, and the subliminal manipulation were all unchanged. In addition, however, participants were informed about the presence of rules dictating the structure of the training strings and were required to judge both whether each test-string conformed to those rules and to report the basis for their judgment. This broader decision context eliminated the effect of subliminal primes on ratings of familiarity even when participants' reported basis for their judgments revealed no conscious knowledge of the rule structure. These results demonstrate that unconscious sources of familiarity can be selected or excluded according to conscious task contexts. The findings are incompatible with theories that equate familiarity with automaticity and those that state people must always be aware of the structural antecedents of metacognition.

Keywords: familiarity, strategic control, unconscious priming, non-conscious

Implicit learning is a process by which one acquires knowledge of rules or regularities without intention to learn those rules and much of the acquired knowledge cannot easily be expressed (see P. Reber, 2013; Rebuschat, 2013, for recent reviews). In a typical artificial grammar learning (AGL) study, participants are exposed to a number of letter strings that look more-or-less randomly ordered but are generated by a rule-based grammar structure (the training phase). They are then informed of the existence of rules governing strings, but not what those rules are, before classifying novel strings in terms of whether they conform to or violate the studied structure (see Dienes [2012a] and Pothos [2007] for reviews and Scott and Dienes [2010a] for a dual-process model of AGL). Judging whether a given test string follows the same regularities as training strings is, to a large extent, based on *familiarity* with the materials (e.g., Higham, Vokey, & Pritchard, 2000; Scott & Dienes, 2008, 2010a, 2010b; Servan-Schreiber & Anderson, 1990; Whittlesea & Leboe, 2000). Norman, Price, and Duff (2006, 2010) argued that familiarity serves the function of indicating to people that they have knowledge about a stimulus, even when they do not consciously know what that knowledge is. Familiarity thus forms a useful basis for classification when a person possesses what is termed

This article was published Online First August 11, 2014.
Andy D. Mealor, Zoltan Dienes, and Ryan B. Scott, School of Psychology and the Sackler Centre for Consciousness Science, University of Sussex.
This research was supported by a grant from the Economic and Social Research Council (ESRC; http://www.esrc.ac.uk/; Grant RES-062-23-1975) to R.B.S. and Z.D.
Correspondence concerning this article should be addressed to Andy D. Mealor, School of Psychology, University of Sussex, Falmer, Brighton BN1 9QH, United Kingdom. E-mail: a.d.mealor@sussex.ac.uk

'unconscious structural knowledge.' Unconscious structural knowledge is said to exist when a person discriminates accurately, as in the case of AGL the individual may know that a given string is ungrammatical, but lack conscious access to the underlying structural knowledge permitting that judgment. For example, the person may not consciously realize that the lack of grammaticality is attributable to the repetition of a particular letter. Thus, a feeling of familiarity arising from consistency in the grammar structure but which exists without conscious knowledge of the features contributing to that feeling, indicates unconscious structural knowledge.

Familiarity is a feeling indicating a continuous degree of oldness arising from the structural coherence of the stimulus (i.e., how well the structure of the stimulus matches structural representations in memory, Dienes, Scott, & Wan, 2011; Scott & Dienes, 2008, 2010b). The feeling depends on the extent to which a stimulus is consistent with previously learned structures (e.g., Chubala & Jamieson, 2013); for example, it could be based on the ability of a neural network to auto-associate the presented stimulus (i.e., a neural network that tries to predict the same stimulus from itself, Cleeremans & Dienes, 2008). The extent to which a network can auto-associate a stimulus may give rise to feelings of familiarity either because the stimulus is processed fluently or because a graded representation is generated carrying the content that the stimulus is well formed, regardless of the time taken to process the stimulus. Biasing judgments through processing fluency can increase claims of semantic coherence (e.g., Topolinski & Strack, 2009) and affect familiarity associated with recognition (e.g., Jacoby & Whitehouse, 1989). However, Scott and Dienes (2010c) provide an example of when fluency has almost no influence on feelings of familiarity. In AGL, processing fluency manipulations can bias judgments of grammaticality (e.g., Johansson, 2009). Thus, the context in which decisions are made appears crucial to the subjective processes leading to the decision.

Certain processing manipulations may induce a nonspecific global, 'free-floating' sense of coherence or familiarity. Crucially, this free-floating feeling of familiarity can expose judgments (e.g., of memory, coherence, regularity) to bias. When the source of the feeling is not obvious to the participant, it can be misattributed to a salient source such as the task at hand. When the source of bias is noticed, its influence on judgment is discounted (Jacoby & Whitehouse, 1989; Schwarz & Clore, 2007; Whittlesea & Williams, 2001; Whittlesea, Jacoby, & Girard, 1990). For example, Goldinger and Hansen (2005) additively increased claims of familiarity-based recognition (defined as difficult to remember stimuli) for both hits and false alarms when an undetected low-amplitude buzz was synchronized with recognition trials. The control group were aware of the buzz and did not show the same effect. Ziembowicz et al. (2013) paired melodies constructed from a musical grammar with 3D shapes on a monitor which would be possible or impossible in the real world. One of these modalities was irrelevant to the task at hand. When participants were trained on melodies from a musical grammar, pairing possible but task-irrelevant 3D shapes during test trials increased claims that both grammatical and ungrammatical passages conformed to the training grammar. When the modalities reversed, the same effect occurred: after incidental musical grammar training, grammatical and ungrammatical sequences played as background noise. When paired with a grammatical passage, claims that the shape was possible increased regardless of whether it was or not. That is, coherence between modalities additively increased claims of pattern recognition or possibility. Thus processing of coherence stemming from sources other than the immediate focus of attention can bias judgment, which can potentially lead one to believe the salient stimulus shares some property (e.g., coherence, regularity) with the source of bias, particularly when one is not aware of the source.

Because a feeling of familiarity does not in itself indicate why a stimulus elicits that feeling, it can be difficult in some (but not all) situations to attribute the feeling to the correct source. Put another way, if there are two possible sources of familiarity, a person might find it hard to know which one of the sources was really responsible—even if the intention is to respond only on the basis of one of the sources. For this reason, Jacoby (1991) operationally defined familiarity as the type of memory insensitive to intentions. By this approach, responses brought about without (or in opposition to) the intention of the participant indicate the objective presence of familiarity and distinguishes familiarity from intentional uses of memory such as recollection orthe application of hypothesized rules that can be used strategically.

In the context of AGL, Higham et al. (2000) trained participants on two grammars but instructed participants to ignore strings from one of those grammars. Despite participants' intentions, the to-be-ignored strings were endorsed more often than strings conforming to neither grammar (although not to the same extent as to-be-endorsed strings under unspeeded response conditions). This finding was interpreted as obligatory familiarity acquired and elicited as a result of experience with the materials. However, equating automaticity with familiarity has recently been questioned in AGL, specifically in studies in which *subjective* measures of familiarity have been assessed (Mealor & Dienes, 2013a; Norman, Price, & Jones, 2011; Scott & Dienes, 2008; Wan, Dienes, & Fu, 2008).

The extent to which familiarity is relied upon in AGL (e.g., without additional recollective experience) depends on the conscious status of the underlying structural knowledge guiding classifications (Dienes & Scott, 2005; Scott & Dienes, 2008). Structural knowledge is considered to be conscious when people claim to classify strings on the basis of, for example, the presence or absence of elements remembered from training or hypothesized rules. This form of knowledge would be considered available to strategic control, by virtue of being conscious (Jacoby, 1991). In contrast structural knowledge is considered to be unconscious where people claim to classify strings on the basis of intuitive feelings, the relative familiarity of a test string, or random guessing and the antecedents of these feelings cannot be explicated. Note that while objective similarity measures such as repetition structure and associative chunk strength can predict familiarity ratings (Scott & Dienes, 2008), this does not imply that participants are conscious of these regularities being a source of familiarity. Indeed, Scott and Dienes (2008) demonstrate that such objective features influence rated feelings of familiarity even when participants report not knowing the basis for those feelings, clearly indicating unconscious structural knowledge.

Is this form of knowledge applied automatically? In fact, intentional control of unconscious structural knowledge has been demonstrated in AGL. For example, when participants are exposed to training strings derived from two grammars during training and subsequently required to endorse test-strings conforming to just one of those grammars, their familiarity ratings and endorsements attributed to familiarity are found to reflect the target grammar more than the to-be-ignored grammar (Mealor & Dienes, 2013a; Norman et al., 2011; Wan et al., 2008). Thus, the source of familiarity is to some degree under intentional control, which would be expected on general computational grounds: Neural networks are context sensitive, and the ability of a network to auto-associate a stimulus could naturally be expected to be responsive to context to some extent.

Given familiarity can be sensitive to context, its relation to unconscious knowledge needs to be considered. The claim that structural knowledge (e.g., the knowledge embedded in the synaptic strengths of a neural network) is unconscious when participants use familiarity partly rests on a claim by participants that they are not aware of the source of their feelings. Specifically, when participants have been asked to indicate the basis of their classifications in artificial grammar learning, they will often choose the attribution that it was based on familiarity for reasons they cannot explicate further (e.g., Scott & Dienes, 2008; Wan et al., 2008). A skeptic of the existence of unconscious knowledge (e.g., Dulany, 2012; Shanks, 2005) may claim that, contrary to what participants say, participants are always consciously aware of the structural features of a situation that led to the generation of a feeling of familiarity; indeed, being consciously aware of the stimulus and the relevant structural properties caused the familiarity.

Here we address this potential criticism by attempting to manipulate familiarity using a subliminal stimulus. If participants always have conscious knowledge regarding the source of feelings of familiarity, then such unconscious manipulation should fail. On the other hand, if participants can be unaware of the basis of their feelings of familiarity, it should be possible to create a free-floating familiarity capable of being misattributed to conscious sources. Such a subliminal familiarity manipulation would in turn permit a key test, namely that reliably unconscious sources of familiarity (subliminal sources) can be strategically excluded according to the task context. Here we manipulate the task context by placing the familiarity judgment either alone or in the wider context of judgments relating to structural adherence to the grammar rules. Priming manipulations have previously been employed in AGL as a means to manipulate fluency. For example, Johansson (2009) found that, for speeded judgments, test strings subliminally primed by the same versus a different target resulted in increased endorsement rates. Our manipulation is, however, quite distinct from this kind of fluency manipulation in that we sought to create a free floating feeling of familiarity derived from a stimulus unrelated to the task at hand. We chose the participant's surname as the highly familiar prime because this is a stimulus one has enormous previous experience with but is in no overt way related to grammar knowledge (cf. Pfister, Pohl, Kiesel, & Kunde, 2012). The unfamiliar prime was a string of letters, randomized between trials to ensure participants would not acquire any familiarity with this prime type. We used the grammar cross-over design of Dienes and Altmann (1997), which employs two grammars acting as controls for each other, therefore ungrammatical strings in this design do, in fact, conform to a structure that participants can become sensitive to over the course of testing (Mealor & Dienes, 2013a; Rohrmeier & Cross, 2014). Thus, random letter primes and ungrammatical strings were conceptually distinct.

Experiment 1 examined whether the familiarity manipulation was effective in the absence of any wider decision context; that is, participants rated the familiarity of each test string without any further judgments required. Experiment 2 asked for precisely the same ratings but now placed these judgments in a wider decision context with additional, qualitatively different decisions; that is, participants were required to judge also whether the test strings conformed to the rules present in the training grammar and to report the basis for their judgment.

Experiment 1

Method

Design and participants. Twenty participants were recruited from the University of Sussex (60% female) in exchange for course credit. Mean age was 22 years (*SD* = 4.82 years). The two grammar cross-over design of Dienes and Altmann (1997) was used whereby half the participants were trained on grammar A and half on grammar B. At test all participants classified the same test strings, exactly half of which conformed to each grammar. In this way the nongrammatical test strings for one group were grammatical for the other group, thereby eliminating the need for an untrained control group. The within-subject independent variables of interest were test string grammaticality (grammatical vs. ungrammatical) and prime type (surname vs. random).

Materials. The set of test and training strings were generated from the same grammars as used by Scott and Dienes (2008). String length was between five and nine characters. The training lists comprised 15 training strings from the respective grammar. Each list was repeated three times and randomized separately among participants. The test materials consisted of 30 novel test strings from each grammar presented twice, once preceded by the surname prime, once preceded by the random prime. The presentation order was randomized between each participant. Each participant's subjective threshold of awareness was determined using three-letter words randomly selected from a pool of 351. Surnames were chosen as the consistently familiar name prime as these are both personally relevant and added plausibility to the cover story that names were recorded during the experimental session merely so the experimenter could keep details of remuneration.

Procedure. Participants were tested individually at a computer. All participants in both experiments were tested by the first author in the context of a short-term memory task. At the beginning of the experiment, they were required to input age, surname (in upper case letters), and gender and were told this was merely for the experimenter's records. During the training phase, the training strings appeared on the monitor centrally in black text for 5000 ms followed by a blank screen for 5000 ms. Participants were instructed to memorize the string while it was present and then write down as much as they could recall once the screen went blank (not before). Their written responses were removed at the end of the training phase. The procedure for determining each participant's subjective threshold of awareness then commenced. On each trial, a forward mask was presented for 350 ms. This mask consisted of a row of pound signs (£) equal in length to the participant's surname. This was followed by a randomly selected three letter target word presented for 500 ms. The word was presented in gray to reduce contrast against the white background. Finally, the word was followed by a backward mask, the same as the forward mask, presented for 350 ms. There was an intertrial interval of 150 ms. If the participant could report the displayed target, they pressed the 1 key; if not they pressed the 0 key. When pressing 1, they were asked to type in what they saw. They were advised to press 1 even if they simply thought they saw a word and could not reproduce it; they were permitted to guess or simply leave the input blank in these instances. Five practice trials ensured participants were accustomed to the protocol before the threshold trials began. Once the threshold trials began the initial duration of 500 ms was reduced by one screen refresh (13.33 ms) each time the participant reported having seen a word; this was irrespective of whether they correctly entered the word. The reduction in display duration continued until there had been five consecutive trials where the participant reported not having seen a word. This final duration was used in the subsequent test phase. Each test trial began with a forward mask, prime, and backward mask before the grammar string appeared. The surname prime was set to the surname entered at the beginning of the experiment. The random letter prime was set to the same length as the surname and consisted of randomly selected capital letters. A new random letter prime was created for each random prime trial to avoid the possibility of participants becoming familiar with this prime type. Again, the prime was displayed in gray text. The display duration for the prime was set to the individual subjective threshold identified in the previous stage. After the backward mask the participants were asked whether they believed they could see the prime and were asked to input what they saw. They were asked to select how familiar the string felt relative to those previously copied on a 1 to 9 scale (where 1 = *not at all familiar*; 5 = *somewhat familiar*; 9 = *very familiar*). Note that no reference to grammar rules or structure was made during Experiment 1. Surname trials and random letter prime trials were coded with arbitrary numbers before analyses ensuring anonymity.

Results

The mean display time of the prime was 64 ms (*SD* = 16 ms). Test trials in which participants reported seeing the prime (regardless of whether the prime was surname or random letters) were excluded from the subsequent analyses; these constituted 6% (*SD* = 24%) of all test trials.

A 2 (Grammaticality: grammatical vs. ungrammatical) × 2 (Prime type: surname vs. random letter) repeated measures ANOVA was conducted on familiarity ratings (*n* = 20). See Figure 1 for

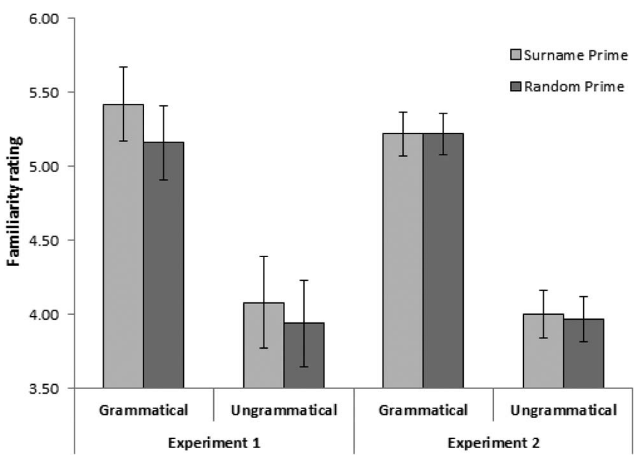

Figure 1. Mean familiarity ratings as a function of prime type and grammaticality in Experiments 1 and 2. Bars show ±1 standard error.

descriptive statistics. There was a significant main effect of grammaticality, with grammatical strings rated as more familiar ($M = 5.29$, $SE = 0.24$) than ungrammatical strings ($M = 4.01$, $SE = 0.30$), $F(1, 19) = 31.18$, $p < .001$, $\eta_p^2 = .62$. There was a significant main effect of prime type. Strings preceded by the surname prime were rated as more familiar ($M = 4.75$, $SE = 0.25$) than those preceded by the random prime ($M = 4.55$, $SE = 0.25$), $F(1, 19) = 6.34$, $p = .021$, $\eta_p^2 = .25$. These variables did not significantly interact, $F(1, 19) = 0.53$, $p = .477$, $\eta_p^2 = .03$.

Discussion

Experiment 1 demonstrated that masked priming with a stimulus with high preexperimental subjective familiarity (the participant's surname) elevated familiarity ratings toward stimuli with differing levels of familiarity (grammatical and ungrammatical strings) relative to priming with a consistently unfamiliar stimulus. This finding suggests the priming manipulation was successful in creating free-floating feelings of familiarity that were misattributed to target stimuli (cf. Ziembowicz et al., 2013). A main effect of grammaticality on familiarity ratings was also obtained, with grammatical strings receiving higher ratings than ungrammatical strings. Even when knowledge is not directly tested, strings obeying the training structure were generally rated as more familiar. This further supports the notion that a major source of responding in AGL is the relative familiarity of test strings (Scott & Dienes, 2008), which can be elicited even when classification performance is not directly assessed and supports the use of familiarity ratings as an indirect test of knowledge sensitive to grammaticality (cf. Wan et al., 2008). See Newell and Bright (2001) and Zizak and Reber (2004) for similar analyses employing liking ratings.

The findings of Experiment 1 mimic those of many perceptual fluency manipulations in AGL, insofar as the increases in familiarity were independent of grammaticality (e.g., Johansson, 2009; Topolinski & Strack, 2009; Scott & Dienes, 2010c). However, our approach involved creating nonspecific free-floating familiarity through priming with stimuli not related to the current task (cf. Ziembowicz et al., 2013). Further, the prime was unlikely to have changed the fluency with which the target stimulus was processed; rather it contributed to feelings of familiarity by way of a graded representation that coherence existed. The subliminal stimulus affected the metacognitive experience of familiarity through the combination and confounding of inputs from quite dissimilar sources. The additional, irrelevant source of (un)familiarity from the prime was attributed to the salient source, that is, the current test string. Thus, participants cannot always be aware of the structural sources of the feelings of familiarity: Some structural knowledge must be unconscious, consistent with, for example, Dienes (2012a). The results contradict claims that all structural knowledge must be conscious (e.g., Dulany, 2012).

Experiment 1 demonstrated that, under conditions in which participants were unaware of the structured nature of the letter strings, the subliminal manipulation could bias their ratings of familiarity. Experiment 2 examined whether the same bias would occur, or would be unconsciously excluded, under conditions where the structured nature of the stimuli was made apparent and the familiarity ratings placed in a wider decision context. Specifically, participants were informed that the training strings conformed to a set of rules and were required to judge which of the test strings obeyed those same rules and report the basis for their decision. The decision basis is captured by a structural knowledge attribution requiring participants to attribute the judgment of grammaticality to one of several sources (Dienes & Scott, 2005): random responding (it had no basis), feelings of intuition or familiarity, or rules and recollections. The attributions have been used extensively in implicit learning research to separate conscious from unconscious structural knowledge, that is, to separate responses based on random selection, intuition, or familiarity, on the one hand, or on rules or recollection, on the other (as used by e.g., Hamrick & Rebuschat, 2012; Kemény & Lukács, 2013; Neil & Higham, 2012; Norman & Price, 2012; Rebuschat, Hamrick, Sachs, Riestenberg, & Ziegler, 2014; Williams & Rebuschat, 2012).

Experiment 2

Method

Design and participants. Eighty-four participants were recruited from the University of Sussex (78% female). Mean age was 21 years

(*SD* = 4.14 years). None had participated in Experiment 1. An a priori power analysis based on the effect size observed in Experiment 1 (*dz* = .57) indicated that we would need an *n* of 42 to have confidence of replicating the priming effect (power = .95). We chose to double this figure on the basis that we wanted sufficient power to examine the effect when responses were split into conscious and unconscious structural knowledge attributions, such that the total trials where split into roughly two halves. The same grammar cross-over design was used as in Experiment 1.

Materials and procedure. The materials, training phase, and subjective threshold procedure were the same as those in Experiment 1. After participants' subjective threshold of awareness had been determined, they were provided with an instruction sheet pertaining to the grammaticality judgment portion of the test phase which they read through before the trials commenced. After the prime display, first they inputted how familiar the string felt relative to those copied during training in the same manner as Experiment 1. Second, they were asked if they thought the string obeyed the same rules as the training strings (1 = *yes*; 0 = *no*). Third, they were asked for the source of their grammar judgment based on the five options from Scott and Dienes (2008), which corresponded to five numbers on the keyboard: (1) random selection; (3) familiarity; (5) intuition; (7) rule(s); (9) memory. The definition of these categories was as follows: *Random* – You picked yes or no completely at random; *Familiarity* – You picked yes or no based on the relative familiarity of the string; *Intuition* – You picked yes or no based on a hunch or feeling but couldn't explain its nature; *Rule(s)* – You picked based on one or more rules or partial rules learned during the first part of the experiment and could state the nature of those rules if asked to do so; *Memory* – You picked yes or no based on a specific memory of the strings from the first part of the experiment (e.g., remembering definitely having seen or not seen part or all the string earlier). Participants were permitted to remind themselves of what these categories represented from the information sheet during the knowledge attribution decision.

Results

Two participants were excluded on the basis that the number of trials for which they reported being aware of the primes was greater than 2.5 *SD* from the mean (both reported awareness greater than 50% of trials). The mean display time of the prime was 57 ms (*SD* = 14 ms). Test trials in which participants reported seeing the prime were excluded from the subsequent analyses and constituted 7% (*SD* = 26%) of all test trials, comparable with the 6% excluded from Experiment 1.

Familiarity ratings. We first repeat the key analysis from Experiment 1, examining the influences on familiarity ratings. A 2 (Grammaticality: grammatical vs. ungrammatical) × 2 (Prime type: surname vs. random letter) repeated measures ANOVA was conducted on familiarity ratings (*n* = 82). See Figure 1 for descriptive statistics. There was a significant main effect of grammaticality, with grammatical strings receiving higher ratings (*M* = 5.22, *SE* = 0.14) than ungrammatical strings (*M* = 3.99, *SE* = 0.15), $F(1, 81) = 134.32$, $p < .001$, $\eta_p^2 = .62$. The main effect of prime was not significant, with strings following the surname prime receiving extremely similar ratings (*M* = 4.61, *SE* = 0.14) to those following the random prime (*M* = 4.60, *SE* = 0.14), $F(1, 81) = 0.11$, $p = .746$, $\eta_p^2 < .01$. The interaction was also nonsignificant, $F(1, 81) = 0.12$, $p = .729$, $\eta_p^2 < .01$. This result is in stark contrast to the influence of prime type on familiarity ratings observed in Experiment 1. To determine whether the nonsignificant effect of prime reflected experimental insensitivity or evidence for the null hypothesis (here, no difference between prime types upon familiarity ratings), a Bayes factor was calculated. Bayes factors indicate continuous degrees of support for hypotheses, where values over 3 can be considered substantial support for the experimental hypotheses; values less than 1/3 can be considered substantial evidence for the null and values around 1 indicate no strong support in either direction, suggesting data insensitivity (see Dienes, 2008, 2011, 2014 for rationale). The alternative hypothesis (i.e., that there was an effect of prime on familiarity ratings) was modeled as a half-normal with the standard deviation set to the difference found for the same comparison obtained in Experiment 1 (.186). The mean difference between familiar and unfamiliar primes found in Experiment 2 (.013, *SE* of the difference = .039) yielded a Bayes factor, *B* = 0.27, indicative of substantial evidence for the null. Thus, a reliable effect was found in Experiment 1, which was eliminated in Experiment 2 (note the larger sample size in Experiment 2 and the standardized effect sizes for the prime comparison of $\eta_p^2 = .25$ and $\eta_p^2 < .01$ in Experiments 1 and 2, respectively).

Second, influences on familiarity ratings were analyzed as a function of structural knowledge attribution (see Figure 2). Random selection, intuition, and familiarity responses index unconscious structural knowledge attributions and, as such, were pooled into a single category. Rules and memory responses index conscious structural knowledge attributions and thus were pooled into a separate category. See Dienes (2012a) for evidence that these are qualitatively different types of knowledge, in ways expected by theories of consciousness. Conscious and unconscious structural knowledge attributions were examined separately to allow all relevant data to be used for each knowledge type. Note the degrees of freedom: not all participants used all response types and hence could be included in the analyses. A grammaticality × prime type ANOVA on the familiarity ratings associated with unconscious structural knowledge attributions revealed an expected significant main effect of grammaticality, $F(1, 78) = 87.38$, $p < .001$, $\eta_p^2 = .53$, but no significant effect of prime, $F(1, 78) = 0.04$, $p = .847$, $\eta_p^2 < .01$, nor an interaction, $F(1, 78) = 0.67$, $p = .416$, $\eta_p^2 = .01$. The mean difference between surname and random letter primes within unconscious structural knowledge attributions collapsed over grammaticality was −.013 (as mean familiarity was slightly lower following the familiar context, *SE* of the difference = .067). A Bayes factor was calculated with the same parameters as for the data collapsed over structural knowledge attribution. This yielded *B* = 0.29, thus the data favor the null in the case of unconscious structural knowledge.

We sought to establish whether responses specifically attributed to familiarity would or would not show the priming effect from Experiment 1 (cf. Wan et al., 2008, for strategic control of familiarity). A total of 69 participants used at least one familiarity attribution for both prime types and grammaticality conditions (see Figure 3). The ANOVA revealed a significant main effect of grammaticality, $F(1, 68) = 56.18$, $p < .001$, $\eta_p^2 = .45$. There was no significant effect of prime, $F(1, 68) = 0.93$, $p = .336$. $\eta_p^2 = .01$, nor a significant interaction, $F(1, 68) = 0.01$, $p = .917$, $\eta_p^2 < .01$. Collapsed over grammaticality, the mean difference between surname and random letter primes was −.096 (again, as mean familiarity was slightly lower

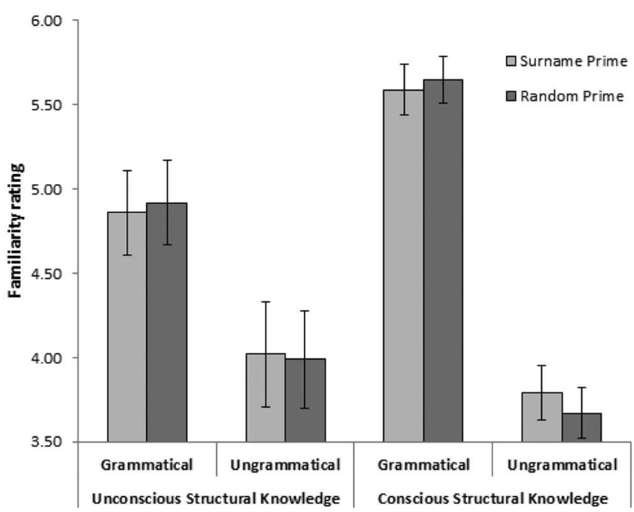

Figure 2. Mean familiarity ratings as a function of prime type and structural knowledge type in Experiment 2. Bars show ±1 standard error.

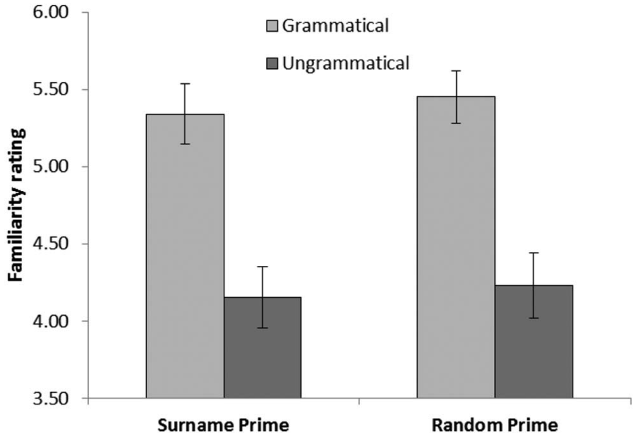

Figure 3. Mean familiarity ratings within familiarity attributions as a function of prime type and grammaticality in Experiment 2. Bars show ±1 standard error.

following the familiar context, *SE* of the difference = .099). A Bayes factor was calculated with the same parameters as for the data collapsed over structural knowledge attributions, yielding $B = 0.26$. The data favor the null in the case of responses specifically attributed to familiarity. The same analyses on conscious structural knowledge attributions reveal a significant main effect of grammaticality, $F(1, 67) = 79.28$, $p < .001$, $\eta_p^2 = .54$ and no significant effect of prime, $F(1, 67) = 0.08$, $p = .785$, $\eta_p^2 = .01$, nor an interaction, $F(1, 67) = 0.49$, $p = .487$, $\eta_p^2 = .01$. Modeling the mean difference collapsed over grammaticality (.035, *SE* of the difference = .126), with the same parameters as for unconscious structural knowledge attributions gives a $B = 0.68$; thus indicating the data are largely insensitive in the case of conscious structural knowledge, though predictions are, in any case, less strong in relation to the conscious structural knowledge attributions.

Distribution of response types. Next we examine how the proportion of conscious versus unconscious structural knowledge attributions was influenced by the familiarity manipulation. A significantly greater proportion of grammaticality judgments were attributed to conscious structural knowledge following the surname prime ($M = .32$, $SE = .02$) than the random prime ($M = .30$, $SE = .03$), $t(81) = 2.36$, $p = .021$, $dz = 0.26$.

Discrimination and response criterion. Next we examine whether discrimination sensitivity or response bias were influenced by the subliminal manipulation. Figure 4 shows signal detection descriptive statistics. In signal detection theory as applied to AGL, discrimination ability, d', corresponds to the difference in standardized hits minus false alarms. Increasing discrimination is shown as d' exceeds 0. This was calculated and entered into a 2 (Prime type: surname vs. random letter) × 2 (Structural knowledge attribution: conscious vs. unconscious) repeated measures ANOVA ($n = 63$, as not all participants had relevant data for hit and false alarm rates broken down by structural knowledge and prime type). This analysis revealed only a significant main effect of response type, with conscious structural knowledge attributions resulting in better discrimination ($M = 0.84$, $SE = .10$) than unconscious structural knowledge attributions ($M = 0.57$, $SE = .07$), $F(1, 62) = 7.91$, $p = .007$, $\eta_p^2 = .11$. The main effect of prime was nonsignificant, as was the interaction, $F\text{s} < 1.5$. Response criterion, *C*, indicates the tendency for participants to respond in an affirming manner irrespective of whether trials are grammatical or ungrammatical. As C decreases, a more liberal response criterion is indicated and demonstrates a bias to accept strings as grammatical, which may be expected following the surname prime relative to the random letter prime (cf. Ziembowicz et al., 2013). However, a 2 (Prime type: surname vs. random letter) × 2 (Structural knowledge attribution: conscious vs. unconscious) repeated

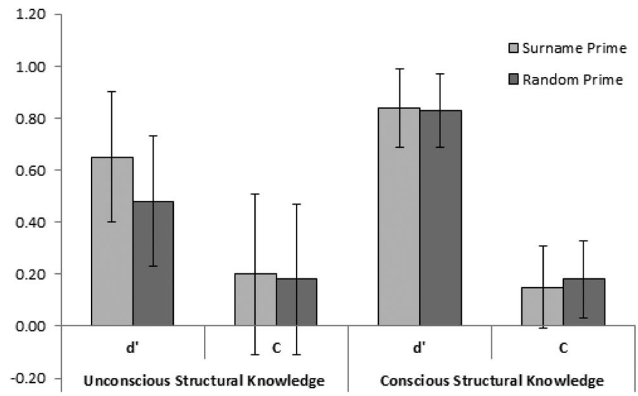

Figure 4. Mean discrimination, *d′*, and response criterion, C, as a function of prime type and structural knowledge type in Experiment 2. Bars show ±1 standard error.

measures ANOVA ($n = 63$) revealed this was not the case with no significant main effects of prime or structural knowledge type, nor an interaction, Fs < 1. The signal detections statistic, *C*, as calculated above, is the typical measure of response bias. However, to permit a more direct comparison with relevant previous research, we also examine bias in terms of the proportion of strings endorsed as grammatical. Ziembowicz et al. (2013, Experiments 1 and 2) found that presenting possible 3D shapes alongside a musical grammar increased claims that musical strings obeyed the grammar (irrespective of grammaticality) compared with pairing with impossible three-dimensional shapes. The observed influence resulting from an unrelated source of coherence has at least superficial similarity to our own manipulation and therefore warrants comparison. The arithmetic mean increase over these experiments in the proportion of accepted strings was .11. A 2 (Grammaticality: grammatical vs. ungrammatical) × 2 (Prime type: surname vs. random letter) × 2 (Structural knowledge attribution: conscious vs. unconscious) ANOVA ($n = 65$)[1] on the proportion of strings accepted as grammatical in the current experiment revealed no significant main effect of prime. The overall accepted proportion of trials following the surname prime was .439 and following the random letter prime was .437, $F < 1$. The difference reported by Ziembowicz et al. was taken as a rough estimate of the expected effect size, should there be one; thus the alternative hypothesis was modeled as a half-normal with the *SD* set to the mean found by Ziembowicz et al. The obtained difference (.002, *SE* of the difference $= .014$) yielded $B = 0.14$. In contrast to Ziembowicz et al., our data favor the null hypothesis that the surname prime did not increase the acceptance of strings as grammatical.

Discussion

The effect of priming on familiarity ratings obtained in Experiment 1 was not replicated in Experiment 2. In fact, for this same ratings task we obtained substantial evidence for the null for unconscious structural knowledge attributions and for familiarity collapsed over structural knowledge types. The key procedural difference between Experiments 1 and 2 was that in Experiment 2 the familiarity judgments were placed into a wider decision context where the underlying grammatical structure of the strings was made salient. The results are consistent with the notion that the task context can result in the unconscious selection or exclusion of different sources of familiarity; in Experiment 2, the irrelevant source of familiarity differences resulting from the subliminal prime no longer

[1] Here an expected main effect of grammaticality was also obtained. The proportion of grammatical strings accepted as such was significantly higher than that of ungrammatical strings, $F(1, 64) = 93.31$, $p < .001$. There was also a significant Structural knowledge attribution × Grammaticality interaction, $F(1, 64) = 12.58$, $p = .001$. The difference between the proportion of accepted grammatical and ungrammatical strings was higher for conscious than unconscious structural knowledge attributions. Other Fs < 1.15.

influenced explicit familiarity ratings. Following the familiar prime, participants also reported a small (2% of trials), but significant, increase in reliance on conscious structural knowledge than following the unfamiliar prime. Although this is only a preliminary result, a free-floating feeling of familiarity could enhance conviction in salient recollections or hypothesized rules whereas an unfamiliar context decreases this conviction, or disrupts conscious access to stored knowledge. Note that this does not imply disruption of *accurate* conscious structural knowledge as we did not obtain evidence for changes in discrimination; rather, priming could affect the subjective *experience* of applying knowledge or give the illusion that responses are based on memory, rather than intuitions. In other words, the prime resulted in a change in metacognitive criterion between conscious and unconscious structural knowledge attributions, but not response criterion as in endorsement or rejection of sequences. Future research could investigate this further.

General Discussion

There was a striking difference in the effects of priming with familiar and unfamiliar stimuli between the current experiments. Averaging over grammaticality, the effect of the surname prime versus random prime on familiarity ratings was significantly different between Experiment 1 and Experiment 2, $t(100) = 2.11$, $p = .037$, Cohen's $d = 0.53$. Using an indirect test of knowledge in Experiment 1, priming did influence subjective reports of familiarity, that is, metacognitive experience. This finding is consistent with the notion that the context under which judgments (e.g., regularity, memory) are made can be biased by irrelevant, global factors (Goldinger & Hansen, 2005; Ziembowicz et al., 2013). In contrast, however, this effect vanished in Experiment 2 where the ratings of familiarity occurred in a wider decision context highlighting the salience of the grammar structure. This *prima facie* contradicts a number of studies, which have shown conditions designed to increase *fluency* do influence recognition or classification judgments (e.g., Jacoby & Whitehouse, 1989; Topolinski & Strack, 2009; Whittlesea et al., 1990). Our familiarity manipulation is, however, different from these fluency manipulations. Whereas the fluency manipulations aim to influence the processing of the target stimulus, our manipulation sought to generate a feeling of familiarity from an entirely unrelated source. It appears that, where the familiarity source is distinct and unrelated to the goal of the conscious task, then that source can be excluded even where the source itself is not consciously perceived.

The apparent importance of the conscious context is consistent with previous findings. Johansson (2009) found perceptual primes increased claims of grammaticality in AGL only under speeded conditions designed to increase nonanalytic processing (and consequently reduce conscious task focus). Similarly, Mealor and Dienes (2012, 2013b) found that people tend to dwell on their response to get the most from their familiarity-based knowledge when given the opportunity to do so (see also Dewhurst, Holmes, Brandt, & Dean, 2006, for similar interpretations of recognition memory data). It is quite possible that participants in Experiment 2 were operating in a more analytical frame of mind than in Experiment 1, given the additional task demands, and this additional precision impedes the influence of irrelevant familiarity signals. This perhaps reflects a need for conscious focus to facilitate unconscious selection of the most relevant information sources. But what is the target of this focus? Our aim was to investigate free-floating familiarity with respect to the reported conscious status of structural knowledge; therefore, both a classification and structural knowledge attribution were required in Experiment 2. Thus it is possible that familiarity signals from the grammar strings became the most salient source of familiarity in the decision context once participants knew about the existence of grammars, or it could be that the introspective decision increased participants' sensitivity to grammar string familiarity. Furthermore, it is possible that participants experience multiple types of familiarity (e.g., Type A related to the prime and Type B related to grammaticality decisions), which became confounded in Experiment 1 but could be selected appropriately in Experiment 2 (cf. Wan et al., 2008), perhaps when participants realized that differences in subjective familiarity could distinguish grammaticality (Scott & Dienes, 2010a). Or it could be that the change in task set means that one phenomenologically single type of subjective familiarity is triggered by different environmental structures. Future work could disentangle these possibilities.

In Experiment 1, participants' familiarity ratings were swayed by an unrelated and unconsciously perceived source. Experiment 1 thus demonstrated that the structural basis of a feeling of familiarity can be unconscious, as postulated by Norman et al. (2006, 2011) and Dienes et al. (2011), and contrary to skeptics of the existence of unconscious knowledge (e.g., Dulany, 2012). In Experiment 2, the right conscious task context permitted the unconscious familiarity source to be excluded from influence. Experiment 2 thus demonstrates that people have some metacognitive control over which sources of familiarity are exploited. An area for future research is the extent to which feelings of familiarity can be used to progressively explicate knowledge by a continuing refocusing on the sources providing it, as postulated by Scott and Dienes (2010a). Relatedly, the current results speak against familiarity showing its influence automatically (as in Jacoby, 1991), as the same priming procedure produced strikingly different results between the two experiments. In fact, Experiment 2 may be indicative of a form of *unconscious* strategic control. Previous studies, which have provided evidence for strategic control of unconscious structural knowledge (Mealor & Dienes, 2013a; Norman et al., 2011; Wan et al., 2008), showed that conscious feelings of familiarity based on unconscious structural knowledge could be applied strategically when participants were instructed to do so. The current results extend those findings to include strategic control over the influence of *subliminal* sources of information (cf. Armstrong & Dienes, 2013, for subliminal priming). A difference between the latter case and the current study is that for Armstrong and Dienes there seemed to be an unconscious intention to exclude (as with hypnosis; Dienes, 2012b), but there is no reason to postulate an unconscious intention here: Participants intentionally intend to respond to grammaticality and a consequence of that is excluding extraneous sources.

Finally, to date, relatively little published research has investigated the effects of priming in AGL, particularly with a focus on whether structure can be acquired without conscious perception (cf. Bornstein, 1994). Newell and Bright (2003) presented training strings for 100 ms and found that the same strings represented at test were endorsed more often than baseline, but novel strings from the same grammar were not. Although the primes used by Newell and Bright cannot be considered subliminal, recent work by Armstrong and Dienes (2013) showed that people are sensitive to syntactical negation rules at levels reliably below subjective awareness. Thus sufficiently sensitive tests could, in principle, demonstrate more sophisticated capabilities of unconscious cognition.

References

Armstrong, A. M., & Dienes, Z. (2013). Subliminal understanding of negation: Unconscious control by subliminal processing of word pairs. *Consciousness & Cognition, 22,* 1022–1040. doi:10.1016/j.concog.2013.06.010

Bornstein, R. F. (1994). Are subliminal mere exposure effects a form of implicit learning? *Behavioural and Brain Sciences, 17,* 398–399.

Chubala, C. M., & Jamieson, R. K. (2013). Recoding and representation in artificial grammar learning. *Behavior Research Methods, 45,* 470–479. doi:10.3758/s13428-012-0253-6

Cleeremans, A., & Dienes, Z. (2008). Computational models of implicit learning. In R. Sun (Ed.), *Cambridge handbook of computational psychology* (pp. 396–421). New York, NY: Cambridge University Press. doi:10.1017/CBO9780511816772.018

Dewhurst, S. A., Holmes, S. J., Brandt, K. R., & Dean, G. M. (2006). Measuring the speed of the conscious components of recognition memory: Remembering is faster than knowing. *Consciousness and Cognition, 15,* 147–162. doi:10.1016/j.concog.2005.05.002

Dienes, Z. (2008). *Understanding psychology as a science: An introduction to scientific and statistical inference*. Hampshire, England: Palgrave Macmillan.

Dienes, Z. (2011). Bayesian versus orthodox statistics: Which side are you on? *Perspectives on Psychological Science, 6,* 274–290. doi:10.1177/1745691611406920

Dienes, Z. (2012a). Conscious versus unconscious learning of structure. In P. Rebuschat & J. Williams (Eds.), *Statistical learning and acquisition* (pp. 337–364). Berlin, Germany: Mouton de Gruyter Publishers.

Dienes, Z (2012b). Is hypnotic responding the strategic relinquishment of metacognition? In M. Beran, J. L. Brandl, J. Perner, & J. Proust (Eds.), *The foundations of metacognition* (pp. 267–278). New York, NY: Oxford University Press. doi:10.1093/acprof:oso/9780199646739.003.0017

Dienes, Z. (2014). Using Bayes to get the most out of non-significant results. *Frontiers in Psychology*.

Dienes, Z., & Altmann, G. (1997). Transfer of implicit knowledge across domains: How implicit and how abstract? In D. Berry (Ed.), *How implicit is implicit learning?* (pp. 107–123). New York, NY: Oxford University Press.

Dienes, Z., & Scott, R. (2005). Measuring unconscious knowledge: Distinguishing structural knowledge and judgment knowledge. *Psychological Research, 69,* 338–351. doi:10.1007/s00426-004-0208-3

Dienes, Z., Scott, R. B., & Wan, L. L. (2011). The role of familiarity in implicit learning. In P. Higham & J. Leboe (Eds.), *Constructions of remembering and metacognition: Essays in honour of Bruce Whittlesea* (pp. 51–62). London, UK: Palgrave Macmillan.

Dulany, D. E. (2012). How should we understand implicit and explicit processes in scientific thinking. In R. W. Proctor & E. J. Capaldi (Eds.), *Psychology of science: Implicit and explicit processes* (pp. 199–227). New York, NY: Oxford University Press.

Goldinger, S. D., & Hansen, W. A. (2005). Remembering by the seat of your pants. *Psychological Science, 16,* 525–529. doi:10.1111/j.0956-7976.2005.01569.x

Hamrick, P., & Rebuschat, P. (2012). How implicit is statistical learning? In P. Rebuschat & J. Williams (Eds.), *Statistical learning and language acquisition* (pp. 365–382). Berlin, Germany: Mouton de Gruyter Publishers.

Higham, P. A., Vokey, J. R., & Pritchard, J. L. (2000). Beyond dissociation logic: Evidence for controlled and automatic influences in artificial grammar learning. *Journal of Experimental Psychology: General, 129,* 457–470. doi:10.1037/0096-3445.129.4.457

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language, 30,* 513–541. doi:10.1016/0749-596X(91)90025-F

Jacoby, L. L., & Whitehouse, K. (1989). An illusion of memory: False recognition influenced by unconscious perception. *Journal of Experimental Psychology: General, 118,* 126–135. doi:10.1037/0096-3445.118.2.126

Johansson, T. (2009). In the fast lane towards implicit learning: Nonanalytic processing and fluency in artificial grammar learning. *European Journal of Cognitive Psychology, 21,* 129–160. doi:10.1080/09541440802049002

Kemény, F., & Luckacs, A. (2013). Self-insight in probabilistic category learning. *Journal of General Psychology, 140,* 57–81. doi:10.1080/00221309.2012.735284

Mealor, A. D., & Dienes, Z. (2012). No-loss gambling shows the speed of the unconscious. *Consciousness and Cognition, 21,* 228–237. doi:10.1016/j.concog.2011.12.001

Mealor, A. D., & Dienes, Z. (2013a). Explicit feedback maintains implicit knowledge. *Consciousness and Cognition, 22,* 822–832. doi:10.1016/j.concog.2013.05.006

Mealor, A. D., & Dienes, Z. (2013b). The speed of metacognition: Taking time to get to know one's structural knowledge. *Consciousness and Cognition, 22,* 123–136. doi:10.1016/j.concog.2012.11.009

Neil, G. J., & Higham, P. A. (2012). Implicit learning of conjunctive rule sets: An alternative to artificial grammars. *Consciousness and Cognition, 21,* 1393–1400. doi:10.1016/j.concog.2012.07.005

Newell, B. R., & Bright, J. E. H. (2001). The relationship between the structural mere exposure effect and the implicit learning process. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology, 54,* 1087–1104. doi:10.1080/713756009

Newell, B. R., & Bright, J. E. H. (2003). The subliminal mere exposure effect does not generalise to structurally related stimuli. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale, 57,* 61–68. doi:10.1037/h0087413

Norman, E., & Price, M. C. (2012). Social intuition as a form of implicit learning: Sequences of body movements are learned less explicitly than letter sequences. *Advances in Cognitive Psychology, 8,* 121–131. doi:10.5709/acp-0109-x

Norman, E., Price, M. C., & Duff, S. C. (2006). Fringe consciousness in sequence learning: The influence of individual differences. *Consciousness and Cognition, 15,* 723–760. doi:10.1016/j.concog.2005.06.003

Norman, E., Price, M., & Duff, S. (2010). Fringe consciousness: A useful framework for clarifying the nature of experience-based feelings. In A. Efklides & P. Misailidi (Eds.), *Trends and prospects in metacognition research* (pp. 63–80). New York, NY: Springer.

Norman, E., Price, M. C., & Jones, E. (2011). Measuring strategic control in artificial grammar learning. *Consciousness and Cognition, 20,* 1920–1929. doi:10.1016/j.concog.2011.07.008

Pfister, R., Pohl, C., Kiesel, A., & Kunde, W. (2012). Your unconscious knows your name. *PLoS ONE, 7*. doi:10.1371/journal.pone.0032402

Pothos, E. M. (2007). Theories of artificial grammar learning. *Psychological Bulletin, 133,* 227–244. doi:10.1037/0033-2909.133.2.227

Reber, P. J. (2013). The neural basis of implicit learning and memory: A review of neuropsychological and neuroimaging research. *Neuropsycho-*

logia, 51, 2026–2042. doi:10.1016/j.neuropsychologia.2013.06.019
Rebuschat, P. (2013). Measuring implicit and explicit knowledge in second language research. *Language Learning, 63,* 595–626. doi:10.1111/lang.12010
Rebuschat, P., Hamrick, P., Sachs, R., Riestenberg, K., & Ziegler, N. (2014). Implicit and explicit knowledge of form-meaning connections: Evidence from subjective measures of awareness. In J. Bergsleithner, S. Frota, & J. K. Yoshioka (Eds.), *Noticing: L2 studies and essays in honor of Dick Schmidt.* Honolulu, HI: University of Hawaii at Manoa, National Foreign Language Resource Center.
Rohrmeier, M., & Cross, I. (2014). Modelling unsupervised online-learning of artificial grammars: Linking implicit and statistical learning. *Consciousness and Cognition, 27,* 155–167. doi:10.1016/j.concog.2014.03.011
Schwarz, N., & Clore, G. L. (2007). Feelings and phenomenal experiences. In A. Kruglanski & E. T. Higgins (Eds.), *Social psychology. Handbook of basic principles* (2nd ed., pp. 385–407). New York, NY: Guilford Press.
Scott, R. B., & Dienes, Z. (2008). The conscious, the unconscious, and familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34,* 1264–1288. doi:10.1037/a0012943
Scott, R. B., & Dienes, Z. (2010a) The metacognitive role of familiarity in artificial grammar learning: Transitions from unconscious to conscious knowledge. In A. Efklides & P. Misailidi (Eds.), *Trends and prospects in metacognition research* (pp. 37–61). New York, NY: Springer. doi:10.1007/978-1-4419-6546-2_3
Scott, R. B., & Dienes, Z. (2010b). Prior familiarity with components enhances unconscious learning of relations. *Consciousness and Cognition, 19,* 413–418. doi:10.1016/j.concog.2009.12.012
Scott, R. B., & Dienes, Z. (2010c). Fluency does not express implicit knowledge of artificial grammars. *Cognition, 114,* 372–388. doi:10.1016/j.cognition.2009.10.010
Servan-Schreiber, E., & Anderson, J. R. (1990). Learning artificial grammars with competitive chunking. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16,* 592–608. doi:10.1037/0278-7393.16.4.592
Shanks, D. (2005). Implicit learning. In K. Lamberts & R. Goldstone (Eds.), *Handbook of cognition* (pp. 202–220). London: Sage.
Topolinski, S., & Strack, F. (2009). The architecture of intuition: Fluency and affect determine intuitive judgments of semantic and visual coherence and judgments of grammaticality in artificial grammar learning. *Journal of Experimental Psychology: General, 138,* 39–63. doi:10.1037/a0014678
Wan, L., Dienes, Z., & Fu, X. (2008). Intentional control based on familiarity in artificial grammar learning. *Consciousness and Cognition, 17,* 1209–1218. doi:10.1016/j.concog.2008.06.007
Whittlesea, B. W. A., Jacoby, L. L., & Girard, K. (1990). Illusions of immediate memory: Evidence of an attributional bias for feelings of familiarity and perceptual quality. *Journal of Memory and Language, 29,* 716–732. doi:10.1016/0749-596X(90)90045-2
Whittlesea, B. W. A., & Leboe, J. P. (2000). The heuristic basis of remembering and classification: Fluency, generation and resemblance. *Journal of Experimental Psychology: General, 129,* 84–106. doi:10.1037/0096-3445.129.1.84
Whittlesea, B. W. A., & Williams, L. D. (2001). The discrepancy-attribution hypothesis: II. Expectation, uncertainty, surprise, and feelings of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27,* 14–33. doi:10.1037/0278-7393.27.1.14
Williams, J. N., & Rebuschat, P. (2012). Statistical learning and syntax: What can be learned and what difference does meaning make? In P. Rebuschat & J. Williams (Eds.), *Statistical learning and language acquisition* (pp. 237–264). Berlin, Germany: Mouton de Gruyter Publishers.
Ziembowicz, M., Nowak, A., & Winkielman, P. (2013). When sounds look right and images sound correct: Cross-modal coherence enhances claims of pattern presence. *Cognition, 129,* 273–278. doi:10.1016/j.cognition.2013.07.010
Zizak, D. M., & Reber, A. S. (2004). Implicit preferences: The role(s) of familiarity in the structural mere exposure effect. *Consciousness and Cognition, 13,* 336–362. doi:10.1016/j.concog.2003.12.003

Received November 27, 2013
Revision received July 3, 2014
Accepted July 3, 2014 ■