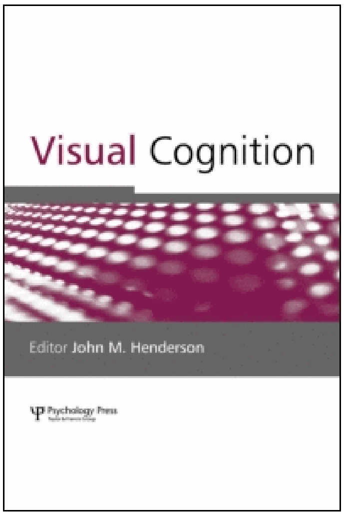

Visual Cognition
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713683696

Age-of-acquisition effects in picture naming: Are they structural and/or semantic in nature?

Marylène Chalard [a]; Patrick Bonin [a]
[a] Université Blaise Pascal, Clermont-Ferrand, France

To cite this Article Chalard, Marylène and Bonin, Patrick'Age-of-acquisition effects in picture naming: Are they structural and/or semantic in nature?', Visual Cognition, 13: 7, 864 — 883
To link to this Article: DOI: 10.1080/13506280544000084
URL: http://dx.doi.org/10.1080/13506280544000084

VISUAL COGNITION, 2006, 13 (7/8), 864–883

Psychology Press
Taylor & Francis Group

Age-of-acquisition effects in picture naming: Are they structural and/or semantic in nature?

Marylène Chalard and Patrick Bonin

Université Blaise Pascal, Clermont-Ferrand, France

Pictures having early acquired names are named faster than pictures having late acquired names. Age-of-acquisition (AoA) effects in picture naming are generally ascribed to lexical phonological representations, but alternative hypotheses state that they are located at the levels of semantic and/or object recognition. In Experiment 1, a semantic locus of AoA effects was tested. Participants performed both a picture naming task and a name-object verification task on the same items in two different sessions. AoA effects were reliable in picture naming latencies but not in name-object verification times. In Experiment 2, an object recognition task was used with the same items as employed in Experiment 1. Late acquired items were responded to faster than early acquired items. The findings do not support a semantic or a structural locus of AoA effects in picture naming.

Object naming is faster with pictures having early acquired (EA) names as compared to pictures having late acquired (LA) names. Age-of-acquisition (hereafter AoA) effects are now well-established in picture naming[1] (e.g., Barry, Hirsh, Johnston, & Williams, 2001; Barry, Morrison, & Ellis, 1997; Bonin, Chalard, Méot, & Fayol, 2002; Bonin, Fayol, & Chalard, 2001; Chalard, Bonin, Méot, Boyer, & Fayol, 2003; Ellis & Morrison, 1998).

[1] In the present paper, we chose the term of AoA to remain compatible with the AoA literature. However, we and others have argued elsewhere that AoA effects are better described and operationalized as frequency trajectory effects (Bonin, Barry, Méot, & Chalard, 2004; Zevin & Seidenberg, 2002, 2004). Frequency trajectory refers to changes in frequency over ages and is naturally correlated with AoA (Zevin & Seidenberg, 2004). We have shown that frequency trajectory effects are reliable in picture naming but not in word reading or spelling-to-dictation (Bonin et al., 2004). It should be noted that, for the purposes of the present paper, the distinction between frequency trajectory and AoA effects is not crucial.

Please address all correspondence to Marylène Chalard, Laboratoire de Psychologie Sociale et Psychologie Cognitive (LAPSCO/CNRS), 34, avenue Carnot, 63037 Clermont-Ferrand, France. Email: chalard@srvpsy.univ-bpclermont.fr

The authors wish to thank Chris Barry, Bob Johnston, Catriona Morrison, and an anonymous reviewer for helpful comments and Delphine Martin for running Experiment 1.

http://www.psypress.com/viscog DOI: 10.1080/13506280544000084

Although AoA effects are well-established at an empirical level, we are far from possessing *a clear and unified* account of these effects. In particular, the level(s) of representations underlying AoA effects in picture naming is now a matter of debate. As we shall see, different levels of representations have been proposed as underlying AoA effects in object naming. The present study was designed to test for a structural and a semantic locus of AoA effects in object naming.

Object naming requires the involvement of different kinds of representations. Following the visual processing of the objects, structural representations are activated (e.g., Humphreys, Riddoch, & Quinlan, 1988; Whatmough, Chertkow, Murtha, & Hanratty, 2002). Structural representations correspond to stored visual representations of objects. These representations contact semantic representations, which in turn correspond to functional and associative knowledge. Levelt and colleagues view lexical access as a two-step process. This process involves (1) the activation and the selection of a lexical entry, called a lemma, which provides abstract syntactic representations such as grammatical category, and (2) the retrieval of phonological representations referred to as lexemes (e.g., Levelt, 1989). However, the two-step view of lexical access has been criticized (e.g., Caramazza, 1997). We shall not take a stance on this issue since our main goal is to investigate the AoA effect on prelexical levels in picture naming. Finally, an articulatory plan is elaborated and executed.

As far as the locus of AoA effects in picture naming is concerned, the level of lexical phonological representations is the one that has been most frequently proposed (Brown & Watson, 1987; Gerhand & Barry, 1998, 1999a, 1999b; Gilhooly & Watson, 1981; Morrison, Hirsh, Chappell, & Ellis, 2002). Given that some studies report no reliable AoA effects in tasks indexing the prelexical and postlexical levels involved in picture naming (e.g., Morrison, Ellis, & Quinlan, 1992), the most likely locus of AoA effects must be lexical. Morrison and Ellis (1995) tested a postlexical (articulatory) locus of AoA effects by means of a delayed word naming task: Participants had to read a word aloud after the presentation of a visual cue. Because no reliable AoA effect was found, an articulatory locus of AoA effects was excluded. Morrison et al. (1992) tested a prelexical (semantic) locus of AoA effects in picture naming using a categorization task in which the participants had to decide by means of two keys whether they thought the picture presented on the screen was "man-made" or "natural". No AoA effect was observed, whereas it was significant in picture naming using the same pictures. Consequently, a semantic locus of AoA effects in picture naming was rejected. If the assumption that lexical access involves lemma selection and lexeme retrieval is adopted, then AoA effects can take place either at the lemma level, at the phonological level or in the links relating the two levels (e.g., Levelt, Roelofs, & Meyer, 1999). Since AoA effects are found on word reading latencies, Morrison et al. (2002) favoured a phonological locus of AoA effects given the assumption that lemma access is not required in word reading whereas both word reading and picture naming obligatorily require phonological retrieval.

In accordance with a phonological locus of AoA effects, Brown and Watson (1987) proposed an account of AoA effects referred to as the phonological completeness hypothesis. According to this, the phonological representations of EA words are holistic in nature, whereas those of LA words are more fragmented. Therefore, the former are quicker to retrieve than the latter. Often cited in the past, this account has recently been called into question. This hypothesis accords with the existence of a critical period of language acquisition during which the phonological representations of early acquired words would be established in memory in a way that differs from those of words acquired beyond this critical period. However, certain studies have reported AoA effects with words learned well beyond any critical period of first-language acquisition, for instance in reading Japanese *Kanji* (Yamazaki, Ellis, Morrison, & Lambon Ralph, 1997), in adults' written naming (Bonin, Méot, & Boyer, 2003b), or in picture naming in a second language (Izura & Ellis, 2002; Morrison, Hirsh, & Carnicer, 2001).

It follows from the phonological completeness account that LA words should be segmented faster than EA words. However, using a phonological segmentation task in adults Monaghan and Ellis (2002) found evidence contrary to this view. At present, there is no convincing evidence supporting the phonological completeness hypothesis of AoA effects.

Ellis and Lambon Ralph (2000) have proposed that AoA effects are encoded in the strength of the links relating different kind of representations, and that they are therefore not rooted in a specific type of representation, i.e., phonological or semantic representations. These authors' simulations have shown that the patterns introduced early in the training sessions were better represented than the patterns introduced later and that the simulated "AoA" effects could not be reduced to cumulative frequency effects (see also Morrison et al., 2002, for behavioural evidence).

Of importance for our approach here is the fact that several authors have claimed that AoA effects can be ascribed to prelexical levels involved in picture naming, i.e., the structural level (Moore, Smith-Spark, & Valentine, 2004; Vitkovitch & Tyrrell, 1995) or the semantic level (Brysbaert, van Wijnendaele, & de Deyne, 2000). Vitkovitch and Tyrrell (1995) conducted a multiple regression study of picture naming and object decision, i.e., deciding whether a stimulus is a real object or not. The reliable predictors of object naming speed were AoA and name agreement. In the case of object decision, they were visual complexity and AoA. Since object decision does not require overt production, it has been assumed that lexical access did not occur in this task (Kroll & Potter, 1984; Vitkovitch & Tyrrell, 1995). Because

AoA was reliable in object decision and object decision involves access to structural representations, as does picture naming, Vitkovitch and Tyrrell suggested that AoA effects are not limited to the lexical level and can also be ascribed to the structural level. However, they did not include in their regression analyses certain variables known to exert an impact in picture naming latencies: Image agreement (Barry et al., 1997; Bonin et al., 2002), conceptual familiarity (Ellis & Morrison, 1998), image variability (or imageability) (Bonin et al., 2002; Ellis & Morrison, 1998). Since it has been assumed that these variables act at pre-lexical levels such as the structural or the semantic level, we cannot exclude that the possibility the AoA effect found in object decision RTs was not in fact attributable to some uncontrolled variable.

A perceptual locus of AoA effects has been put forward by Moore et al. (2004) on the basis of the following observations. Participants had to classify pictures as "real objects" or "nonobjects". Real objects had names that varied on AoA. Care was taken to match the early and late acquired object names on number of phonemes, visual complexity, name and image agreement, conceptual familiarity, and word frequency. An AoA effect was found on classification times. The possibility that the classification task involved implicit naming was tested using the same task, with the exception that the objects were contrasted on objective word frequency. Assuming that word frequency effects are genuine lexical effects (e.g., Jescheniak & Levelt, 1994), the rationale was that the finding of a word frequency effect on classification times would suggest that this task leads to the activation of object names. Therefore, by extension, the AoA found on classification times might be ascribed to lexical processes. In contrast, if no reliable word frequency effect is found on classification times, it would suggest that the AoA effect found in the classification task is rooted in perceptual processes. Although RTs for objects with low frequency names were shorter than for those with high frequency names, this effect was significant in the by-participant analysis only. Following their line of reasoning, Moore et al. concluded that the AoA effect found on object classification times is attributable to the perceptual level. There are, however, two important concerns that can be raised. The first concern is that imageability (and/or image variability) was not taken into account. AoA and imageability correlate highly (Barry & Gerhand, 2003; Bonin et al., 2004). Therefore, it cannot be excluded that the AoA effect found in the classification task was due to imageability instead of AoA. The second concern relates to the rationale underlying the authors' use of the frequency manipulation. It should be remembered that recent studies have not found reliable frequency effects in picture naming when AoA was controlled for (Barry et al., 2001; Bonin et al., 2001, 2002; Chalard et al., 2003). Thus, a necessary step in validating the authors' line of reasoning would have been to show that the frequency manipulation of their critical set of items led to reliable frequency effects on picture naming latencies. In fact, Moore et al.'s findings are inconclusive as to whether AoA effects are perceptual in nature.

According to Brysbaert et al. (2000), the idea that AoA effects may have a semantic locus has been too rapidly rejected. These researchers have provided evidence which, according to them, favours a semantic locus of AoA effects. They have reported AoA effects in a word-associate generation task, which is assumed to be "semantic" in nature. Participants had to say aloud the first word that came to mind in response to a word inductor. AoA, word frequency, and imageability were reliable predictors of the time required to produce an associate word. However, as acknowledged by Brysbaert et al., this task involves the generation of a verbal response. Therefore, if AoA effects emerge as a result of verbal retrieval, it is not surprising that they can also be seen in this task. Another experiment was therefore conducted using another semantic task which requires no verbal response. Participants had to categorize each presented word as corresponding to a "first name" or to a word with a "definable meaning". Reliable AoA and word frequency effects were found but the effect of imageability was not significant. The lack of a reliable imageability effect is problematic since imageability is considered as a variable which truly indexes semantic representations (e.g., Jones, 1985; Strain, Patterson, & Seidenberg, 1995, in word reading). Brysbaert et al.'s evidence in favour of a semantic locus of AoA effects is not straightforward since we cannot be certain that the classification task they used does not lead to the activation of lexical phonology.

Convincing evidence against a semantic locus of the AoA effect was recently provided by Izura and Ellis (2004). The experiments of interest here were lexical decision experiments involving bilingual speakers of Spanish having English as their second language. The acquisition of a second language consists in learning new associations between phonological and orthographic representations and preexisting semantic representations. Since the lexical decision task has been assumed to involve access to semantic representations, at least under certain conditions (Plaut, 1997), as well as to phonological representations (Gerhand & Barry, 1999b), the use of bilingual speakers and early and late acquired words in both languages allowed Izura and Ellis to subject the semantic locus hypothesis of AoA effects to vigorous testing. If one assumes that second language acquisition builds on the semantic representations established during first language acquisition, a semantic locus of AoA effects leads to the prediction that AoA effects observed in the first language are translated to the second language since the semantic representations underlying both languages are the same. In one experiment, Izura and Ellis used two sets of words contrasted on AoA in the first language and second languages. The first set consisted of words acquired early in the first language, i.e., Spanish, but whose translations in the second language, i.e., English, were acquired relatively later in life. The second set consisted of words acquired late in the first language but whose translations in the second language were acquired early in life. Lexical decision latencies were affected by the order of acquisition of the words in the second language regardless of the age at which the translation equivalents were acquired in the first (native) language. These findings do not support the idea of an impact at the semantic level since this hypothesis predicts faster responses for the first set of words than for the second set.

Given that a prelexical locus of AoA effects in picture naming is not unambiguously supported by the evidence reported thus far, the goal of the experiment reported below was to test further a prelexical locus of AoA effects using both a picture naming and a name-object verification task.

The name-object verification task was the same as the one used by Jescheniak and Levelt (1994). A word was presented visually and followed by a picture. The participants had to decide whether the name evoked the same object as the one depicted by the picture. The name–object verification task is obviously a semantic task because it necessarily requires the activation of semantics in order for decisions to be made. Since object naming obligatorily requires semantic access (Bonin, 2003), if AoA effects are localized, partly or totally, at the structural and/or the semantic level respectively, they should be reliable in both the name-object verification and the picture naming tasks. On the contrary, if AoA effects have a lexical origin, since the name-object verification task does not require the production of object names, we should observe that AoA effects are reliable in picture naming and not in name-object verification. In line with this prediction, Jescheniak and Levelt did not find reliable word frequency effects on name-object verification RTs but reliable ones on picture naming latencies. Unfortunately, in this study, word frequency was confounded with AoA (Ellis & Morrison, 1998).

EXPERIMENT 1

Method

Participants. Twenty-seven undergraduate students (mean age 20 years) from Blaise Pascal University (Clermont-Ferrand) were recruited. They received course credits for their participation in order to fulfil a course requirement. All were native speakers of French with normal or corrected-to-normal vision. Fourteen of them were randomly assigned to the name verification task in the first session and to the spoken picture naming task in the second session, while the reverse distribution was used for the other participants.

TABLE 1
Statistical characteristics of the experimental stimuli used in Experiment 1

	Early acquired			*Late acquired*			
	Mean	*SD*	*Min–max*	*Mean*	*SD*	*Min–max*	*p-values*
AoA	1.61	0.21	[1.19–1.88]	2.57	0.51	[2.04–4.15]	< .0001
Name agreement	96.43	7.16	[71–100]	94.33	7.41	[75–100]	n.s.
Image agreement	3.45	0.59	[2.23–4.83]	3.45	0.72	[1.83–4.57]	n.s.
Conceptual familiarity	3.10	1.07	[1.40–4.93]	2.96	1.16	[1.07–4.80]	n.s.
Visual complexity	2.96	0.72	[1.55–4.31]	2.80	0.90	[1.00–4.62]	n.s.
Word frequency (log + 1)	1.22	0.42	[0.44–1.89]	1.26	0.41	[0.40–1.99]	n.s.
Number of letters	6.10	1.45	[4–10]	6.50	1.17	[4–9]	n.s.
Number of phonemes	4.40	1.48	[2–8]	4.67	0.92	[3–7]	n.s.
Number of syllables	1.73	0.69	[1–3]	1.83	0.53	[1–3]	n.s.
Imageability	4.74	0.14	[4.28–4.96]	4.36	0.51	[2.60–5.00]	< .001

Stimuli. The experimental stimuli consisted of 60 drawings of common objects selected from the Snodgrass and Vanderwart (1980) database. One set of 30 pictures corresponded to EA names and the other set of 30 pictures corresponded to LA names. AoA scores were extracted from the Alario and Ferrand (1999) study. AoA scores were obtained by asking adults to estimate the age at which they thought they had learned each of the words in either their spoken or written form using a 5-point scale (with 1 = learned at 0–3 years and 5 = learned at 12+, with 3-year age bands in between). As shown in Table 1, EA and LA picture names were matched on name agreement, image agreement, conceptual familiarity, visual complexity, word frequency, number of letters, phonemes, and syllables. Due to the stringent selection restrictions, it was not possible to control for imageability. As a result, we included this factor as covariate in the by-item analyses of variance.

The measures of name agreement, image agreement, conceptual familiarity, and visual complexity were taken from Alario and Ferrand (1999). Name agreement refers to the degree to which participants agree on the name of the picture. It was measured by considering the percentage of participants who gave the most proposed name for a particular picture. Image agreement refers to the degree to which the image generated by participants in response to a picture name matched the picture's appearance. It was rated using a 5-point scale (1 = the picture provided a poor match for the image given by the participant, 5 = the picture provided a good match for the image given by the participant). Conceptual familiarity corresponded to the familiarity of the concept depicted and was also measured on a 5-point scale (1 = a very unfamiliar object, 5 = a very familiar object). Visual complexity referred to the number of lines and details in the drawing. Again, the participants had to judge the complexity of each drawing on a 5-point-scale (1 = very simple drawing, 2 = very complex drawing). Word frequency values were taken from the LEXIQUE database (New, Pallier, Ferrand, & Matos, 2001) and corresponded to written word frequency (referred to as Frantext in the database). In Table 1, word frequency values are transformed to log(x + 1). Finally, imageability scores were provided by Bonin, Méot, Aubert, Malardier, Niedenthal, and Capelle-Toczek (2003a). Imageability referred to the ease with which a particular picture name aroused a mental image and was rated on a 5-point scale (1 = very difficult to arouse a mental image, 5 = very easy to arouse a mental image). Ten additional pictures were used in the training phase. An additional pool of 60 pictures was used for the "no" responses in the name–object verification task. Half of them referred to EA words and the other half to LA words. In addition, 20 pictures were used as warm-ups.

Apparatus. The experiment was run on a PowerMacintosh computer and was designed with PsyScope Version 1.2 (Cohen, MacWhinney, Flatt, & Provost, 1993). The computer controlled the presentation of the pictures and recorded the spoken latencies. Spoken latencies were collected using a button-box connected to the computer and to a small tie-pin microphone.

Procedure. The participants performed the name–object verification task and the picture naming task individually. The tasks were completed a week apart. Half of the participants began with the name verification task and the other half with the picture naming task.

Picture naming. The participants were told that they would see a picture on the screen and that they had to say aloud the name of the picture as rapidly as possible. Each trial began with a visual cue ("*") presented for 500 ms followed by the picture. The picture remained on the screen until the participants initiated the spoken response. The next trial began 2000 ms after the participants had initiated their responses. The experimenter monitored the participants' responses and scored them for correctness.

Name–object verification. The participants had to decide whether or not the object depicted by the picture presented on the screen referred to the object name presented visually just before it. Each trial had the same structure: A visual cue ("*") was displayed for 500 ms followed by a word which remained on the screen for 1000 ms. The picture was presented 1000 ms later and remained on the screen until the participant had spoken her/his response aloud. The next trial began 2000 ms later. The participants were asked to say aloud "same" when the picture referred to the name presented before and "different" when the picture did not correspond to the previously presented name. We chose to collect spoken latencies in this task in order to facilitate the comparison with the spoken picture naming task. As in the picture naming task, the experimenter monitored the participant's responses and scored them for correctness.

Results

In picture naming, observations were discarded from the latency analyses in the following cases: (1) The participant did not provide a name for a picture; (2) a name different from the expected one was produced; (3) the participants stuttered or repaired the utterance after a disfluency; (4) the participants produced nonlinguistic sounds, such as mouth clicks, before the production of the picture name; (5) a technical problem occurred.

In name-object verification, only trials for which the response "same" was required were considered in the analyses. The observations for which one of the following cases occurred were discarded from the latency analyses: (1) The participants responded erroneously, i.e., "different" to a stimulus for which a "same" response was expected; (2) a case similar to those encountered in picture naming in conditions 3, 4, and 5 occurred; 8.89% and 4.14% were discarded from the latency analyses in the picture naming and in the name verification task, respectively. Latencies exceeding two standard deviations above the participant and item means were also excluded (1.36% and 1.42% of the data in picture naming and name–object verification, respectively). Overall, 10.25% and 5.56% of the trials were discarded from the latency analyses in the picture naming and name verification tasks, respectively.

In all the experiments, the conventional level of .05 for statistical significance was adopted and each of the analyses was carried out on the participant means ($F1$) and on the item means ($F2$). Imageability was included as a covariate in the analyses by items. Errors and latencies were subjected to analyses of variance with AoA (early and late acquired), task (picture naming and name verification) and order (picture naming followed by name verification and the reverse) as experimental factors. The mean spoken latencies, their standard deviations and the error rates are presented in Table 2.

Errors. In the analyses of the error rates, only the trials that fulfilled conditions 1 and 2 for picture naming and condition 1 for name verification were taken into account. Picture naming yielded more errors than name–object verification, $F1(1, 25) = 41.71$, $MSE = 14.60$; $F2(1, 58) = 18.04$, $MSE = 75.11$. LA words induced fewer errors than EA words. However, this effect was significant in the by-participant analysis only, $F1(1, 25) =$

TABLE 2
Mean spoken latencies (SL), standard deviations of these means (SD), and error rates (E) from Experiment 1 as a function of AoA, task, and order

	First			*Second*		
	SL	*SD*	*E*	*SL*	*SD*	*E*
Picture naming						
EA	844	95.3	5.12	831	72.6	2.62
LA	944	97.1	8.97	918	89.5	8.57
Name verification						
EA	691	75.7	2.38	652	80.3	0.51
LA	706	110.7	2.62	644	88.7	0.77

17.46, $MSE = 10.22$; $F2 < 1$. There were more errors during the first session than during the second one, although it was significant in the by-item analysis only, $F1 < 1$; $F2(1, 58) = 5.69$, $MSE = 28.94$. A significant interaction was observed between AoA and task with the result than the AoA effect was larger in picture naming than in verification, $F1(1, 25) = 16.46$, $MSE = 8.86$; $F2(1, 58) = 4.32$, $MSE = 75.11$. Post hoc tests (Newman-Keuls) revealed that the AoA effect was significant in picture naming ($p < .01$) but not in verification. The interaction between task and order was significant in the by-participant analysis only, $F1(1, 25) = 5.07$, $MSE = 14.60$; $F2 < 1$. No other interaction was significant.[2]

Latencies. Responses were faster in the name-object verification task than in the picture naming task, $F1(1, 25) = 182.64$, $MSE = 6576.5$; $F2(1, 58) = 330.53$, $MSE = 8484.4$. Participants responded faster to pictures with EA labels than to those with LA labels. The main effect of AoA was significant in the by-participant analysis only, $F1(1, 25) = 49.30$, $MSE = 1299.4$; $F2(1, 57) = 1.68$. Although latencies in the first task were longer than in the second one, this effect was only significant in the by-item analysis, $F1 < 1$; $F2(1, 58) = 26.20$, $MSE = 3398.8$. A significant interaction between task and AoA was observed, $F1(1, 25) = 57.77$, $MSE = 937.4$; $F2(1, 58) = 14.18$, $MSE = 8484.4$. Newman-Keuls tests indicated that the AoA effect was significant in the picture naming task ($p < .001$ on both participants and items) but not in the name-object verification task. The task interacted significantly with the order of presentation, $F1(1, 25) = 4.96$, $MSE = 6576.5$; $F2(1, 58) = 4.41$, $MSE = 1939.2$, with the result that a greater benefit was

[2] Imageability, entered as a covariate in the by-item analysis, was significant when error rates were taken as the dependent variable. Nevertheless, this variable did not interact with any of the other independent variables, i.e., AoA, task, order.

observed on the latencies in the name-object verification task (+51 ms) than on those in the picture naming task (+19 ms) when these tasks were performed during the second session. No other interaction was significant.[3]

Discussion

The main finding from Experiment 1 is the observation that the AoA effect on latencies was significant in picture naming but not in name-object verification. It is important to stress that this effect was obtained using the same participants and items in both tasks. It is therefore clear that AoA effects are due to a level of processing which is required in picture naming and not in name-object verification. Following the Jescheniak and Levelt (1994) word frequency study, we have assumed that the name–object verification task does not require name retrieval, i.e., lexical access. It should be noted that even if we had admitted that the name-object verification task involves name retrieval, the lack of an AoA effect in the current task is problematic for this assumption.

Since object naming and verification mobilize access to structural and semantic representations, the findings from Experiment 1 strongly suggest that AoA effects in picture naming are not rooted in a prelexical locus, contrary to the claim made by Moore et al. (2004) and Vitkovitch and Tyrell (1995). It could be argued that because the critical set of items contrasted on AoA was always verified as "same", the AoA effect on verification latencies was cancelled out by the initial presentation of the written names. The problem with this explanation is that imageability—introduced as a covariate factor—was significant: Why, then, does presenting the name of the objects should suppress AoA and not imageability? Since imageability is recognized as indexing semantic representations (e.g., Bird, Howard, & Franklin, 2000; Jones, 1985; see Alario, Ferrand, Laganaro, New, Frauenfelder, & Segui, 2004; Bonin et al., 2004, for imageability effects in French picture naming), its reliable influence in name-object verification accords with the hypothesis that this task is a genuine semantic task.

We found that name verification benefits more than picture naming during the second phase of the experiment. The direction of the priming effects may be accounted for by assuming that picture naming involves deeper processing at the conceptual level than name verification.

Though the interaction between AoA, order of presentation, and task was not significant, it could be argued that the AoA effect in the verification task

[3] Imageability, entered as a covariate in the by-item analysis, was significant when spoken latencies were taken as the dependent variable. Nevertheless, this variable did not interact with the independent variables (i.e., AoA, task, order).

RTs was attenuated because of the repetition of the items (see Barry et al., 2001, for this type of effect in picture naming). A closer examination of the results indicated that during the first week, when no priming effects were operative, an AoA effect was observed in picture naming but was not reliable in name–object verification.

EXPERIMENT 2

According to Levelt (2002), Bonin et al. (2001) did not control for object recognition speed in their AoA picture naming study and this is a serious omission since Bonin et al. have interpretated AoA effects in both spoken and written naming as lexical effects. In line with Levelt's concerns, Moore et al. (2004) and Vitkovitch and Tyrrell (1995) have found AoA effects in perceptual tasks.

According to Moore et al. (2004), certain AoA effects might be attributable to a perceptual level. If the AoA effect found in the picture naming latencies of Experiment 1 were due to the perceptual processes involved in picture naming, an AoA effect should also have been observed in the name–object verification latencies since both tasks involve perceptual processes and, more precisely, access to structural representations. In order to confirm the findings from Experiment 1, we designed another task aimed at testing for a prelexical locus of AoA effects, namely an object recognition task. In this task, participants are first shown a set of pictures which they have to look at carefully and remember. They are then shown this set of pictures mixed with some new pictures. They have to decide as quickly as possible whether the pictures have already been presented or not. A similar task has already been used in certain picture naming studies (Levelt et al., 1991; Schriefers, Meyer, & Levelt, 1990) to test whether certain effects found in picture naming have a perceptual/conceptual origin. Following Levelt's (2002) advice, the critical set of pictures, i.e., those names that vary on AoA, were introduced in the second phase of the experiment. We chose to use a "go/no-go" task instead an "old/new" task given that the former seems to impose a lesser processing cost than the latter (Perea, Rosa, & Gomez, 2002). In effect, in a go/no-go task, in contrast to an "old/new" task, the participants have to provide a response only for one type of stimulus out of two, whereas in the latter they have to provide a response for each type of stimulus. If AoA effects in picture naming are located, partly or fully, at the object recognition level, they should emerge on the "go" responses in the object recognition task.

Method

Participants. Twenty-three participants taken from the same pool as those involved in Experiment 1 (mean age 19.5 years) participated in Experiment 2. None of them had taken part in Experiment 1.

Stimuli. The experimental stimuli were the same as those used in Experiment 1. This set of drawings was associated with a "go" response. The set of pictures which required a "no-go" response corresponded to the "different" stimuli in the name–object verification task in Experiment 1. Twenty stimuli (10 presented in the first phase and 10 not presented in the first phase) were used in the training phase.

Apparatus. The experiment was run on a PowerMacintosh computer and was designed using PsyScope Version 1.2 (Cohen et al., 1993). The computer controlled the presentation of the pictures and recorded key press latencies.

Procedure. The experiment consisted of two phases. In the first phase, the participant was told to look carefully at each picture since she/he would have to recognize these pictures in a second phase. A trial had the following structure: A ready signal ("*") appeared on the screen for 500 ms and was followed by a picture which remained on the screen for 1500 ms. The next trial began after a delay of 2000 ms. Seventy stimuli were presented during this phase. In the second phase, the entire set of pictures was presented. The participant had to decide whether any given picture had been presented in the first phase or not. Whenever the picture was recognized as having been presented during the first phase, the participant had to not respond ("no-go response"). On the contrary, whenever the picture was "new", the participant had to press, as rapidly as possible, a key with the index finger of his/her dominant hand ("go response"). Each trial began with a ready signal ("*") which remained on the screen for 500 ms and was followed by the presentation of a picture. In all cases, the picture was removed from the screen after a delay of 2000 ms. The intertrial interval was 2000 ms.

Results

Only trials which required a "go" response were analysed. One experimental item yielded an error rate of more than 50% *("cuillère"—spoon)* and was excluded from the analyses. Observations corresponding to errors, i.e., pressing the key when pictures had not been presented during the first phase, were discarded from the latency analyses (9.43%). Also, latencies exceeding two standard deviations above the participant and item means were excluded (2.58%). Overall, 12.01% of the observations were discarded from the latency analyses.

As in Experiment 1, imageability was included as a covariate factor in the analyses by items. Errors and latencies were subjected to ANOVAs with AoA as an experimental factor. The mean RTs, their standard deviations, and the error rates are presented in Table 3.

The AoA effect was not significant on errors, $F1(1, 22) = 2.17$, $MSE = 30.14$, $p > .10$; $F2 < 1$. Surprisingly, responses were significantly faster for pictures corresponding to LA names than for those having EA names, $F1(1, 22) = 15.88$, $MSE = 1108.84$; $F2(1, 56) = 7.13$, $MSE = 3612.32$.[4]

Discussion

The most noticeable finding from Experiment 2 is that the AoA effect on RTs was reliable in the opposite direction to that which had been predicted. A closer look at the items revealed that 21 pictures corresponded to living things for early acquired items, whereas 3 pictures corresponded to living things for late acquired items. Given that some studies have shown that picture recognition is not based on the same features for living and nonliving things, the difference identified between early and late acquired items on the living/nonliving dimension might account for the reverse AoA effect. Indeed, Marques (2002) has demonstrated that visual features are more central to conceptual representations than functional features, but only for living things. This distinction between living and nonliving things echoes the distinction between man-made and biological/natural categories (Humphreys et al., 1988; Warrington & Shallice, 1984; but see Laws, Gale, Frank, & Davey, 2002). Biological categories (e.g., animals, fruits) have many perceptually similar exemplars, whereas man-made categories, based on more abstract or functional features, are more perceptually distinct.

TABLE 3
Mean key press latencies (L), standard deviations of these means (SD), and error rates (E) from Experiment 2 as a function of AoA

	L	*SD*	*E*
EA	826	76.1	10.64
LA	787	74.9	8.26

[4] Imageability, introduced as a covariate in the by-item analyses, was not significant in the error rates analysis as in the latencies analysis.

According to Humphreys et al. (1988), biological categories correspond to structurally similar exemplars, whereas man-made categories correspond to structurally dissimilar exemplars. Structurally similar items (i.e., biological) have more perceptual neighbours than structurally dissimilar (i.e., man-made) items. It has been shown that structurally similar objects result in longer latencies than structurally dissimilar objects (see Humphreys et al., 1988, for picture naming). Therefore, it is possible that the early acquired items took longer to be recognized than the late acquired items because the former consisted essentially of natural things whereas the latter consisted essentially of man-made items. However, the reverse AoA effect was still reliable with structural similarity introduced as a covariate in the by-item analysis, $F2(1, 55) = 4.68$, $MSE = 3677.92$, and neither imageability nor structural similarity was significant. Therefore, the reverse AoA effect observed in object recognition cannot be accounted for by differences in structural similarity.

Although we are left with no explanation regarding the reverse AoA effect in object recognition, it is worth noting that some studies have reported a reverse AoA effect in free recall (Dewhurst, Hitch, & Barry, 1998; Morris, 1981) and in word recognition (Dewhurst et al., 1998). This reverse pattern is generally explained in terms of distinctive encoding (Dewhurst et al., 1998; Morris, 1981), that is to say LA items are likely to be more distinctive in memory than EA ones. Extrapolating from these studies, it is possible that the pictorial representations corresponding to LA items are more distinctive than those corresponding to EA items. However, what makes the former more distinctive than the latter remains to be identified and is well beyond the scope of the present study.

In contrast to what was found in Experiment 1, imageability was not significant. Assuming that imageability truly indexes access to semantic representations, this result suggests that the object recognition task used here does not require the involvement of semantic representations. This task may be viewed as relying on episodic memory. However, object identification is clearly required in object recognition. A perceptual locus of AoA effects as proposed by Moore et al. (2004) and Vitkovitch and Tyrrell (1995) is not supported by the present findings. Indeed, if the AoA effect found in picture naming in Experiment 1 had a genuine perceptual origin, we should have found that EA items took less time to be identified than LA items and not the reverse pattern as found in Experiment 2.

GENERAL DISCUSSION

The aim of the present study was to test a structural and a semantic locus of AoA effects in picture naming. In Experiment 1, the participants performed both a picture naming and a name–object verification task on the same set of items contrasted on AoA. The most important finding was that the type of task interacts with AoA, with the result that the AoA effect is reliable only in picture naming. The absence of a reliable AoA effect in name–object verification does not accord with Brysbaert et al.'s (2000) study in which AoA effects were observed in semantic tasks. The name–object verification task used here is clearly a task which logically requires the involvement of semantic codes. In effect, in order to decide that the name of an object refers or does not refer to the same concept as the one depicted by a picture, semantic representations must necessarily be activated and compared. The observation of a reliable contribution of imageability on the name–object verification latencies adds further support for the idea that the name verification task used here truly involves semantics.

In the light of these findings, it is difficult to argue that AoA effects in picture naming have a semantic origin. It is important to stress that the findings from Experiment 1 were obtained from the same participants and using the same items. In our view, the simple experimental dissociation observed here provides strong evidence against a semantic locus of AoA effects in picture naming and, to some extent, against recent semantic accounts of AoA effects such as Steyvers and Tenenbaum's (2005) model. In this model, EA words develop more semantic associations than LA words, with the result that EA words have a more central position in the network than LA words.

In order to establish the robustness of the findings from Experiment 1, a second experiment was designed. We used an object recognition task to test a prelexical locus of AoA effects in picture naming. The participants were first shown a series of pictures, which they were asked to remember, and were then presented with "new" pictures mixed with "old" pictures. The new pictures were the critical set of pictures contrasted on AoA and indeed the same items as those used in Experiment 1. Against all expectations, a reliable reversed AoA effect was observed on key press responses, that is to say LA items were recognized faster than EA ones. Although we have no explanation for this finding, it is clearly at odd with the findings of Moore et al. (2004) and those of Vitkovitch and Tyrrell (1995) who have shown that EA stimuli are visually processed more rapidly than LA ones. However, the task used in Experiment 2 is different from the one used by Moore et al. and Vitkovitch and Tyrrell. In these studies, a reality object decision task was used. The nature of the task used to tap object identification processes might be responsible for the discrepancy. Chalard (2002) used a reality object decision task on the basis of the stimuli employed in Bonin et al.'s (2001) study in which strong AoA effects were found in picture naming latencies. The pictures of nonobjects were taken from the Kroll and Potter (1984) database. The pictures that referred to EA names were recognized faster than those referring to LA names. Though the size of the AoA effect (23 ms) was very close to the size of the AoA effect found by Moore et al. (24 ms), it was significant only in the by-participant analysis. However, imageability is confounded with AoA in Chalard's experiment. Therefore, the true variable acting in this task might be imageability, not AoA.

Overall, the present study makes it unlikely that AoA effects—faster and more accurate responses to early acquired words than to late acquired words—in picture naming are located at the level of object identification or semantic processes, since we found either a null effect or a reversed effect of AoA in tasks designed to test these processes. Therefore, in the same way as other authors, we suggest that AoA effects in picture naming are localized at the level of phonological codes (Gerhand & Barry, 1999a, 1999b; Izura & Ellis, 2002; Morrison et al., 2002) or in the links between semantic and phonological representations (Ellis & Lambon Ralph, 2000). One unresolved issue is to provide a clear account of the processes that underlie the emergence of AoA effects. One often cited account of AoA effects is the phonological completeness hypothesis (Brown & Watson, 1987) according to which the phonological representations of EA words are more holistic whereas those of LA words are more fragmented. However, this hypothesis has been challenged by Monaghan and Ellis (2002).

A promising account of AoA effects has been provided by Ellis and Lambon Ralph (2000). They have shown that AoA effects emerge in connectionist networks in which learning is cumulative and interleaved. AoA effects are the result of the alteration of the weights relating input and output units by means of intermediate units. AoA effects reflect a loss of plasticity in the network to encode late patterns as efficiently as early patterns. Moreover, AoA effects are stronger when the links relating input and output units are arbitrary (see also Zevin & Seidenberg, 2002, for a similar claim). Our findings are in accordance with Ellis and Lambon Ralph's view which posits that AoA effects are located in the link connecting semantic representations to phonological representations. However, our findings do not help to distinguish precisely between a phonological locus of AoA effects and a "link" locus of AoA effects.

In conclusion, the current findings add to the growing body of evidence that AoA effects in picture naming cannot be ascribed to the structural and/or the semantic level(s). AoA effects in picture naming are certainly lexical in nature. Although the debate as to whether AoA effects can be found in semantic tasks which require little if any phonological processing is far from over, the evidence that would unambiguously favour a semantic locus of AoA effects in general is at present tenuous.

REFERENCES

Alario, F.-X., & Ferrand, L. (1999). A set of 400 pictures standardized for French: Norms for name agreement, image agreement, familiarity, visual complexity, image variability, and age of acquisition. *Behavior Research Methods, Instruments, and Computers*, *31*, 531–552.

Alario, F.-X., Ferrand, L., Laganaro, M., New, B., Frauenfelder, U. H., & Segui, J. (2004). Predictors of picture naming speed. *Behavior Research Methods, Instruments, and Computers*, *36*, 140–155.

Barry, C, & Gerhand, S. (2003). Age-of-acquisition and concreteness effects in reading, naming and comprehension in a deep dyslexic patient. In P. Bonin (Ed.), *Mental lexicon: "Some words to talk about some words"*. New York: Nova Science Publishers.

Barry, C, Hirsh, K. W., Johnston, R. A., & Williams, C. L. (2001). Age of acquisition, word frequency, and the locus of repetition priming of picture naming. *Journal of Memory and Language*, *44*, 350–373.

Barry, C, Morrison, C. M., & Ellis, A. W. (1997). Naming the Snodgrass and Vanderwart pictures: Effects of age of acquisition, frequency, and name agreement. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology*, *50A*, 560–585.

Bird, H., Howard, D., & Franklin, S. (2000). Why is a verb like an inanimate object? Grammatical category and semantic category deficits. *Brain and Language*, *72*, 246–309.

Bonin, P. (2003). *Production verbale de mots. Approche cognitive* [Word production: A cognitive approach]. Brussels, Belgium: De Boeck.

Bonin, P., Barry, C, Méot, A., & Chalard, M. (2004). Age of acquisition in word reading and other tasks: A never ending story? *Journal of Memory and Language*, *50*, 456–476.

Bonin, P., Chalard, M., Méot, A., & Fayol, M. (2002). The determinants of spoken and written picture naming latencies. *British Journal of Psychology*, *93*, 89–114.

Bonin, P., Fayol, M., & Chalard, M. (2001). Age of acquisition and word frequency in written picture naming. *Quarterly Journal of Experimental Psychology*, *54A*, 469–489.

Bonin, P., Méot, A., Aubert, L., Malardier, N., Niedenthal, P., & Capelle-Toczek, M.-C. (2003a). Normes de concrétude, de valeur d'imagerie, de fréquence subjective et de valence émotionnelle pour 867 mots. *L'Année Psychologique*, *104*, 655–694.

Bonin, P., Méot, A., & Boyer, B. (2003b). Where are AoA effects in written picture naming? Some insights with the use of objective written AoA norms. In P. Bonin (Ed.), *Mental lexicon: "Some words to talk about some words"*. New York: Nova Science Publishers.

Brown, G. D. A., & Watson, F. L. (1987). First in, first out: Word learning age and spoken word frequency as predictors of word familiarity and word naming latency. *Memory and Cognition*, *15*, 208–216.

Brysbaert, M., van Wijnendaele, I., & de Deyne, S. (2000). Age-of-acquisition effects in semantic processing tasks. *Acta Psychologica*, *104*, 215–226.

Caramazza, A. (1997). How many levels of processing are there in lexical access? *Cognitive Neuropsychology*, *14*, 177–208.

Chalard, M. (2002). *Effets de l'age d'acquisition et de la fréquence objective en production verbale orale et écrite de mots isolés* [Effects of age of acquisition and objective word frequency in spoken and written word production]. Unpublished thesis.

Chalard, M., Bonin, P., Méot, A., Boyer, B., & Fayol, M. (2003). Objective age-of-acquisition (AoA) norms for a set of 230 object names in French: Relationship with psycholinguistic variables, the English data from Morrison et al. (1997), and naming latencies. *European Journal of Cognitive Psychology*, *15*, 209–245.

Cohen, J., McWhinney, B., Flatt, M., & Provost, J. (1993). PsyScope: An interactive graphic system for designing and controlling experiments in the psychology laboratory using Macintosh computers. *Behavior Research Methods, Instruments, and Computers*, *25*, 257–271.

Dewhurst, S. A., Hitch, G. J., & Barry, C. (1998). Separate effects of word frequency and age of acquisition in recognition and recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*, 284–298.

Ellis, A. W., & Lambon Ralph, M. A. (2000). Age of acquisition effects in adult lexical processing reflect loss of plasticity in maturing systems: Insights from connectionist networks. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*, 1103–1123.

Ellis, A. W., & Morrison, C. M. (1998). Real age-of-acquisition effects in lexical retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*, 515–523.

Gerhand, S., & Barry, C. (1998). Word frequency effects in oral reading are not merely age-of-acquisition effects in disguise. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*, 267–583.

Gerhand, S., & Barry, C. (1999a). Age-of-acquisition and frequency effects in speeded word naming. *Cognition*, *73*, 27–36.

Gerhand, S., & Barry, C. (1999b). Age of acquisition, word frequency, and the role of phonology in the lexical decision task. *Memory and Cognition*, *27*, 592–602.

Gilhooly, K. J., & Watson, F. L. (1981). Word age-of-acquisition effects: A review. *Current Psychological Reviews*, *1*, 269–286.

Humphreys, G. W., Riddoch, M. J., & Quinlan, P. T. (1988). Cascade processes in picture identification. *Cognitive Neuropsychology*, *5*, 67–103.

Izura, C, & Ellis, A. W. (2002). Age of acquisition in word recognition and production in first and second languages. *Psicologica*, *23*, 245–281.

Izura, C, & Ellis, A. W. (2004). Age of acquisition effects in translation production tasks. *Journal of Memory and Language*, *50*, 165–181.

Jescheniak, J. D., & Levelt, W. J. M. (1994). Word frequency effects in speech production: Retrieval of syntactic information and of phonological form. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*, 824–843.

Jones, G. V. (1985). Deep dyslexia, imageability, and ease of predication. *Brain and Language*, *24*, 1–19.

Kroll, J. F., & Potter, M. C. (1984). Recognizing words, pictures, and concepts: A comparison of lexical, object, and reality decisions. *Journal of Verbal Learning and Verbal Behavior*, *23*, 39–66.

Laws, K. R., Gale, T. M., Frank, R., & Davey, N. (2002). Visual similarity is greater for nonliving than living things: The importance of musical instruments and body-parts. *Brain and Cognition*, *48*, 421–424.

Levelt, W. J. M. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.

Levelt, W. J. M. (2002). Picture naming and word frequency: Comments on Alario, Costa and Caramazza. *Language and Cognitive Processes*, *17*, 663–671.

Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences*, *22*, 1–75.

Levelt, W. J. M., Schriefers, H., Vorberg, D., Meyer, A. S., Pechmann, T., & Havinga, J. (1991). The time course of lexical access in speech production: A study of picture naming. *Psychological Review*, *98*, 122–142.

Marques, J. F. (2002). Names, concepts, features and the living/nonliving things dissociation. *Cognition*, *85*, 251–275.

Monaghan, J., & Ellis, A.W. (2002). Age of acquisition and the completeness of phonological representations. *Reading and Writing*, *15*, 759–788.

Moore, V., Smith-Spark, J. H., & Valentine, T. (2004). The effects of age of acquisition on object recognition. *European Journal of Cognitive Psychology*, *16*, 417–439.

Morris, P. E. (1981). Age of acquisition, imagery, recall, and the limitations of multiple-regression analysis. *Memory and Cognition*, *9*, 277–282.

Morrison, C. M., & Ellis, A. W. (1995). Roles of word frequency and age of acquisition in word naming and lexical decision. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*, 116–133.

Morrison, C. M., Ellis, A. W., & Quinlan, P. T. (1992). Age of acquisition, not word frequency, affects object naming, not object recognition. *Memory and Cognition*, *20*, 705–714.

Morrison, C. M., Hirsh, K. W., & Carnicer, E., (2001). *Age of acquisition and speech production in bilingual picture naming*. Paper presented at the 12th European Society for Cognitive Psychology and 18th British Psychological Society meeting, Edinburgh, UK.

Morrison, C. M., Hirsh, K. W., Chappell, T., & Ellis, A. W. (2002). Age and age of acquisition: An evaluation of the cumulative frequency hypothesis. *European Journal of Cognitive Psychology*, *14*, 435–459.

New, B., Pallier, C, Ferrand, L., & Matos, R. (2001). Une base de données lexicales du français contemporain sur Internet: LEXIQUE. *L'Année Psychologique*, *101*, 447–462.

Perea, M., Rosa, E., & Gomez, C. (2002). Is the go/no-go lexical decision task an alternative to the yes/no lexical decision task? *Memory and Cognition*, *30*, 34–35.

Plaut, D. C. (1997). Structure and function in the lexical system: Insights from distributed models of word reading and lexical decision. *Language and Cognitive Processes*, *12*, 765–805.

Schriefers, H., Meyer, A. S., & Levelt, W. J. M. (1990). Exploring the time course of lexical access in language production: Picture-word interference studies. *Journal of Memory and Language*, *29*, 86–102.

Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory*, *6*, 174–215.

Steyvers, M., & Tenenbaum, J.B. (2005). The large-scale structure of semantic networks: Statistical analyses and a model of semantic growth. *Cognitive Science*, *29*, 41–78.

Strain, E., Patterson, K. E., & Seidenberg, M. S. (1995). Semantic effects in single-word naming. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*, 1140–1154.

Vitkovitch, M., & Tyrrell, L. (1995). Sources of disagreement in object naming. *Quarterly Journal of Experimental Psychology*, *48A*, 822–848.

Warrington, E. K., & Shallice, T. (1984). Category-specific impairment. *Brain*, *107*, 829–853.

Whatmough, C, Chertkow, H., Murtha, S., & Hanratty, K. (2002). Dissociable brain regions process object meaning and object structure during picture naming. *Neuropsychologia*, *40*, 174–186.

Yamazaki, M., Ellis, A. W., Morrison, C. M., & Lambon Ralph, M. A. (1997). Two age of acquisition effects in the reading of Japanese Kanji. *British Journal of Psychology*, *88*, 407–421.

Zevin, J. D., & Seidenberg, M. S. (2002). Age of acquisition effects in word reading and other tasks. *Journal of Memory and Language*, *47*, 1–29.

Zevin, J. D., & Seidenberg, M. S. (2004). Age of acquisition effects in reading aloud: Tests of cumulative frequency and frequency trajectory. *Memory and Cognition*, *32*, 31–38.