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Age-of-acquisition affects word naming in Italian only when stress is irregular

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ABSTRACT

In Italian, effects of age of acquisition (AoA) have been found in object naming, semantic categorization of words and lexical decision, but not in word naming (reading aloud). The lack of an AoA effect in Italian word naming is replicated in Experiment 1 which involved reading aloud two-syllable words which all have regular spelling–sound correspondences and regular stress patterns. Studies of English word naming have reported stronger effects of AoA for irregular or exception words than for words with regular, consistent spelling–sound correspondences. There are no grapheme–phoneme irregularities in Italian, but words containing three or more syllables can carry either regular stress on the penultimate syllable or irregular stress on the antepenultimate syllable. Experiment 2 found effects of AoA on reading three-syllable words for words with irregular stress. The results are interpreted in terms of the 'mapping hypothesis' of AoA, with effects arising as a result of a difficulty to generalize earlier-acquired patterns to irregular late-acquired words.

The age at which words are acquired affects adults' processing speed in a variety of languages and a variety of tasks, including picture naming, semantic categorization, lexical decision and word naming (see Johnston & Barry, 2006; Juhasz, 2005, for reviews). The current study is concerned with the effect of age of acquisition (AoA) on the time needed to read familiar words aloud (word naming). Faster reading of early than late acquired words has been reported in a range of languages, including Chinese, Dutch, English, French, Japanese, Spanish and Turkish. To date, these effects have survived attempts to account for them in terms of other factors such as word frequency and imageability (see, e.g., Bonin, Barry, Méot, & Chalard, 2004; Cortese & Khanna, 2007; Ghyselinck, Lewis, & Brysbaert, 2004).

An exception to the general statement that word naming latencies are faster for early than late acquired words comes from studies of reading in Italian. It is not that AoA does not affect lexical processing in Italian, because effects have been reported in object naming (Bates, Burani, D'Amico, & Barca, 2001; Dell'Acqua, Lotto, & Job, 2000) as well as in lexical decision and semantic categorization of words (Burani, Arduino, & Barca, 2007; Menenti & Burani, 2007). To date, however, attempts to detect an effect of AoA on Italian word naming speed have produced negative results. In a regression study of Italian word naming, Barca, Burani, and Arduino (2002) found effects of length/neighborhood size and word frequency, but not AoA (see also Bates et al., 2001). Burani et al. (2007) found effects of frequency but not AoA in both regression and factorial studies of Italian word naming. What might it be about the Italian language that makes faster processing of early than late acquired words relatively easy to detect in object naming, semantic categorization and lexical decision tasks, but hard to find in word naming?

One clue may come from the experimental investigations of J. Monaghan and Ellis (2002a,b) and the simulations of P. Monaghan and Ellis (2010). The latter study was an attempt to understand AoA effects in word naming using computational modeling. P. Monaghan and Ellis (2010) entered cumulatively and incrementally 6229 words into training in a connectionist model of English word naming which learned to associate written and spoken words in the absence of semantic representations. After some time spent learning the 103 commonest words that feature in reading material written for Grade 1 readers, lower frequency Grade 1 words were added into training followed progressively by words that appear only in material for Grade 2 readers, and so on up to words that only appear in texts written for adults. Words were trained at each stage with frequencies that reflected the frequency of occurrence of each word at the appropriate grade. Analysis of the quality of the representations developed by the model by the end of training showed that

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there was a cost associated with late acquisition that occurred over and above the contributions of frequency and other factors.

Importantly for present purposes, P. Monaghan and Ellis (2010) demonstrated that their developmental simulation of reading showed an effect first reported behaviorally by J. Monaghan and Ellis (2002a, b) who found that the impact of AoA on English word naming was greater for words with irregular or exceptional spelling–sound correspondences than words with regular or consistent correspondences. P. Monaghan and Ellis (2010) argued that as far as word naming is concerned, regular, consistent words do not suffer from being late acquired because the spoken word-forms they seek to activate when presented to the model do not compete with the pronunciations that might be activated by earlier-acquired neighbors. Thus, TRANCE is a late acquired word, but its pronunciation is consistent with that of early acquired words like DANCE and CHANCE, so TRANCE is able to activate its pronunciation without experiencing competition from other words. The situation for the late acquired irregular word PINT is different because it must compete against earlier-acquired neighbors which have already established rival pronunciations (e.g., HINT and MINT).

Competition for access to alternative pronunciations of the same letter sequences will not occur in Italian because the regularity (transparency) of its orthography means that the pronunciation of any written word can be predicted with a high degree of accuracy. Simulations by Lambon Ralph and Ehsan (2006) and Zevin and Seidenberg (2002) showed that if the mappings between inputs and outputs are highly regular and predictable, as they are in Italian spelling–sound correspondences, there may be little cost to being late acquired. When the pronunciation of every word matches its spelling, the associations that form between letters and phonemes as a result of learning early words will generalize perfectly to learning and subsequently processing later acquired words. There are a few orthographic complexities in Italian where the pronunciation of a letter can depend on the other letters that follow it. Those complexities influence word naming speed (Burani, Barca, & Ellis, 2006) but are entirely consistent and governed by rules.

The one place where inconsistency exists, and therefore where competition may arise in reading Italian words aloud, is in assigning stress to words (Krämer, 2009). Two syllable words are almost always stressed on the first syllable (*e.g.*, "TOro" [bull]). The majority of words with three syllables are stressed on the penultimate syllable (*e.g.*, "caSTOro" [beaver]). A minority of three-syllable words are, however, stressed on the antepenultimate syllable (*e.g.*, "FOsforo" [phosphorus]). The same applies to words with four or more syllables. Therefore, words of three or more syllables are inconsistent for stress assignment, with stress on the penultimate syllable being the regular pattern while stress on the antepenultimate syllable is the irregular (less frequent) pattern.

While AoA effects may be absent for Italian words with regular stress (which is all two-syllable words and the majority of words with three or more syllables), late acquired words with irregular stress patterns might show AoA effects, because they may be opposed in reading by words that carry regular stress. The studies that reported no effect of AoA on Italian word naming have employed a majority of words with regular stress, with only around 15% words bearing irregular stress (Barca et al., 2002; Burani et al., 2007). If AoA effects attach only to irregularly stressed words, those proportions may have been too small to detect any effects.

The aim of the present study was to further study AoA effects in Italian by means of the only irregularity in its orthography–phonology mappings: stress assignment. Experiment 1 assessed naming of matched sets of early and late acquired words composed of two syllables. Such words have consistent spelling–sound correspondences and consistent stress patterns. We did not therefore expect to observe effects of AoA on naming speeds. Experiment 2, in contrast, employed three-syllable words with either regular or irregular stress patterns and presented them in either 'mixed' blocks containing half regular and half irregular words randomly interleaved, or 'pure' blocks made up of only regular or only irregular words. The question was whether an effect of AoA would be observed for words with irregular patterns, and whether the unpredictability of the stress patterns induced by interleaving equal numbers of the two types of words in the mixed context would magnify any effects of AoA.

1. Experiment 1. Naming two-syllable Italian words

1.1. Method

1.1.1. Participants

Forty students of *La Sapienza* University of Rome (mean age = 25 - years; range = 19–38 years), participated in the study. All were native speakers of Italian.

1.1.2. Materials

Two sets of 34 low-to-medium frequency two-syllable words (taken from Barca et al., 2002) that varied for AoA (early and late acquired) were created (see Appendix A). The two sets were matched for word frequency, imageability, concreteness, initial phoneme characteristics (voicing and manner of articulation), length in letters, orthographic complexity (Burani et al., 2006), number of orthographic neighbors, and bigram frequency (all t comparisons with p values at least $>.05$). Table 1 shows the characteristics of the items used in Experiment 1.

1.1.3. Procedure

The items were divided into two blocks of 34 stimuli each, composed of half early and half late acquired words. Each participant read both blocks of words. The order of block presentation was counterbalanced across participants. The order of presentation of words within blocks was randomized for each participant.

Each trial began with a blank screen presented for 400 ms. A central fixation point then appeared and remained for 400 ms. A word was then presented in upper case 10 pt Arial font for a maximum of 1500 ms. Participants were instructed to read each word aloud as quickly and as accurately as possible. The onset of the response was recorded by means of DMDX software (Forster & Forster, 2003). Each experimental session began with a practice set of 12 words, matched in length and frequency to the experimental items.

1.1.4. Data analysis

We used the linear mixed effects modeling, a type of analysis that controls for the crossed random effects of participants and items (Baayen, Davidson, & Bates, 2008), run in SPSS19.

Table 1
Summary statistics: mean (and standard deviation) of the items used in Experiment 1.

	Two syllables	
Item variables	Early acquired	Late acquired
Age of acquisition	2.81 (0.40)	4.29 (0.60)
Word frequency	23.16 (45.76)	23.60 (42.88)
Imageability	5.35 (0.70)	5.06 (0.85)
Concreteness	5.82 (0.69)	5.63 (0.85)
Length in letters	4.53 (0.61)	4.88 (0.88)
Contextual rules	0.47 (0.71)	0.38 (0.60)
N-size	2.97 (2.63)	2.41 (2.22)
Bigram frequency	10.77 (0.41)	10.76 (0.45)