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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)

1.2. Results

Mispronunciation errors were removed from the analysis of RTs along with responses shorter than 100 ms. This resulted in the exclusion of 2.21% of the total data. RTs to early (Mean: 443 ms; SE: 11.34) and late acquired words (Mean: 449 ms; SE: 11.35) were compared using a mixed effects model with participants and items as random factors and AoA as fixed effect. Table 2 shows the mixed model analysis estimates and tests of fixed effects. The 6 ms difference between early and late acquired words was not significant. Error rates were not high enough (Mean percentage: 0.62) to allow for analysis.

1.3. Discussion

Two-syllable words in Italian, with transparent spelling–sound correspondences and a predictable stress pattern, failed to show an effect of AoA in word naming. This lack of an AoA effect is in line with the results of studies by Barca et al. (2002), Bates et al. (2001) and Burani et al. (2007), which used predominantly words with regular stress, and with the predictions of the mapping hypothesis (Lambon Ralph & Ehsan, 2006).

2. Experiment 2. Naming three-syllable Italian words with regular or irregular stress

Experiment 2 used only three-syllable words. AoA and stress regularity were manipulated orthogonally. Also, words were presented in either pure blocks containing only regular or only irregular words, or mixed blocks containing an equal number of regular and irregular words interleaved in a random order.

With three-syllable words for which stress is unpredictable, an effect of AoA was expected. The effect of AoA was expected to be greater in mixed blocks where the two kinds of stress were together and participants could not anticipate the stress pattern that the following word may have (Colombo & Zevin, 2009). Also, only the irregular words learnt at a later stage in life (*i.e.*, late acquired antepenultimate-stressed words) were expected to exhibit processing costs because they have a stress pattern which is different from the pattern that was early learnt in the great majority of cases, and the early learnt pattern cannot be extended to these words.

No main effect of stress regularity was expected, because all the selected words, both regularly and irregularly stressed, had a majority of "stress friends", i.e., many other words sharing orthographic ending and stress with the target word, and it has been shown that, when a word like "FOssile" (fossil) belongs to a family of several other irregular words ending in *-ile* such as "RETtile" (reptile) and "PUgile" (boxer), it is as readily named as a word with regular stress (Burani & Arduino, 2004, Expt. 1; Colombo, 1992, Expt. 4).

2.1. Method

2.1.1. Participants

Thirty-two students of *La Sapienza* University of Rome participated in the experiment (mean age = 30 years; range = 19–40 years). All were native speakers of Italian. None had participated in the previous experiment.

2.1.2. Materials

Four sets of 22 low-to-medium frequency three-syllable words were created in which AoA and stress regularity varied orthogonally (see Appendix B). As in Experiment 1, the psycholinguistic values for the stimuli were taken from Barca et al. (2002). The four sets were matched on the same variables as in Experiment 1 (all F comparisons $<.2$ with p values $\geq .20$). Table 3 shows the characteristics of the items used in Experiment 2. As noted above, and to avoid a possible confounding with the stress distribution of Italian that favors regular stress, we chose words with regular and irregular stress with the largest stress friendship as possible, calculated on a frequency count of written Italian (Bertinetto et al., 2005). The pairwise comparisons between sets on word frequency were all non-significant, with the highest t value being for regularly-stressed, early acquired *vs.* irregularly-stressed, late acquired, $t(42) = 1.12$.

2.1.3. Procedure

Each participant read four blocks of 22 items each. One block contained only regular words (pure regular), one contained only irregular words (pure irregular), and two blocks contained half regular and half irregular words (mixed blocks). The words were divided into two sets (A and B). Half the participants received set A in the pure blocks and set B in the mixed blocks while the remaining participants received set B in the pure blocks and set A in the mixed blocks. Hence, each participant read every word once, in either a pure or a mixed block. The two pure blocks and the two mixed blocks were always presented together, one after the other. Within that constraint, the order of presentation of the pure and mixed blocks was counterbalanced across participants. The order of items within each block was randomized for each participant. Other aspects of the procedure were the same as in Experiment 1.

2.2. Results

Pronunciation errors were removed and RTs trimmed as in Experiment 1, resulting in 1.60% of the data being excluded from the analysis of RTs. Table 4 shows the mean naming latencies of correct, trimmed responses in the experimental sets, standard errors and the percentage of errors.

A mixed effects model was used with RTs as dependent variable, participants and items as random effects, and block composition (pure *vs.* mixed), stress regularity (regular *vs.* irregular), and AoA (early *vs.* late) as fixed factors. Table 5 shows the mixed model analysis estimates and tests of fixed effects.

The effect of AoA was significant, with faster overall RTs to early than to late acquired words. The effects of block composition and stress regularity did not reach significance. The interaction between AoA and stress regularity was significant. The interaction is shown in Fig. 1. Simple effects analysis found that the effect of AoA was significant for the

Table 2
Mixed model analysis estimates and tests of fixed effects in Experiment 1.

Parameter	Estimate	Std. Error	F	Numerator df	Denominator df	Sig.
Intercept	448.82	11.35	1580.92	1	39.29	0.000***
AoA	−5.99	3.52	2.90	1	2588.43	0.089

*** $p<.001$.

Table 3
Summary statistics: mean (and standard deviation) of the items used in Experiment 2.

	Stress			
	Regular		Irregular	
Item variables	Early acquired	Late acquired	Early acquired	Late acquired
Age of acquisition	2.80 (0.48)	4.36 (0.67)	2.80 (0.46)	4.45 (0.72)
Word frequency	22.92 (26.20)	17.24 (26.48)	22.67 (23.95)	13.80 (27.79)
Imageability	5.53 (0.48)	5.13 (0.93)	5.49 (0.74)	5.07 (0.96)
Concreteness	5.50 (0.94)	5.38 (1.14)	5.39 (1.06)	5.47 (1.14)
Length in letters	6.77 (0.87)	7.09 (0.92)	6.68 (0.65)	6.73 (0.94)
Contextual rules	0.64 (0.73)	0.64 (0.79)	0.45 (0.60)	0.82 (0.85)
N-size	0.59 (0.80)	0.77 (1.51)	0.55 (0.67)	0.18 (0.50)
Bigram frequency	10.82 (0.33)	10.69 (0.44)	10.82 (0.39)	10.81 (0.30)

Table 4
Mean latencies of correct responses (Mean), standard errors (SE), and errors in percentage (%E) of the experimental sets in Experiment 2.

	Age of acquisition					
	Early acquired			Late acquired		
	Mean	*SE*	*%E*	Mean	*SE*	*%E*
Pure blocks						
Regular stress	491	18.73	0.28	494	18.75	2.56
Irregular stress	488	18.72	0.57	508	18.73	0.00
Mixed blocks						
Regular stress	494	18.75	0.28	505	18.73	0.85
Irregular stress	488	18.74	0.57	519	18.73	0.28

irregular words but not for the regular words. The mixed model analysis estimates and tests of fixed effects as a function of stress type are shown in Table 6. None of the other interactions, i.e., AoA × Block, Block × Stress, Block × AoA × Stress, reached significance. Error rates were not high enough to allow for ANOVA.

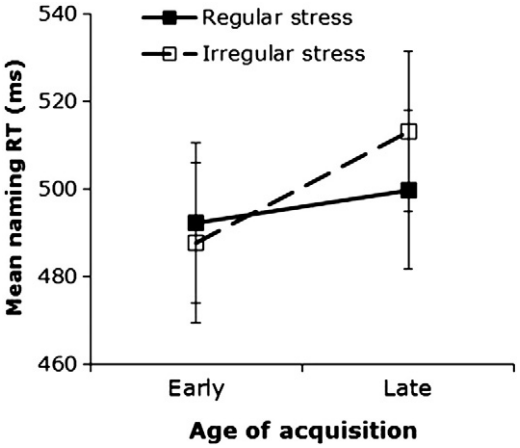

Fig. 1. Graph showing the interaction in Experiment 2 between AoA and stress regularity. Error bars show standard errors.

2.3. Discussion

Experiment 2 obtained the first evidence of an effect of AoA in Italian word naming. There was a main effect of AoA on naming speed for the three-syllable words which interacted with stress regularity. As expected, the main effect of stress regularity was not significant for words which had a large number of stress friends (Burani & Arduino, 2004; Colombo, 1992), but stress regularity interacted with AoA: only naming RTs for words with irregular stress were affected by AoA (Fig. 1).

The results found here are consistent with the notion that the mappings between spelling and pronunciation for irregularly stressed words in Italian are sufficiently inconsistent to display AoA effects. A possible explanation for the finding that AoA affected irregular but not regular words (AoA x stress regularity interaction) will be addressed in the following section.

3. General Discussion

Previous studies conducted in Italian have reported effects of AoA in object naming, semantic categorization and lexical decision, but not in word naming (Barca et al., 2002; Bates et al., 2001; Burani et al., 2007; Dell'Acqua et al., 2000; Menenti & Burani, 2007). The studies of word naming employed a representative proportion of irregularly stressed words, with only about 15% of stimulus words carrying irregular stress. Those studies found no significant effect of AoA on word naming speed. The same pattern was evident for the two-syllable words in the present Experiment 1 (which all carry regular stress on the first syllable) and for the regularly stressed three-syllable words in Experiment 2.

The mapping account of AoA effects (Ellis & Lambon Ralph, 2000; Lambon Ralph & Ehsan, 2006; P. Monaghan & Ellis, 2010) predicts that if AoA effects are to be found in Italian word naming, they will take the form of a cost associated with naming late acquired words which carry irregular stress. From this perspective, AoA effects are due to the properties of a network that loses plasticity as it learns new words, thus only later encountered words that show a pattern which is different from the pattern that was early learnt in the great majority of cases (*i.e.*, only later acquired irregularly stressed words) are the type of words that should show an AoA effect (see also Zevin & Seidenberg, 2002). That prediction was supported by the finding in Experiment 2 that AoA exerted a significant effect on naming RTs for irregular words but not regular words (Fig. 1). That pattern echoes the results obtained for items with 'quasi-consistent' input–output mappings in the simulations of Lambon Ralph and Ehsan (2006), and the report by J. Monaghan and Ellis (2002a,b) of an effect of AoA on naming RTs for English words with irregular but not regular spelling-sound correspondences.

Experiment 2 also included a manipulation of block composition. The prediction was that the AoA effect should mainly show up when the list context makes stress assignment less predictable, that is to say in the mixed blocks. Colombo and Zevin (2009) have shown that the stress characteristics of a list act as a context that modulates the assignment of stress. In lists that are homogeneous for stress, the repeated application of a metrical frame for stress can exert an influence on the stress pattern applied to a following stimulus. Specifically, in such list contexts participants homogenized the stress pattern assigned to a subsequent word to match that of the list context. In a connectionist model, such a prosodic priming of stress information could be explained by the modification of the level of activation of the output because of the repeated naming of items with a given stress pattern (Colombo & Zevin, 2009). This would increase the gain from the direct—and more consistent—spelling-to-sound mappings and, thus, diminish the contribution of the more arbitrary semantically-mediated spelling-to-sound mappings (Colombo & Zevin, 2009). As a consequence, the presence of the AoA effect would be attenuated within the context of a repeated stress pattern, such as that of the pure blocks. Even though the cost associated with late

Table 5
Mixed model analysis estimates and tests of fixed effects in Experiment 2.

Parameter	Estimate	Std. Error	F	Numerator df	Denominator df	Sig.
Intercept	518.57	18.73	777.65	1	15.14	0.000***
Block	−10.92	8.52	2.06	1	2727.65	0.151
Stress	−13.54	8.53	1.04	1	2727.57	0.309
AoA	−30.95	8.54	15.01	1	2727.61	0.000***
Block × Stress	0.39	12.08	0.02	1	2727.70	0.883
Block × AoA	10.83	12.05	1.16	1	2727.35	0.282
Stress × AoA	19.64	12.08	4.44	1	2727.56	0.035*
Block × Stress × AoA	−3.29	17.07	0.04	1	2727.62	0.847

* $p<.05$.
*** $p<.001$.

Table 6
Mixed model analysis estimates and tests of fixed effects in Experiment 2 as a function of stress type.

Parameter	Estimate	Std. Error	F	Numerator df	Denominator df	Sig.
Regular stress						
Intercept	505.09	17.89	838.53	1	14.99	0.000***
Block	−10.70	8.47	1.35	1	1341.97	0.246
AoA	−11.11	8.47	1.51	1	1341.83	0.219
Block × AoA	7.51	11.97	0.39	1	1341.58	0.530
Irregular stress						
Intercept	518.49	19.65	698.54	1	15.02	0.000***
Block	−10.91	8.59	0.81	1	1350.56	0.369
AoA	−31.02	8.60	17.72	1	1350.44	0.000***
Block × AoA	10.91	12.15	0.81	1	1350.45	0.369

*** $p<.001$.

acquired words was larger in the mixed blocks as compared to pure blocks (21 and 11 ms difference, respectively), this difference was not significant. Thus the results of Experiment 2 did not support the list context prediction.

In addition to the mapping hypothesis, another theory—the semantic hypothesis—can partially account for the behavioral effects of AoA found in the present study. According to the semantic hypothesis, the order of acquisition of concepts affects the strength (i.e., interconnectivity) of their conceptual–semantic representations (e.g., Brysbaert & Ghyselinck, 2006; Steyvers & Tenenbaum, 2005). This hypothesis predicts that effects will be strongest in tasks where semantic representations are involved, and weakest in tasks where those representations are not required. Accessing word meanings from print should always show AoA effects, as shown for Italian by Menenti and Burani (2007), who found AoA effects in visual tasks tapping into semantics, such as semantic categorization of written words and lexical decision (see also Burani et al., 2007). Thus, the semantic hypothesis states that AoA effects emerge from two different sources: a frequency-related source and a semantically-related one (Brysbaert & Ghyselinck, 2006). The absence of AoA and other semantic effects in the presence of word frequency effects on Italian word naming was interpreted by Burani et al. (2007) as evidence for lexical-direct reading in Italian—which is sensitive to frequency-related properties of words—dissociable from lexical-semantic reading—where the semantically-related AoA effect would take place.

Within such account it could be conceived that, when one feature of the pronunciation—namely stress assignment—is highly irregular, the reading system would shift towards a stronger reliance on lexical-semantic reading, where AoA may have a specific effect. Evidence for an adjustment to the relative contributions of direct and semantically-mediated spelling-to-sound translation has been found by Tabossi and Laghi (1992), also in Italian. They found semantic priming effects in word naming with non-words included in the list by adding irregularly-stressed words. Normally, AoA effects are not observed for fully consistent words such as the Italian three-syllable regular words. However, if a preponderance of low-frequency irregular words makes semantic information highly valuable, i.e., for their correct pronunciation, then the semantic system may become more actively involved in the pronunciation of words whose phonology is otherwise relatively easy to compute from their orthography (Zevin & Balota, 2000). However, in the framework of the semantic hypothesis there would be no reason to expect that, overall, only irregularly stressed words would show an AoA effect.

In contrast, the interaction of AoA with stress regularity found in Experiment 2, with the effect of AoA being significant only for the irregularly stressed words, is easily explained by the mapping hypothesis. According to this explanation, only the late acquired irregular words are penalized because the earlier patterns cannot be generalized to those words. One challenge for future research will be to see if this general form of explanation can be extended to account for AoA effects in other languages with transparent orthographies such as Spanish, Turkish, or Japanese Kana (see, e.g., Cuetos & Barbón, 2006; Raman, 2006; Havelka & Tomita, 2006), and to see if in those languages, as in Italian, AoA effects dwell within islands of irregularity.

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Appendix A. Items used in Experiment 1

Two syllables, early acquired								
Italian	English	Freq	AoA	IMAG	Conc	Letters	N-size	BiFreq
Aria	Air	256.33	2.39	3.95	5.23	4	2	11.58
Aula	Classroom	65.67	3.20	5.77	5.93	4	3	10.71
Brodo	Broth	18.33	2.25	5.41	5.59	5	1	10.29
Buccia	Peel	6.67	2.82	5.48	6.59	6	2	10.22
Cera	Wax	7.67	3.36	4.93	5.32	4	7	11.58
Colpa	Guilt	98.33	3.20	2.82	4.39	5	5	10.72
Drago	Dragon	8.00	2.36	5.45	5.57	5	0	10.52
Erba	Grass	41.67	2.32	6.16	6.70	4	1	10.54
Fata	Fairy	5.33	2.20	4.70	4.93	4	6	11.14
Foca	Seal	1.67	2.86	5.80	5.61	4	5	10.62
Gufo	Owl	1.67	3.07	5.77	5.70	4	1	9.76
Mago	Wizard	21.67	2.55	4.84	5.73	4	5	10.68
Mulo	Mule	2.33	2.86	5.50	5.61	4	7	10.39
Nido	Nest	14.67	2.59	5.41	6.48	4	4	10.81
Nodo	Knot	16.33	2.91	5.05	6.30	4	7	10.82
Orso	Bear	17.67	2.39	6.09	6.52	4	9	10.80
Orto	Kitchen garden	13.67	3.05	5.66	4.61	4	8	11.04

(*continued on next page*)

Appendix A (*continued*)

Two syllables, early acquired								
Pacco	Parcel	8.00	3.09	5.64	4.82	5	6	11.02
Panno	Cloth	3.67	3.50	5.36	5.68	5	3	11.17
Pepe	Pepper	36.00	3.18	5.61	6.73	4	2	10.82
Piuma	Feather	3.67	3.00	5.73	5.50	5	0	10.49
Pugno	Fist	37.33	2.77	5.23	4.89	5	0	10.37
Scudo	Shield	10.33	3.36	5.20	5.86	5	1	10.44
Seme	Seed	12.00	3.11	5.02	6.50	4	1	11.19
Sorso	Sip	3.33	3.41	3.89	5.68	5	4	11.07
Stalla	Cattleshed	3.00	2.80	5.75	6.20	6	2	11.49
Sugo	Sauce	6.00	2.43	5.84	6.43	4	0	10.34
Suora	Nun	7.67	2.73	5.73	6.20	5	1	11.15
Talpa	Mole	2.33	3.30	5.23	6.80	5	0	10.59
Tosse	Cough	5.33	2.14	5.07	4.91	5	0	11.14
Tuta	Overalls	11.00	2.98	5.63	5.16	4	2	10.95
Uovo	Egg	16.00	2.11	6.39	6.70	4	3	10.59
Vasca	Basin	17.67	2.55	5.73	6.50	5	2	10.86
Volpe	Fox	6.33	2.75	5.98	6.61	5	1	10.38
	Mean	23.16	2.81	5.35	5.82	4.53	2.97	10.77
	Sd	45.76	0.40	0.70	0.69	0.61	2.63	0.41
Two late acquired								
Italian	English	Freq	AoA	IMAG	Conc	letters	N-size	BiFreq
Arte	Art	191.67	4.23	3.84	4.61	4	1	11.37
Atrio	Foyer	7.00	5.18	4.59	6.02	5	0	11.38
Boia	Hang-man	7.33	5.30	4.50	5.91	4	2	10.34
Cipria	Powder	2.33	4.80	5.61	6.09	6	0	10.91
Corvo	Crow	3.00	3.52	5.91	6.82	5	6	10.90
Cranio	Skull	11.67	4.66	5.75	6.30	6	1	11.10
Cubo	Cube	4.33	3.77	5.68	4.50	4	4	10.09
Dramma	Drama	45.33	5.48	3.93	4.55	6	1	10.64
Elmo	Helmet	2.00	4.50	4.86	4.89	4	3	10.66
Faro	Lighthouse	9.00	3.73	5.91	6.57	4	8	11.08
Fibbia	Buckle	0.33	4.70	5.30	6.52	6	1	10.21
Fieno	Hay	4.67	3.75	5.41	5.45	5	2	11.01
Folla	Crowd	53.33	4.05	5.39	5.86	5	6	11.00
Frate	Friar	14.00	3.84	5.86	6.05	5	1	10.99
Garza	Gauze	1.67	4.41	5.34	6.52	5	1	10.12
Golfo	Gulf	24.00	4.80	4.70	4.55	5	1	9.79
Moda	Fashion	142.33	4.57	4.00	4.14	4	5	10.66
Mucchio	Heap	12.33	4.00	4.05	5.30	7	1	10.38
Mummia	Mummy	2.00	3.95	5.14	6.39	6	0	10.18
Nuca	Neck nape	11.00	4.43	5.00	5.20	4	2	10.41
Orma	Footprint	2.33	3.95	5.20	6.00	4	4	10.81
Orzo	Barley	1.67	3.73	4.93	4.34	4	4	9.95
Pala	Shovel	2.67	3.77	5.55	6.52	4	5	11.45
Palco	Box	27.67	4.27	5.36	4.66	5	7	10.95
Palma	Palm	12.67	3.75	6.02	4.98	5	4	10.79
Perla	Pearl	3.67	3.52	6.02	6.73	5	0	11.17
Schiavo	Slave	6.33	4.09	4.25	5.23	7	0	10.91
Sede	Seat	116.33	5.18	3.16	4.80	4	3	11.27
Seno	Breast	35.67	3.68	6.36	6.77	4	2	11.60
Targa	Plate	10.67	3.84	5.77	6.73	5	1	10.61
Trota	Trout	4.00	3.80	5.68	6.59	5	1	10.99
Urna	Urn	3.67	5.84	4.80	5.68	4	0	10.60
Vetta	Summit	12.00	4.43	5.55	5.70	5	4	11.07
Vizio	Vice	13.67	4.55	2.75	4.57	5	1	10.49
	Mean	23.60	4.30	5.06	5.63	4.88	2.41	10.76
	SD	42.88	0.60	0.85	0.85	0.88	2.22	0.45

Note. Freq: Written frequency on one million occurrences; AoA: Age of acquisition on subjective ratings; IMAG: Imageability; Conc: Concreteness; letters: length in letters; CONT RULE = number of *c, g,* and *sc* letters, that need the following letter context to be assigned the correct pronunciation; N-size: orthographic neighborhood size; BiFreq: Bigram frequency, transformed on the basis of the natural logarithm. AoA, IMAG and Conc ratings are on a seven-point scale (all values taken from LEXVAR database, http://www.istc.cnr.it/material/database, see Barca et al., 2002).

Appendix B. Items used in Experiment 2

Regularly-stressed words, early acquired								
Italian	English	Freq	AoA	IMAG	Conc	Letters	N-size	BiFreq
Alunno	Pupil	1.00	3.07	5.41	3.59	6	0	10.96
Balcone	Balcony	13.00	2.86	5.98	4.93	7	2	10.74
Befana	"Befana"	7.33	1.93	5.25	4.66	6	0	10.34
Cammello	Camel	4.00	3.16	5.93	5.89	8	0	10.86
Canzone	Song	57.00	2.50	5.02	5.52	7	1	10.88
Colore	Color	83.33	2.27	4.73	5.65	6	3	11.41
Cometa	Comet	1.67	3.07	5.89	6.07	6	0	11.22

Appendix B (*continued*)

Regularly-stressed words, early acquired								
Compagno	Mate	62.33	3.18	5.41	4.50	8	1	10.77
Confetto	Sugared almond	1.00	2.77	5.89	6.80	8	0	10.83
Fantasma	Ghost	21.67	2.77	4.68	4.27	8	1	10.63
Farina	Flour	21.33	2.75	6.05	6.64	6	1	11.12
Fucile	Rifle	20.00	3.07	6.02	5.36	6	1	10.49
Imbuto	Funnel	3.00	3.02	5.84	6.59	6	0	10.37
Insetto	Insect	7.00	3.05	5.50	6.55	7	1	10.97
Medaglia	Medal	18.67	3.32	5.68	6.14	8	0	10.75
Nipote	Nephew	32.00	3.18	4.70	5.36	6	0	10.58
Pomata	Ointment	0.00	3.36	5.59	6.64	6	1	11.18
Rumore	Noise	47.67	2.52	4.82	4.59	6	1	10.47
Sapone	Soap	7.00	2.02	6.07	5.57	6	0	11.08
Sciroppo	Syrup	5.33	2.48	5.52	4.57	8	0	10.55
Sorella	Sister	80.33	1.77	5.55	4.57	7	0	11.43
Vulcano	Volcano	9.67	3.48	6.09	6.57	7	0	10.34
	Mean	22.92	2.80	5.53	5.50	6.77	0.59	10.82
	SD	26.20	0.48	0.48	0.94	0.87	0.80	0.33
Regularly-stressed words, late acquired								
Italian	English	Freq	AoA	IMAG	Conc	Letters	N-size	BiFreq
Albergo	Hotel	67.33	3.70	5.66	6.55	7	0	10.14
Asfalto	Asphalt	17.67	3.86	5.73	5.73	7	0	10.54
Bufera	Storm	10.67	4.23	4.73	4.32	6	0	10.05
Cornice	Frame	16.67	3.64	5.91	5.25	7	0	10.97
Cravatta	Tie	13.33	3.52	6.00	5.43	8	0	11.01
Fanale	Headlight	1.00	4.67	5.57	6.66	6	4	11.12
Fiducia	Trust	117.33	4.70	3.00	2.05	7	0	10.24
Furgone	Van	16.33	4.23	5.75	6.80	7	0	10.23
Galera	Prison	27.00	4.02	4.89	4.80	6	1	11.10
Impulso	Impulse	16.67	5.75	2.61	4.52	7	0	9.94
Lucchetto	Padlock	1.67	3.93	5.84	6.73	9	0	10.65
Merluzzo	Cod	3.33	5.09	5.39	5.93	8	0	9.92
Mulino	Mill	5.67	3.64	5.59	5.86	6	0	10.73
Palato	Palate	2.00	3.66	4.93	5.86	6	5	11.36
Patente	Driving license	21.00	5.27	5.75	4.02	7	3	11.31
Scaffale	Shelf	2.00	4.14	5.39	5.84	8	0	10.51
Scorpione	Scorpion	5.67	4.41	5.34	5.70	9	0	10.84
Sergente	Sergeant	10.33	5.14	4.30	5.20	8	0	10.92
Taverna	Tavern	3.33	5.14	5.48	4.41	7	1	10.95
Timone	Tiller	10.33	4.39	5.36	6.25	6	3	11.05
Tiranno	Tyrant	3.67	5.18	3.73	4.16	7	0	10.98
Vassoio	Tray	6.33	3.59	5.82	6.25	7	0	10.71
	Mean	17.24	4.36	5.13	5.38	7.09	0.77	10.69
	SD	26.48	0.67	0.93	1.14	0.92	1.51	0.44
Irregularly-stressed words, early acquired								
Italian	English	Freq	AoA	IMAG	Conc	Letters	N-size	BiFreq
Anatra	Duck	1.67	3.27	5.64	6.84	6	0	11.38
Aquila	Eagle	10.00	2.91	6.07	6.91	6	0	10.16
Diavolo	Devil	49.33	2.82	4.48	4.36	7	0	11.08
Favola	Tale	27.33	1.70	4.30	3.52	6	1	10.86
Femmina	Female	20.00	2.55	5.41	5.16	7	0	10.48
Fulmine	Lightning	15.67	2.93	5.93	4.27	7	0	10.31
Gomito	Elbow	11.67	2.75	5.86	6.02	6	2	10.69
Incubo	Nightmare	39.00	3.36	3.64	4.68	6	0	10.17
Lampada	Lamp	17.00	2.84	6.48	6.59	7	1	10.75
Mandorla	Almond	2.00	3.39	5.75	6.57	8	1	10.96
Nuvola	Cloud	8.00	2.16	5.70	3.95	6	1	10.14
Pagina	Page	71.33	2.89	5.48	5.05	6	1	10.96
Pecora	Sheep	11.00	2.18	6.00	5.55	6	0	11.22
Pentola	Pot	11.67	3.11	6.18	4.68	7	1	11.37
Pettine	Comb	6.33	2.36	6.20	5.32	7	0	11.17
Pollice	Thumb	9.33	2.25	6.30	6.91	7	2	11.05
Polvere	Dust	43.00	2.84	4.89	4.61	7	0	10.85
Principe	Prince	94.67	2.57	4.68	4.84	8	0	10.79
Scatola	Box	22.67	2.73	5.84	6.70	7	1	11.24
Spigolo	Edge	0.67	3.41	5.00	4.77	7	1	10.49
Stomaco	Stomach	24.67	3.43	4.89	6.50	7	0	11.17
Vipera	Viper	1.67	3.14	6.07	4.75	6	0	10.83
	Mean	22.67	2.80	5.49	5.39	6.68	0.55	10.82
	SD	23.95	0.46	0.74	1.06	0.65	0.67	0.39
Irregularly-stressed words, late acquired								
Italian	English	Freq	AoA	IMAG	Conc	Letters	N-size	BiFreq
Alluce	Big toe	2.00	4.02	5.57	4.93	6	0	10.71
Bibita	Drink	1.00	3.59	5.89	4.68	6	0	10.32
Bussola	Compass	5.33	4.18	5.64	6.45	7	0	10.45

(*continued on next page*)

Appendix B (*continued*)

Irregularly-stressed words, late acquired								
Carcere	Prison	128.33	3.86	5.84	6.25	7	0	11.18
Cofano	Bonnet	3.00	4.41	5.59	6.00	6	0	10.95
Edera	Ivy	8.00	3.55	5.52	6.39	5	1	11.30
Elica	Propeller	1.33	4.11	5.91	6.43	5	2	11.20
Fascino	Charm	49.67	5.25	3.48	4.48	7	0	10.88
Forfora	Dandruff	3.00	5.02	5.32	6.48	7	0	10.28
Lapide	Tombstone	1.33	5.23	5.89	6.43	6	0	10.83
Margine	Margin	20.33	5.20	3.20	5.30	7	0	10.86
Martire	Martyr	2.67	5.20	3.43	3.00	7	0	11.02
Pillola	Pill	10.67	3.68	5.57	4.82	7	0	11.12
Pugile	Boxer	9.00	3.86	5.68	6.20	6	0	10.51
Pulpito	Pulpit	4.33	5.84	3.68	3.16	7	0	10.20
Scapolo	Bachelor	5.33	5.45	3.93	5.20	7	1	10.82
Scheletro	Skeleton	5.00	3.52	5.77	6.11	9	0	11.04
Sigaro	Cigar	5.67	4.14	6.09	6.77	6	0	10.88
Sogliola	Sole	1.67	3.93	5.80	6.70	8	0	10.97
Tenebra	Darkness	0.67	5.07	4.05	4.91	7	0	10.72
Trappola	Trap	15.67	3.89	4.68	3.75	8	0	10.75
Vescovo	Bishop	19.67	4.77	5.02	5.93	7	0	10.79
	Mean	13.80	4.45	5.07	5.47	6.73	0.18	10.81
	SD	27.79	0.72	0.96	1.14	0.94	0.50	0.30

Note. Freq: Written frequency on one million occurrences; AoA: Age of acquisition on subjective ratings; IMAG: Imageability; Conc: Concreteness; letters: length in letters; CONT RULE = number of *c, g,* and *sc* letters, that need the following letter context to assign the correct pronunciation; N-size: orthographic neighborhood size; BiFreq: Bigram frequency, transformed on the basis of the natural logarithm. AoA, IMAG and Conc ratings are on a seven-point scale (all values taken from LEXVAR database, http://www.istc.cnr.it/material/database, see Barca et al., 2002).

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