Reading and Writing: An Interdisciplinary Journal **16:** 179–194, 2003.

Reading aloud: Dissociating the semantic pathway from the non-semantic pathway of the lexical route

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Abstract. According to dual-route models of reading, consistency effects in pseudoword reading are evidence for the activation of lexical information. We investigated whether this lexical interference has a semantic or a non-semantic origin. In Experiment 1, participants named aloud a set of words and pseudowords. The consistency effect in reading pseudowords co-occurred with associative priming effects in reading words but not with semantic priming effects. In Experiment 2, only words were presented. Comparable effects of both associative priming and semantic priming in naming words were found. This pattern provides evidence for the existence of a lexical non-semantic pathway in reading aloud. It also shows that this pathway is sensitive to associative relations among words. Finally, it calls into question the likelihood of a feedback mechanism from the semantic system to the orthographic input lexicon.

Key words: Associative priming, Reading aloud, Semantic priming

Introduction

According to the Dual Route Cascaded (DRC) model of reading (Coltheart, Curtis, Atkins & Haller, 1993; Coltheart & Rastle, 1994; Coltheart, Rastle, Perry, Langdon & Ziegler, 2001), a lexical and a non-lexical route mediate phonological retrieval. The non-lexical route operates on the basis of grapheme-to-phoneme conversion rules. The lexical route retrieves whole-word phonological forms and comprises both a semantic and a non-semantic pathway.

The issue of two lexical pathways is highly controversial, in spite of its relevance for claims about the functional architecture of the reading system (see, e.g., Besner, 1999; Coltheart, 1987; Seidenberg, 1992). Most of the empirical data on this issue come from the neuropsychological literature. Specifically, patients presenting two patterns of selective damage have been described, which supports the existence of two functionally distinct print-to-sound lexical pathways. On the one hand, deep dyslexics' performance (cf. Coltheart, Patterson & Marshall, 1980) speaks in favor of the existence of a lexical semantic pathway. In reading words, these patients produce semantic errors of various types (cf. Barry, 1984), thus signaling access to a damaged semantic system. As Marshall (1984) suggested, this pattern implies that when words are read their meaning is at least approximately known, indicating that the patients rely on a lexical semantic pathway. On the other hand, the performance of the patient described by Funnell (1983) speaks in favor of the existence of a lexical non-semantic pathway. The patient was unable to read aloud pseudowords. He could read aloud words accurately, but his comprehension of words was very poor. This pattern may be explained by postulating that, although the non-lexical route and the lexical semantic route are impaired, a direct pathway from the orthographic lexicon to the phonological lexicon is available (see also Schwartz, Saffran & Marin, 1980; Sartori, Masterson & Job, 1987).

In the present article, we investigated the functional architecture by exploiting the consistency effect in reading pseudowords in Italian recently reported by Job, Peressotti and Cusinato (1998). These authors found that consistent pseudowords, which were derived from words by preserving the context-dependent pronunciation of a grapheme (e.g., /k/ in DELICOTO /delikoto/ from the word DELICATO /delikato/, *delicate*), were read aloud faster than inconsistent pseudowords, for which the pronunciation of the context-dependent grapheme changed (e.g., DELICETO /delitʃeto/). However, this was true only when pseudowords were presented in a list mixed with words, while the effect disappeared when the list was entirely composed of pseudowords.

These results were interpreted within the DRC model (Coltheart et al., 1993) as due to an interference arising at the phonemic system level. At this stage, common to both the lexical and the non-lexical route, phonemic forms are stored for articulation. Both routes are activated upon presentation of a given orthographic string, and when they generate conflicting outputs an interference effect arises. The amount of interference is a function of two factors: (a) The degree of inconsistency between the two outputs, with consistent pseudowords being processed faster than inconsistent pseudowords. (b) The relative weight of each of the two routes, so that the consistency effect would emerge only when the reliance on the lexical route is enhanced by the presence of words. Therefore, for the consistency effect to occur the lexical route must be activated.

A theoretically relevant question then concerns the relative contribution of the lexical semantic and the lexical non-semantic pathways to the interference effect. The two pathways operate on whole-word phonological forms, but while the lexical semantic pathway requires the activation of a word meaning prior to the retrieval of the word pronunciation, the lexical non-semantic pathway has direct links between orthographic and phonological word forms that allow bypassing the semantic system. Since this latter pathway is part of the functional architecture of dual-route models, but is explicitly excluded in other classes of models such as PDP models (for a discussion see Seidenberg, 1992), empirical evidence for or against it is crucial.

The way we addressed this issue was to investigate the pattern of association and dissociation among three behavioral effects – the consistency effect, the semantic priming effect, and the associative priming effect – in reading aloud.

It has been claimed that associative and semantic priming effects are functionally distinguishable (for a review see Williams, 1996). Associative relatedness can be operationally defined as the normative description of the probability that one word will call to mind a second word. Thus, associative relationships reflect word use more than word meaning, with words co-occurring often in people's language being associatively related. On the other hand, semantic relatedness reflects the amount of semantic overlap among word meanings. Obviously, the degree of semantic relatedness and the degree of association often co-vary, and two associated words may also be semantically related. However, two associated words need not be semantically related (e.g., apple – doctor) and two semantically related words need not be associated (e.g., lion – buffalo). Many studies show automatic priming effects with associated words in lexical decision tasks (e.g., Lupker, 1984; Shelton & Martin, 1992; Williams, 1996), while inconclusive evidence has been reported for automatic semantic priming in the absence of association. However, some recent studies suggest that when the degree of semantic similarity is high, priming effects were more systematically obtained both in lexical decision and naming (McRae & Boisvert, 1998; Perea & Gotor, 1997; Thomson-Schill, Kurtz & Gabrieli, 1998). This leaves open the issue of whether semantic and associative priming have a common locus or different functional loci.

Traditionally, associative and semantic priming effects have been accounted for by spreading-activation theories (Lupker, 1984; Perea & Gotor, 1997; Shelton & Martin, 1992, but see Ratcliff & MacKoon, 1988 and Plaut, 1995 for different accounts). In this framework, associative priming is due to the spread of activation at the lexical level, because of the frequent co-occurrence of related words, while semantic priming is due to the activation spreading from a given concept (and/or meaning) to related concepts (and/or meanings) at the semantic level. Accordingly, it may be assumed that within the dual-route framework semantic priming effects reflect (stronger) activation of the lexical semantic pathway, while associative priming effects reflect (stronger) activation of the lexical non-semantic pathway.

The rationale underlying the present work rests on the co-occurrence – or lack thereof – of lexical effects on pseudoword reading and priming effects in word reading. The co-occurrence of the consistency effect and the semantic priming effect would be evidence that the lexical semantic pathway is responsible for the interference arising at the phonemic buffer. On the other hand, the co-occurrence of the consistency effect and the associative priming effect would be evidence that the interference effect is due to the lexical non-semantic pathway. Finally, the co-occurrence of the consistency effect with both associative and semantic effects would be evidence against a functional distinction between the two pathways of the lexical route.

Experiment 1

Words and pseudowords were presented for reading aloud. In Experiment 1A consistent and inconsistent pseudowords were mixed with associatively related word pairs. In Experiment 1B the pseudowords were mixed with semantically related word pairs. In order to avoid strategic expectancy-based processing, the number of related words in the set of stimuli was low (Neely, 1991; Tweedy, Lapinsky & Schvaneveldt 1977), and participants were asked to read both the prime and the target (McNamara & Altarriba, 1988).

Method

Participants

Sixty-four students at the University of Padova volunteered to participate (N = 32 in Experiment 1A and N = 32 in Experiment 1B). Their age ranged from 19 to 30 years.

Stimuli

Three types of stimuli were used: experimental pseudowords, experimental words and filler stimuli. Sixty-four experimental pseudowords (used also in the study by Job et al., 1998, Experiments 1 & 2), were derived from thirty-two tri- and quadrisyllabic words containing the graphemes *c*, *g*, or *sc*, whose pronunciation in Italian varies according to the following rules. They are pronounced /k/, /g/, and /sk/, respectively, when they are followed by either *a*, *o* or *u*, or by a consonant. They are pronounced /tʃ/, /dʒ/, and /ʃ/, respectively, when they are followed by either *i* or *e*. From each of the 32 words we derived 2 pseudowords by changing the vowel following the target grapheme. In one of the two pseudowords the pronunciation of the target grapheme was the same as in the original word (consistent pseudoword), while the other had the alternative pronunciation (inconsistent pseudoword). All the pseudowords were legal.

The experimental word stimuli consisted of 20 target words. They ranged from 4 to 8 letters in length, and were medium-to-high in frequency, with a mean frequency of 77.04 (Bortolini, Tagliavini & Zampolli, 1972). In Experiment 1A the related prime was both semantically and associatively related to its target. In Experiment 1B the related prime was only semantically related to its target.

To select the associated word pairs (Experiment 1A), we presented a set of 80 words to 43 people asking them to write, for each stimulus, the first word coming to their mind. Through this procedure, we selected the 20 word pairs with the strongest degree of association (the same associate word was given by more than the 50% of the participants). In addition, an unrelated control prime was selected for each target sharing initial letter and number of syllables with the corresponding related prime.

Next, we asked 2 groups of 40 people each to evaluate how often the 2 words of the related and unrelated pairs co-occur in everyday language (association judgment group) and how much the meanings of two words overlap (semantic judgment group). For each target, participants were presented with either the related or the unrelated prime–target pair and were asked to give a value on a scale in which 1 represented a very low level of association (or semantic relatedness), and 5 represented a very high level of association (or semantic relatedness). For the association judgment group, the mean value of the degree of association was 4.66 for the related pairs and 1.27 for the unrelated pairs. For the semantic judgment group, the mean value of the degree of semantic relatedness was 4.16 for the related pairs and 1.21 for the unrelated pairs.

To select the semantic word pairs (Experiment 1B), each prime word of Experiment 1A was replaced by a word from the same semantic category as the target but which was not highly associated with the target. Several semantic relations were allowed, with the exclusion of instrument-related pairs which have high co-occurrence probabilities (Moss, Ostrin, Tyler & Marslen-Wilson, 1995).

Two groups of forty participants each evaluated the new related and unrelated word pairs for their degree of association and for their degree of semantic relatedness. The mean value of the degree of association was 2.56 for the related pairs and 1.16 for the unrelated pairs, while the mean value of the degree of semantic relatedness was 4.45 for related pairs and 1.16 for the unrelated pairs.

All experimental prime-target pairs are reported in the Appendix.

The filler stimuli for both Experiment 1A and 1B were 40 pseudowords derived by tri- and quadrisyllabic words by changing 1 letter, and 32 tri- and quadrisyllabic words.

In each experiment, two lists were constructed so that each participant saw only either the consistent or the inconsistent version of each pseudoword; analogously, he/she saw only either the related or the unrelated version of each word pair. The filler stimuli were the same in the two lists. Each list, thus, was composed by 32 pseudowords (half consistent and half inconsistent), 20 word pairs (half related and half unrelated) and 72 filler stimuli, with the proportion of related words being 13.5%. Each list was presented in two fixed random orders with the following constraints: (a) prime and target words followed each other (both in the related and in the unrelated condition); (b) except for the prime–target pairs, there was no relationship (either semantic or associative) between two consecutive items.

Procedure

Stimuli presentation and responses recording were controlled by PsychLab, Version 0.85 (Gum, 1988) run on a Macintosh SE with a Telema voice-key attached to the keyboard to record naming times. A separate microphone was attached to a tape recorder for recording the session.

The stimuli appeared in black capital letters, Geneva 24 print, at the center of the computer screen, preceded by a fixation point. They disappeared as soon as the participants started their vocal response. From the response, 800 msec elapsed before the next trial started. The prime and the target of each word pair followed one another, and both were responded to. Participants were tested individually in a dimly illuminated and sound attenuated room. They were asked to read aloud each stimulus as fast and accurately as possible. The experimental session was preceded by a training session in which 10 unrelated words and 10 pseudowords were presented. Stimuli in the training session did not contain the graphemes *c*, *g*, and *sc*.

Results

The responses times (RTs) of the correct responses were trimmed by replacing scores longer than the mean + 2 SD with the limit value itself (2.64% and 2.39% of the data in Experiment 1A and 1B, respectively). Furthermore, RTs longer than 1000 msec and shorter than 200 msec were considered recording failures and were not included in the analyses (0.71% and 0.74% of the data in Experiment 1A and 1B, respectively). Mean RTs of correct responses and error percentages of Experiment 1A and 1B are reported in Table 1. Separate

Table 1. Correct mean RTs and error rates obtained in Experiment 1.

	Words			Pseudowords		
	Related	Unrelated	Diff.	Consistent	Inconsistent	Diff.
EXP 1A						
RTs (msec)	463	474	–11	529	558	–29
Err (%)	0.55	0.27		3.90	8.99	
EXP 1B						
RTs (msec)	506	502	+4	571	597	–26
Err (%)	0.00	0.00		4.49	8.40	

ANOVAs were carried out on correct RTs to experimental target words and experimental pseudowords considering both participants (F1) and items (F2) as random factors.

In Experiment 1A, consistent pseudowords were named faster than inconsistent pseudowords ($F1(1,31) = 49.23$, $p < 0.001$; $F2(1,31) = 41.88$, $p < 0.001$). Target words were read faster in the related than in the unrelated condition ($F1(1,31) = 26.01$, $p < 0.01$; $F2(1,19) = 7.38$, $p > 0.01$).

In Experiment 1B, the consistency effect in reading pseudowords was significant ($F1(1,31) = 36.19$, $p < 0.001$, $F2(1,31) = 7.52$, $p < 0.01$), but the priming effect in naming target words was not ($F1(1,31) = 1.24$, $p = 0.27$, $F2 < 1$).

The results of Experiment 1 showed that in the experimental conditions in which there was a consistency effect in reading pseudowords, there was associative priming but no semantic priming in reading words. This pattern is consistent with the hypothesis that the consistency effect in reading pseudowords is due to an interference between the non lexical procedure and the lexical non-semantic pathway.

The lack of an effect for the word pairs in Experiment 1B may be attributed to an insufficient sensitivity of the stimuli to detect semantic effects, rather than to the fact that the semantic pathway was not involved. In order to test for this possibility, a new experiment was run. The aim of Experiment 2 was twofold: to investigate if the semantically related prime–target pairs of Experiment 1B were able to produce priming effects and, if so, to assess whether the strength of prime–target relationship in the associatively and in the semantically related pairs differs.

Experiment 2

In Experiment 2A and 2B participants were presented with the same prime–target pairs of Experiment 1A and 1B, respectively. However, no pseudowords were presented. Furthermore, in order to increase the likelihood of semantic processing of the words, participants were asked, in a number of trials, to make a semantic judgment after their reading response.

Method

Participants

Sixty-eight students at the University of Padova voluntarily took part in the experiment (N = 36 in Experiment 2A and N = 32 in Experiment 2B). Their age ranged from 19 to 30 years.

Stimuli

The stimuli used were the 20 prime–target word pairs used in Experiment 1 (half related and half unrelated) and a set of 36 filler words. No pseudoword was presented in this experiment. Primes and targets were semantically and associatively related in Experiment 2A, and they were only semantically related in Experiment 2B. The percentage of related word pairs was 26%. Again, two lists were constructed for each experiment so that for a given target a participant saw either the related or the unrelated prime.

A further set of 38 words was selected for the semantic judgment task. Half were semantically related to either a target or a filler word of the experimental list and half were not.

Procedure

Stimuli presentation and response recording were controlled by PsychLab program, Version 2.03 (Gum, 1996) run on a Macintosh Performa 7200 with a button box and a voice key in Experiment 2A and by PsychLab program, Version 0.85 (Gum, 1988) run on a Macintosh SE with a Telema voice-key attached to the keyboard in Experiment 2B. The entire session was tape recorded.

Participants named aloud each word upon presentation on the screen. After the response, an additional stimulus written in uppercase Geneva 18 appeared in the lower part of the screen. In 50% of the trials it was the signal “Press a key to go on”, and when participants pressed the key the next stimulus to be named was presented. In the remaining trials (never involving primes), a

Table 2. Correct mean RTs obtained in Experiment 2.

	Words		
	Related	Unrelated	Diff.
EXP 2A	474	486	–12
EXP 2B	550	566	–16

word appeared and the participant had to decide whether it was or was not semantically related to the stimulus just read. The response was given by pressing one of the two response keys. When participants pressed any of the two keys the next trial started. In all other respects the procedure was identical to that of Experiment 1.

The experimental session was preceded by a training session in which 20 words were presented for reading and 10 words were presented for the semantic judgment task.

Results

Through the trimming procedure we replaced 0.21% and 0.99% of the data in Experiment 2A and 2B, respectively. Furthermore, RTs longer than 1000 msec and shorter than 200 msec were considered recording failures and were not included in the analyses (2.1% and 0.16% of the data in Experiment 2A and 2B, respectively). Mean RTs obtained in Experiment 2A and 2B are reported in Table 2.[1] An ANOVA on correct RTs to experimental target words was conducted considering both participants (F1) and items (F2) as random factors in each of the sub-experiments.

In both Experiments 2A and 2B target words were read faster in the related than in the unrelated condition (2A: $F1(1,36) = 8.95$, $p < 0.01$; $F2(1,19) = 4.25$, $p > 0.053$; 2B: $F1(1, 31) = 15.56$, $p < 0.001$, $F2(1,19) = 12.22$, $p < 0.01$). No errors were made in response to target words.

The results were clear-cut. Associatively related pairs as well as semantically related pairs produced priming effects which were quantitatively very similar. This rules out the possibility that the semantically related words in Experiment 1B were less related than the associated words in Experiment 1A. It also suggests that the involvement of the lexical semantic pathway in reading may be detected given the right conditions. In the present study, this was achieved because reliance on the semantic system was potentially useful, since pseudowords were excluded from the list and there was a semantic judgement task to perform. In other cases, stimulus characteristics may modulate the relative speed of the two pathways. Thus, we expect semantic features to have an effect on word reading only when the semantic pathway is as fast as the lexical non-semantic pathway. This pattern has been reported by Strain, Patterson and Seidenberg (1995), who observed concreteness effects in reading single words only when low-frequency irregular stimuli were used.

A pattern of results similar to that obtained in this experiment was found in Spanish by Perea & Gotor (1997, Experiment 3) using a masked-prime paradigm with 67 msec SOA. Interestingly, the effects of semantic and associative priming were comparable in size in the reading task. This pattern supports our conclusions that lexical associations are not necessary for semantic priming to occur and that associative relatedness may not have additional effect over and above the semantic relatedness effect.

General discussion

In Experiment 1, associative priming in reading words occurred together with consistency effects in reading pseudowords. However, semantic priming in reading words did not occur together with consistency effects in reading pseudowords.

The association of the consistency effect with associative priming suggests lexical involvement in reading aloud. The dissociation of the consistency effect from the semantic priming effect suggests that the semantic pathway is not involved. It follows that, within the experimental conditions of Experiment 1, reading aloud is accomplished by the lexical non-semantic pathway.

Why is the lexical semantic pathway not involved? Our interpretation is that it is too slow to have an effect on the non-lexical route, and that participants produce their oral response on the basis of the output of the non-lexical and the lexical non-semantic routes. However, it is not the case that the lexical semantic pathway is never involved in reading aloud, since semantic effects were obtained given the task demands of Experiment 2.

The DRC accounts for this pattern in a straightforward way because of its functional architecture and processing assumptions. The model assumes that phonology can be computed through three processing pathways that interact to produce a unique output. The pathways are activated in parallel upon presentation of any orthographic string, but their contribution to the output is modulated by the nature of the stimuli and the task demands. The experimental conditions of Experiment 1 allowed us to detect the functioning of both the non-lexical route and the lexical non-semantic pathway, while those of Experiment 2 allowed us to detect the functioning of the two lexical pathways.

The DRC model as it stands has no explicit representations of either associative or semantic relations. For the latter, it must await the implementation of the semantic system. As for the former, the more likely place for the representation of associative relations is either the orthographic input lexicon or the phonological output lexicon, or both. This may not be a simple matter, since in the present version of the DRC model words have inhibitory links among them in both the input and output lexica. One solution would be to maintain inhibitory links but to modulate the strength of inhibition such that associated words inhibit each other less than non-associated words.[2]

The present results also help to constraint how the different sub-systems postulated by the model may interact. The DRC model is fully interactive, and activation at one level feeds forward and backward on to the other levels. This being the case, we should expect feedback from the semantic system to the orthographic input lexicon to facilitate semantically related pairs also in Experiment 1. This is not the case, as we have seen. Therefore, either there is no activation feeding backward from the semantic system to the orthographic input lexicon, or there is indeed backward activation, but it is too weak, or accumulates too slowly, to produce any effect in the orthographic input lexicon. The full implementation of the semantic system in the model will help to choose between these alternative accounts. It may be interesting to note that the model of reading aloud originally proposed by Newcombe and Marshall (1981) did not allow feedback from lexical semantic representations to visual word representations.

While the aim of the present study was to test predictions derived from the functional architecture of the DRC model, it might be interesting to analyze how Parallel Distributed Processing (PDP) models account for the pattern obtained. According to PDP models, words and non-words are processed through the same network in which orthographic, phonological, and semantic information is represented in terms of distributed patterns of activity (Harm & Seidenberg, 1999; Plaut, 1997; Plaut, McClelland, Seidenberg & Patterson, 1996; Seidenberg & McClelland, 1989). Reading aloud requires the orthographic pattern for a word to generate the appropriate phonological pattern. This can be accomplished via two different computational pathways: the phonological pathway, in which the orthographic units are directly connected to the phonological units, and the semantic pathway, in which the activation of the phonological units is mediated by the activation of the semantic units. In normal reading, both pathways contribute in generating the correct pronunciation, even if their relative weight can be modulated by context variables or individual factors (Seidenberg, 1992). Let us now briefly consider how PDP models account for the effects examined in this paper.

Consistency effects in pseudoword reading arise in the PDP networks because the phonological pathway maps orthographic forms into phonological forms for both words and pseudowords. Indeed, lexical effects in pseudoword reading have been repeatedly simulated (Plaut et al., 1996;

Seidenberg, Plaut, Petersen, McClelland & McRae, 1994). A problem PDP models may face is to account for the absence of the consistency effect when no words are presented in the list, an effect reported by Job et al. (1998). Semantic priming effects are accounted for by PDP models in terms of similar (overlapping) patterns of activation within the semantic units generated by primes and targets. Less time is needed for the semantic units in the system to shift from representing the meaning of the prime to the meaning of the target when the two words are related than when they are unrelated (Masson 1995). Associative priming effects are more problematic for this class of models since they do not assume a "lexical" level of representation. Plaut (1995) recently proposed to define associative relatedness as the likelihood that the target word follows the prime word during the learning phase. The network, during training, learns to make a rapid transmission from the semantic activation pattern generated by the prime to the semantic activation pattern generated by the target. According to Plaut (1995), this is a late effect which becomes stronger at longer SOA. Thus, following this hypothesis, associative priming and semantic priming effects could be empirically dissociated on the basis of a SOA manipulation. Semantic priming effects should emerge at short SOA, associative priming effects at long SOA.

The results of Experiment 1A and 1B, in which the SOA was quite long are consistent with this prediction, as associative priming effects, but not semantic priming effects, were obtained. However, in Experiment 2, in which the SOA was longer, priming effects of the same size were obtained for both semantically and associatively related pairs.

In conclusion, we have presented data showing a pattern of association and dissociation between consistency effects in reading pseudowords and priming effects in reading words. While associative priming co-occurs with consistency effects, semantic priming does not. We have interpreted this pattern as providing evidence for the dissociation of associative and semantic priming, motivating a functional separation between the semantic and the non-semantic lexical pathways of the DRC model.

Acknowledgements

The present research was supported by a grant from MURST, Italy. We thank Max Coltheart and Roberto Dell'Acqua for helpful comments, and Silvia Pizzigoni for her help in data collection. Part of this research was presented at the 1997 Psychonomic Society Meeting in Philadelphia.

Appendix . Primes and targets used in the experiments. The last column on the right reports the targets. The first two columns report associated primes and controls, respectively, used in Experiments 1A and 2A. The third and fourth columns report semantic primes and controls, respectively, used in Experiments 1B and 2B.

Primes				Targets
Associative condition		Semantic condition		
Related	Unrelated	Related	Unrelated	
pilota (*pilot*)	patata (*potato*)	trattore (*tractor*)	tremore (*tremor*)	aereo (*airplane*)
volante (*wheel*)	violino (*violin*)	pedale (*pedal*)	pavone (*peacock*)	auto (*car*)
alto (*high*)	aria (*air*)	tozzo (*stumpy*)	tonno (*tunafish*)	basso (*low*)
bello (*beautiful*)	parte (*part*)	turpe (*awful*)	tarlo (*woodworm*)	brutto (*ugly*)
brodo (*broth*)	baffo (*moustache*)	zuppa (*soup*)	zelo (*zeal*)	dado (*cube*)
anello (*ring*)	aprile (*April*)	palmo (*palm*)	piatto (*dish*)	dito (*finger*)
prima (*before*)	paese (*country*)	tardi (*late*)	tipo (*type*)	dopo (*after*)
feriale (*weekday*)	fondale (*anchorage*)	epifania (*epiphany*)	epilessia (*epilepsy*)	festivo (*festive*)
fine (*end*)	forza (*force*)	partenza (*departure*)	patata (*potato*)	inizio (*beginning*)
pera (*pear*)	pizzo (*lace*)	uva (*grape*)	urlo (*cry*)	mela (*apple*)
api (*bees*)	asso (ace)	pane (*bread*)	punta (*tip*)	miele (*honey*)
presepe (*nativity scene*)	pirata (*pirate*)	dono (*gift*)	dote (*dowry*)	natale (*Christmas*)
slitta (*sling*)	smalto (*enamel*)	vento (*wind*)	visita (*visit*)	neve (*snow*)
matita (*pencil*)	medusa (*jellyfish*)	sfera (*sphere*)	sfarzo (*luxury*)	penna (*pen*)
sale (*salt*)	sedia (*chair*)	olio (*oil*)	onore (*honor*)	pepe (*pepper*)
listino (*quotation*)	lesione (*lesion*)	moneta (*coin*)	mulino (*windmill*)	prezzi (*prices*)
domanda (*question*)	domani (*tomorrow*)	reazione (*reaction*)	rispetto (*respect*)	risposta (*answer*)
fratello (*brother*)	fronte (*forehead*)	zia (*aunt*)	zona (*zone*)	sorella (*sister*)
donna (*woman*)	tempo (*time*)	padre (*father*)	paese (*country*)	uomo (*man*)
prato (*field*)	pazzo (*crazy*)	tinta (*color*)	torta (*cake*)	verde (*green*)

Notes

1. RTs are surprisingly longer in Experiment 2 than in Experiment 1. However, Experiment 2 had an additional task that may have slowed down response times. It is also possible that the difference is due to different groups of participants performing under different conditions.
2. We are grateful to Max Coltheart for suggesting this way of implementing associative priming.

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