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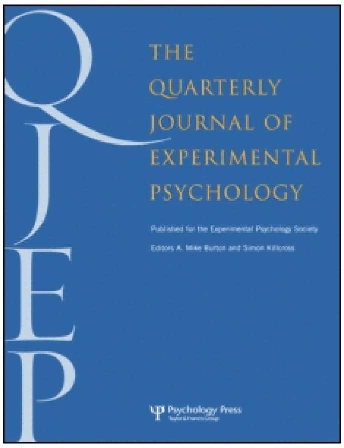

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Is morphological decomposition limited to low-frequency words?

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Short article

Is morphological decomposition limited to low-frequency words?

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On the basis of data from masked priming experiments, it has been argued that an automatic process of decomposition is applied to all morphologically structured stimuli, irrespective of their lexical characteristics (Rastle, Davis, & New, 2004). So far, this claim has been tested only with respect to low-frequency primes and nonword primes. This is a limitation because some models of morphological processing postulate that only high-frequency complex words are recognized as whole forms. Thus, a more stringent test would be to determine whether high-frequency complex words also show evidence of masked priming. We report an experiment that compares masked-priming effects observed when the primes constitute morphologically structured nonwords (e.g., alarmer–ALARM), low-frequency words with a mean frequency of 2 per million (e.g., notional–NOTION), and high-frequency words with a mean frequency of 60 per million (e.g., national–NATION). These three conditions yielded significant and equivalent effects, lending strong support to the notion of a routine form of decomposition that is applied to all morphologically structured stimuli.

Keywords: Morphological processing; Visual word recognition; Dual-route models; Reading; Masked priming.

One of the central challenges for theories of visual word recognition concerns the processing of morphologically complex words such as *distrust* or *darkness*. An important line of research in this respect was initiated by Longtin, Segui, and Halle (2003) and Rastle, Davis, and New (2004). These authors compared masked priming effects for (a) semantically transparent pairs like darkness–DARK; (b) pseudomorphological pairs like corner–CORN; and (c) nonmorphological form pairs like brothel–BROTH (-el never functions as a suffix in English). They found robust priming effects for the semantically transparent pairs and the pseudomorphological pairs, which did not differ in magnitude. Critically, both of these priming effects were greater than those observed in

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the nonmorphological form condition (brothel–BROTH), suggesting that they could not be reduced to simple orthographic overlap. Rastle et al. (2004) argued controversially that these results implicate a rapid process of "morpho-orthographic segmentation" whereby all stimuli with a morphological surface structure are decomposed into their constituents.

Since the publication of these results, evidence for morpho-orthographic segmentation has accumulated rapidly. Indeed, in a meta-analytic review of 18 masked priming experiments across several languages, Rastle and Davis (2008) reported an overall priming effect of 30 ms for prime–target pairs with a transparent morphological relationship (darkness–DARK), a priming effect of 23 ms for prime–target pairs with a pseudomorphological relationship (corner–CORN), and a priming effect of just 2 ms for matched prime–target pairs with a nonmorphological orthographic relationship (brothel–BROTH). This set of findings has also been extended to morphologically structured nonword primes (e.g., adorage–ADORE yields greater priming than adoriln–ADORE; see Longtin & Meunier, 2005; McCormick, Rastle, & Davis, in press).

The notion of an automatic morpho-orthographic segmentation process is consistent with single-route models postulating that morphologically complex words are always recognized on the basis of decomposition (e.g., Taft, 1994) and with parallel dual-route models postulating that morphologically complex words are always recognized through a combination of decomposition and direct lexical retrieval (e.g., Baayen, Dijkstra, & Schreuder, 1997; Kuperman, Bertram, & Baayen, 2008). Not all dual-route models are of the parallel type, however. Some other dual-route models make use of the horse race metaphor, according to which word recognition is determined by the fastest route. These models postulate that the speed of the lexical retrieval route depends on the frequency of the morphologically complex word; as such, they claim that decomposition is involved in the processing of low-frequency words, whereas lexical lookup governs processing for high-frequency words. The notion of an automatic process of morpho-orthographic segmentation is inconsistent with these models, because these models claim that decomposition applies only to low-frequency words.

In some variants of the horse-race style of model, the frequency threshold is very low (effectively zero), so that all known complex words qualify for direct lexical retrieval, and decomposition is limited to neologisms (e.g., "faxable"). Such a model is the AAM model, as can be seen in the citation below:

> The activation of a whole-word orthographic representation proceeds more rapidly than the activation of the combined morphemes that comprise the word . . . the AAM [augmented addressed morphology] model predicts effects of morphological structure only for nonwords. (Caramazza, Laudanna, & Romani, 1988, p. 299–301)

Other versions of the horse-race-style models postulate a frequency threshold for direct lexical retrieval of 6 per million. This (seemingly arbitrary) threshold was proposed initially by Alegre and Gordon (1999), who found no evidence for surface frequency effects for morphologically complex words falling below this value. Though this research has been criticized (see Baayen, Wurm, & Aycock, 2007, who found that surface frequency effects can be detected across the full range, including items below 6 per million, given sufficient power), it and similar proposals for precisely what the frequency threshold might be continue to inform research in this area, as demonstrated by the following excerpt:

> A number of factors can affect the processing route used for inflected words. One of them is word frequency. Stemberger and MacWhinney (1986) suggested that even regular inflected words that are encountered often enough, may be coded into long-term memory as whole units. Thus, high frequency inflected words would be accessed and recognized via the faster full-form route. Evidence for this has been reported by Alegre and Gordon (1999) who studied visual lexical decision performance in English-speaking individuals. They found that full-form representations already start to develop for morphologically complex words when their surface frequency is higher than 6 occurrences per million. Lehtonen, Niska, Wande, Niemi, and Laine (2006) obtained comparable results in Swedish: Native speakers showed a processing cost indicative of morphological decomposition with low frequency inflected nouns with a surface frequency range below 4 per million. On the other hand, medium and high frequency inflected words with surface frequency ranges of approximately 9–40 and

> 40–215 per million, respectively, were found to be processed via the full-form route. (Portin et al., 2008, p. 453)

Still other versions of the horse-race style of model propose that it is not the absolute frequency of the morphologically complex word that is important, but rather the relative frequency of this word to the base word from which it was derived. Hay (2001) argued that morphologically complex forms that are more frequent than their base words (e.g., actually–actual) are more likely to have lexical representations than are complex forms that are less frequent than their base words (e.g., famously–famous), as demonstrated by the following citation:

> The frequency of the base form is involved in facilitating decomposability. When the base is more frequent than the whole, the word is easily and readily decomposable. However, when the derived form is more frequent than the base it contains, it is more difficult to decompose and appears to be less complex. (Hay, 2001, pp. 1049–1050)

Irrespective of whether the frequency threshold is zero (Caramazza et al., 1988), somewhere in the low-frequency range (e.g., Alegre & Gordon, 1999), or relative rather than absolute (Hay, 2001), none of these horse-race models is consistent with an automatic process of morpho-orthographic segmentation that applies to all morphologically structured stimuli (e.g., Longtin et al., 2003; Rastle et al., 2004). However, it could be argued that these models are actually consistent with the evidence for morpho-orthographic segmentation as it stands. Indeed, inspection of the stimuli used within the various masked priming studies of morpho-orthographic segmentation shows that the primes were largely neologisms (e.g., habiter, adorism) and low-frequency derivations (averaging fewer than 3 per million; e.g., acidic, fleshy, amenable, coaster), much lower in frequency than their stem targets. Thus, the failure to demonstrate that morpho-orthographic segmentation also applies to high-frequency words presents a major gap in the theoretical claims made by Rastle et al. (2004).

A more stringent test of Rastle et al.'s (2004) claims would be to investigate whether masked morphological priming effects can be obtained when primes are high in frequency. The citations provided above suggest that morphological priming effects should be most evident when complex primes are low in frequency (Portin et al., 2008), lower in frequency than their stem targets (Hay, 2001) or nonword morphological constructions (Caramazza et al., 1988). Morphological priming should be least likely to arise when complex primes are high in frequency (and higher in frequency than their stem targets). In contrast, models arguing that decomposition is a routine process arising for all morphologically complex stimuli (Baayen et al., 1997; Rastle et al., 2004) predict that neither the frequency nor the lexicality of the prime should have any bearing on whether or not it is decomposed. Equivalent morphological priming effects should be observed in all cases.

This prediction was tested in a single experiment in which we measured the influence of a masked morphological prime on the recognition of a stem target. Three conditions of primes were used: one in which a high-frequency prime was, on average, more than four times more frequent than its stem target (e.g., dreadful–DREAD); one in which a low-frequency prime was, on average, more than four times less frequent than its stem target (e.g., blankly–BLANK); and one in which the prime was a nonword with no lexical frequency (e.g., priorly–PRIOR). Further, the frequencies of the primes (60 per million vs. 2 per million) were selected such that, according to Alegre and Gordon (1999), the first group of primes should have a lexical representation while the second group should not.[1]

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[1] In contrast to our previous work (e.g., McCormick, Rastle, & Davis, 2008; Rastle et al., 2004) we did not include an orthographic form condition modelled on the morphological pairs (e.g., brothel–BROTH; electron–ELECT). Indeed, because of the small number of these stimuli available in English, it would have been impossible to match them to the morphological conditions on the critical prime frequency variable. However, we felt confident that our results could safely be attributed to morphological overlap for two reasons. First, the meta-analytic review conducted by Rastle and Davis (2008) demonstrated over 18 experiments that pairs like brothel–BROTH yield average priming effects close to zero. Second, a form priming account of our effects would predict strong inhibition in the high-frequency prime condition (Davis & Lupker, 2006), precisely the opposite to the predicted (and observed) pattern.

Method

Participants

The participants were 60 volunteers from Royal Holloway, University of London. These participants had normal or corrected-to-normal vision and were native speakers of English. They were offered £5 in exchange for their time.

Stimuli

A total of 120 prime–target pairs were selected from the CELEX database (Baayen, Piepenbrock, & van Rijn, 1993), 40 for inclusion in each of three conditions. Pairs in the *high-frequency prime* condition comprised high-frequency primes that were at least twice as frequent as their respective targets (e.g., government–GOVERN). Pairs in the *low-frequency prime* condition comprised low-frequency primes that were no more than half as frequent as their respective targets (e.g., concretely–CONCRETE). Finally, pairs in the *pseudoword prime* condition comprised morphologically structured pseudoword primes derived from their respective targets (e.g., monkage–MONK). A semantic relatedness pretest using a 9-point scale was carried out using experimental items and fillers in order to check that the words in both real-word prime conditions were equivalently semantically related. This pretest was completed by a separate group of 40 native English-speaking participants who did not take part in the main experiment. Semantic relatedness as assessed with the latent semantic analysis (LSA; Landauer & Dumais, 1997) could not be used as there were insufficient numbers of the lower frequency primes available for an effective comparison to be made across the conditions. Primes and targets were matched across conditions on a range of variables known to affect lexical processing (see Table 1). The same range of frequent suffixes was used in each of the three conditions in order to ensure that differences between suffixes did not influence the decomposition observed. Stimuli can be found in the Appendix.

Unrelated control primes were selected for each of the 120 target words. Control primes were morphologically, semantically, and orthographically unrelated to the targets. They were matched pairwise on length and morphological complexity to each related prime and were matched groupwise on frequency to the related primes in each real-word condition. Control primes ended with the same suffixes as the test primes.

A total of 40 pairs of totally unrelated primes and targets were added to the stimulus set in order to reduce the overall relatedness proportion to 37% (see also Rastle et al., 2004). Two thirds of these filler primes were real suffixed words (27), and one third (13) were pseudoderived words, matching the proportions of the experimental prime words. These filler targets were groupwise matched to the 120 experimental targets on frequency, length, and neighbourhood size. Real-word filler primes were groupwise matched to experimental primes on frequency and length.

A total of 160 nonword targets were selected for the NO response of the lexical decision task. Nonword targets were groupwise matched to the word targets on length and neighbourhood size. These nonword targets were preceded by primes matched groupwise to the experimental primes on morphological status, lexical status, length, and frequency.

Targets from each condition were divided at random into two equal lists for counterbalancing purposes, with half of the targets in each list preceded by related primes and half by unrelated control primes. Participants received only one experimental list and therefore participated in all priming conditions, but saw each target only once. Including the experimental, filler, and nonword trials, each participant made 320 lexical decisions.

Apparatus and procedure

Stimulus presentation and data recording were controlled by the DMDX software (Forster & Forster, 2003) running on a Pentium III personal computer. A two-button response box was used to record lexical decisions, in which the YES response button was controlled by the dominant hand.

Participants were tested in a dimly lit, quiet room. They were advised that they would be

Table 1. *Stimulus characteristics for primes and targets across the three conditions*

	Prime			
	High frequency	*Low frequency*	*Pseudoword*	*ANOVA*
Target frequency	14.62	17.93	15.45	$F(2, 119) = 0.42$, *ns*
Prime frequency	60.15	2.50	–	$F(1, 79) = 20.25$, $p < .001$
Target *N*	1.45	1.4	1.43	$F(2, 119) = 0.01$, *ns*
Prime length	8.43	8.45	8.45	$F(2, 119) = 0.00$, *ns*
Target length	5.90	5.85	5.90	$F(2, 119) = 0.03$, *ns*
Form overlap	0.70	0.69	0.70	$F(2, 119) = 0.12$, *ns*
Suffix frequency	944.45	944.45	944.45	$F(2, 119) = 0.00$, *ns*
Semantic relatedness (1–9)	7.01	7.16	N/A	$t(1, 78) = 0.64$, *ns*

Note: Means and statistical test data. Frequency values are per million (Baayen et al., 1993). ANOVA = analysis of variance. N/A = not applicable.

seeing a series of letter strings presented one at a time and that they would be required to decide as quickly and accurately as possible whether each string was a word or not a word. Participants were not told of the existence of the prime stimulus. Primes were presented in lower case for 42 ms. These primes were preceded by a 500-ms forward mask (consisting of hash marks) and were followed immediately by a target in upper case that remained on screen until a response was made. Targets were presented in a different random order for each participant. Participants were given 10 practice trials before beginning the experiment.

Results

Reaction time (RT) data for incorrect responses were discarded. Ten outlying data points over 2,500 ms or less than 150 ms were also removed prior to analysis (0.1% of correct responses).

Data were analysed by subjects and by items using three-factor analyses of variance (ANOVAs). The analysis by subjects treated priming (two levels) and condition (three levels) as repeated factors and list (two levels) as an unrepeated factor. The analysis by items treated condition and list as unrepeated factors and priming as a repeated factor. Latency and error data by subjects are shown in Table 2. The analysis on RT yielded a main effect of priming, $F_1(1, 58) = 69.70$, $MSE = 770.00$, $p < .001$; $F_2(1, 114) = 44.14$, $MSE = 931.19$, $p < .001$, min $F'(1, 168) = 27.02$, $p < .01$, as did the analysis on error rate, $F_1(1, 58) = 35.649$, $MSE = 0.001$, $p < .001$; $F_2(1, 114) = 12.662$, $MSE = 0.002$, $p < .005$, min$F'(1, 168) = 9.343$, $p < .01$. No other effects on RT or error rate reached significance.

Discussion

This research investigated whether the rapid form of morphological decomposition identified by Rastle et al. (2004) and Longtin et al. (2003) is a routine process applied to all morphologically structured stimuli, or whether it applies only to morphologically complex stimuli that are not sufficiently frequent to have their own lexical representations. We compared masked priming for derived primes that were both high in frequency (on average 60 per million) and of a higher frequency than their stem targets (on average more than four times as frequent) with the effects observed for two types of low-frequency primes. The first type consisted of low-frequency words (on average 2 per million) that were on average more than four times less frequent than their stem targets. The second type consisted of nonwords with no lexical frequency. If morphological decomposition is limited to unfamiliar words, as predicted by the horse-race style of dual-route models quoted in the introduction, then priming

Table 2. *Latency and error data by subjects*

	Prime		
Condition	*High frequency (equipment–EQUIP)*	*Low frequency (harassment–HARASS)*	*Pseudoword (escortment–ESCORT)*
Related primed	613 (5.8)	602 (3.5)	624 (4.0)
Control primed	637 (7.7)	629 (5.3)	645 (6.9)
Priming effect	24 (1.9)	27 (1.8)	21 (2.9)

Note: Latency = reaction time in ms. Error rates in percentages in parentheses.

should be limited to the last two conditions. On the other hand, if morphological decomposition is a routine process that applies to all morphologically structured stimuli, then it should be observed in all three conditions.

The results were straightforward. The priming effect observed with high-frequency primes (24 ms) was equivalent to the one observed with low-frequency primes (27 ms) and with nonword primes (22 ms). These results bolster the claims of Rastle et al. (2004) by showing unambiguously that the morpho-orthographic segmentation process is not restricted to low-frequency words or nonwords.[2] Indeed, in contrast to the horse-race models quoted in the introduction (e.g., Caramazza et al., 1988), in which decomposition is portrayed as a slow (or last-resort) option compared with lexical retrieval, our observation that decomposition is observed for words with such high surface frequencies is testament to the primary role of morphological decomposition in visual word recognition.

Though these data are inconsistent with the horse-race style of dual-route models quoted in the introduction, the finding of automatic morphological decomposition is fully in line with the parallel dual-route models defended by Baayen and colleagues since the mid-1990s (e.g., Baayen et al., 1997; Baayen et al., 2007; Kuperman et al., 2008), which claim that there is across-the-board decomposition of morphologically complex stimuli. In contrast to the horse-race style of dual-route model, these parallel models assert that readers attempt to maximize their chances of word recognition through simultaneous use of all processing cues and mechanisms available to them, including whole-form retrieval and decomposition (e.g., Kuperman et al., 2008). Perhaps an analogy can be made here to the issue of phonological mediation in visual word recognition. Though debate in this area has often been framed in an all-or-none manner (i.e., visual word processing is achieved via the phonological pathway or the visual pathway), more recent theorizing is in line with a weak phonological model in which a visual and a phonological pathway interact and simultaneously contribute to word recognition (Rastle & Brysbaert, 2006). The availability of working computational models of visual word recognition has contributed greatly to this theorizing, and we predict that extending these models to morphological processing would have a similar positive influence in that area.

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[2] One of our reviewers suggested that the presence of nonword primes in our experiment might have inflated the contribution of the decomposition route, resulting in larger priming effects in the high-frequency condition than would be observed in an experiment comprising high-frequency primes only. We believe that this is very unlikely given that (a) there is little evidence for the modulation of masked priming effects due to the nature of the primes (Brysbaert, 2001; Perea & Rosa, 2002); (b) the related nonword primes constituted only 12.5% of the word trials, thus discouraging rather than encouraging morphological decomposition over the whole set of items; and (c) the priming effect observed with low-frequency primes was exactly the same size as that reported by Rastle et al. (2004) in which no nonword primes were used.

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APPENDIX

Stimuli and item means

Prime	*Related prime*	*Unrelated prime*	*Target*	*Related RT*	*Control RT*
High frequency	brutal	verbal	BRUTE	634	674
High frequency	censorship	friendship	CENSOR	611	662
High frequency	comfortable	fashionable	COMFORT	555	574
High frequency	conviction	oppression	CONVICT	552	617
High frequency	dreadful	powerful	DREAD	565	635
High frequency	education	provision	EDUCATE	614	601
High frequency	exactly	clearly	EXACT	518	606
High frequency	financial	celestial	FINANCE	548	623
High frequency	frequently	absolutely	FREQUENT	562	622
High frequency	government	management	GOVERN	615	705
High frequency	marvellous	suspicious	MARVEL	609	645
High frequency	migration	explosion	MIGRATE	575	694
High frequency	national	physical	NATION	618	640
High frequency	organize	civilize	ORGAN	567	625
High frequency	pollution	expansion	POLLUTE	649	795
High frequency	reasonable	inevitable	REASON	553	538
High frequency	scarcely	probably	SCARCE	592	716
High frequency	security	morality	SECURE	599	616
High frequency	trawler	counter	TRAWL	651	682
High frequency	victory	wealthy	VICTOR	540	634
High frequency	capitalism	antagonism	CAPITAL	587	602
High frequency	clerical	disposal	CLERIC	762	691
High frequency	commercial	industrial	COMMERCE	612	579
High frequency	depression	assumption	DEPRESS	654	686
High frequency	editor	vendor	EDIT	539	570
High frequency	equipment	agreement	EQUIP	675	699
High frequency	filthy	bloody	FILTH	726	697
High frequency	flexible	horrible	FLEX	697	601
High frequency	generation	expression	GENERATE	646	589
High frequency	intention	decision	INTENT	649	586
High frequency	merely	slowly	MERE	705	755
High frequency	mobility	identity	MOBILE	589	548
High frequency	nervous	anxious	NERVE	549	561
High frequency	orphanage	entourage	ORPHAN	645	616
High frequency	pompous	various	POMP	652	670
High frequency	ridiculous	suspicious	RIDICULE	644	676
High frequency	sculpture	procedure	SCULPT	751	747
High frequency	tension	oration	TENSE	610	535
High frequency	utterly	finally	UTTER	616	759
High frequency	voltage	teenage	VOLT	612	663
Low frequency	adorable	enviable	ADORE	566	634
Low frequency	assertion	collision	ASSERT	565	607
Low frequency	baronial	arterial	BARON	630	671
Low frequency	blissful	vengeful	BLISS	599	604
Low frequency	comradeship	sponsorship	COMRADE	628	679
Low frequency	correction	propulsion	CORRECT	521	564
Low frequency	crumbly	deathly	CRUMB	557	614

(*Continued overleaf*)

Appendix: *Continued*

Prime	*Related prime*	*Unrelated prime*	*Target*	*Related RT*	*Control RT*
Low frequency	cubism	egoism	CUBE	536	587
Low frequency	dilation	adhesion	DILATE	711	728
Low frequency	dumbly	archly	DUMB	540	590
Low frequency	fibrous	perilous	FIBRE	615	661
Low frequency	fragility	adversity	FRAGILE	572	602
Low frequency	harassment	assortment	HARASS	634	759
Low frequency	libellous	erogenous	LIBEL	754	726
Low frequency	notional	farcical	NOTION	649	661
Low frequency	riotous	zealous	RIOT	576	660
Low frequency	surveyor	imitator	SURVEY	568	637
Low frequency	toaster	sleeper	TOAST	525	581
Low frequency	tutorial	remedial	TUTOR	548	612
Low frequency	virtuous	wondrous	VIRTUE	661	689
Low frequency	anchorage	parentage	ANCHOR	539	565
Low frequency	bafflement	secondment	BAFFLE	731	710
Low frequency	blankly	gruffly	BLANK	568	560
Low frequency	complexity	inequality	COMPLEX	565	588
Low frequency	concretely	stubbornly	CONCRETE	593	590
Low frequency	corruptible	submersible	CORRUPT	627	630
Low frequency	crunchy	flighty	CRUNCH	594	616
Low frequency	dictation	corrosion	DICTATE	709	713
Low frequency	dispensable	certifiable	DISPENSE	679	694
Low frequency	eviction	abrasion	EVICT	684	619
Low frequency	fluently	densely	FLUENT	589	643
Low frequency	fruition	allusion	FRUIT	568	621
Low frequency	insertion	collusion	INSERT	542	549
Low frequency	moderation	percussion	MODERATE	579	622
Low frequency	portraiture	displeasure	PORTRAIT	661	710
Low frequency	shrinkage	pilferage	SHRINK	666	648
Low frequency	terrorize	fossilize	TERROR	579	573
Low frequency	tribal	rental	TRIBE	665	614
Low frequency	virginal	temporal	VIRGIN	540	530
Low frequency	woolly	feebly	WOOL	567	612
Pseudoword	agitatal	corrodal	AGITATE	755	721
Pseudoword	brothage	waferage	BROTH	687	900
Pseudoword	simmerion	frightion	SIMMER	716	753
Pseudoword	benchy	elbowy	BENCH	547	625
Pseudoword	bleakible	swiftible	BLEAK	658	655
Pseudoword	brownly	checkly	BROWN	537	619
Pseudoword	clutchor	assertor	CLUTCH	632	650
Pseudoword	clippy	poachy	CLIP	584	593
Pseudoword	crimsonly	scarletly	CRIMSON	600	647
Pseudoword	devillous	balletous	DEVIL	509	564
Pseudoword	flankial	melonial	FLANK	655	730
Pseudoword	knifous	bladous	KNIFE	546	631
Pseudoword	mattressful	championful	MATTRESS	661	673
Pseudoword	monkage	oathage	MONK	537	569
Pseudoword	parasital	nuisancal	PARASITE	727	788
Pseudoword	poisonize	mediumize	POISON	571	596
Pseudoword	purplity	fiercity	PURPLE	560	617
Pseudoword	quotion	pausion	QUOTE	574	588

(*Continued overleaf*)

Appendix: *Continued*

Prime	*Related prime*	*Unrelated prime*	*Target*	*Related RT*	*Control RT*
Pseudoword	shufflement	distortment	SHUFFLE	647	662
Pseudoword	smoothity	cleverity	SMOOTH	568	567
Pseudoword	alarmal	feveral	ALARM	542	544
Pseudoword	assistion	betrayion	ASSIST	683	635
Pseudoword	astoundable	slitherable	ASTOUND	696	700
Pseudoword	biscuitly	grammarly	BISCUIT	617	584
Pseudoword	blondly	lemonly	BLOND	601	648
Pseudoword	canvassion	blisterion	CANVASS	707	701
Pseudoword	climaxial	dragonial	CLIMAX	621	589
Pseudoword	athletism	costumism	ATHLETE	651	626
Pseudoword	cyclous	flamous	CYCLE	526	566
Pseudoword	escortment	filterment	ESCORT	611	598
Pseudoword	indulgion	whistlion	INDULGE	598	664
Pseudoword	lepoardous	vinegarous	LEOPARD	621	649
Pseudoword	meriture	pouchure	MERIT	663	636
Pseudoword	paganly	jumboly	PAGAN	664	701
Pseudoword	pigeonal	hammeral	PIGEON	560	577
Pseudoword	priorly	bogusly	PRIOR	609	619
Pseudoword	prosperion	furnishion	PROSPER	673	725
Pseudoword	scrawlion	demeanion	SCRAWL	774	704
Pseudoword	sievable	flutable	SIEVE	743	796
Pseudoword	twinklion	commution	TWINKLE	635	638

Note: RT = reaction time, in ms.