Journal of Research in Reading
UKLA The United Kingdom Literacy Association
Journal of Research in Reading, ISSN 0141-0423
Volume 00, Issue 00, 2018, pp 1–11
DOI:10.1111/1467-9817.12240

Phonological effects in visual word recognition: evidence from the processing of two types of Hebrew acronyms

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To investigate phonological effects in visual word recognition, a visual lexical decision task was used in which the critical stimuli were two types of highly familiar Hebrew acronyms: 'phonological' acronyms that are conventionally pronounced as single words via letter-to-sound translation (ד"ש (d"ʃ) = /daʃ/), and 'lexical' acronyms that are conventionally pronounced according to their full multiword name (ת"א(t"ʔ) = /tel/ /aviv/). Thus, in the case of 'phonological' acronyms, phonological recoding may contribute to the recognition process, while in the case of 'lexical' acronyms, it may interfere ((ת"א t"ʔ) ≠ taʔ/). If familiar letter strings are accessed mainly orthographically, as assumed by dual route models, then no difference is expected between these two types of acronyms. Alternatively, if phonological recoding influences word recognition, then 'phonological' acronyms should be easier to recognise. Consistent with this latter interactive-connectionist view, responses were faster and more accurate in the 'phonological' than in the 'lexical' condition.

Highlights

What is already known about this topic

- The most convincing evidence for early phonological effects in visual word recognition comes from studies using the masked priming paradigm with nonwords as primes.

- However, evidence for mandatory phonological activations during the processing of unfamiliar letter strings do not necessarily entail that the recognition of familiar words always involves phonological activations.
- Therefore, the aim of the present study was to investigate the role phonology plays in the recognition of familiar letter strings.

What this paper adds

- In Hebrew, letters represent mostly consonants and readers supply the vowels by themselves. Thus, unlike English, most Hebrew acronyms are treated as regular words ('phonological' acronyms).
- Nevertheless, although all letter strings in Hebrew can be pronounced as is, via spelling-to-sound translation, some acronyms are pronounced according to their full multiword name ('lexical' acronyms).
- Using a visual lexical decision task, we found that 'phonological' acronyms that can be recognised both orthographically and phonologically were recognised faster and more accurate than equally familiar 'lexical' acronyms that can only be recognised orthographically.

Implications for theory, policy or practice

- Consistent with interactive-connectionist models, we show that phonological recoding is not only automatic, but also fast enough to influence the recognition process.
- Importantly, this prominent role of phonology is shown even in a task that emphasises orthographic rather than phonological processes, and even when the letter string is highly familiar.

Despite decades of research, the role phonology plays in visual word recognition is still a matter of debate. On the one hand, dual route models, such as the Dual Route Cascaded (DRC) model (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001), suggest that reading involves two separate, independent pathways: the indirect phonological pathway – from orthography to phonology to meaning – and the direct orthographic pathway – from orthography directly to meaning. According to this view, phonological recoding (i.e., the indirect pathway via spelling-to-sound translation) is critical for the processing of *unfamiliar* letter strings (i.e., nonwords or new words that are not yet coded in our orthographic lexicon). However, with repeated exposure to a word, phonological processes may become less utilised, as whole word recognition via the direct orthographic pathway becomes possible. Specifically, it is assumed that although familiar words can be accessed via both pathways, phonological access via the indirect sub-lexical pathway is relatively slow compared with orthographic access via the direct lexical pathway. As a result, the recognition of *familiar* words is driven primarily by orthography.

On the other hand, connectionist interactive models (e.g., Harm & Seidenberg, 2004; Seidenberg & McClelland, 1989) assume a single reading mechanism in which

orthographic phonological and semantic representations are fully interconnected. With practice, these bidirectional mappings become automatic such that orthographic representations automatically activate their corresponding phonological (and semantic) representations, and these in turn influence the recognition process via feedback connections. In particular, the Bimodal Interactive Activation Model (BIAM; Grainger & Ferrand, 1994, 1996; Grainger & Ziegler, 2007; Grainger & Holcomb, 2009) postulates a reading system in which orthographic and phonological representations are connected not only at the lexical level, but also at the sub-lexical level. Thus, unlike the DRC, the BIAM assumes that phonological recoding (sub-lexical conversion of print-to-sound) continues to play a role in visual word recognition, even when the printed word is highly familiar.

Perhaps the most convincing evidence for early sub-lexical phonological effects in visual word recognition comes from studies using the masked priming paradigm with pseudo-homophones as primes (nonwords that sound like real words, e.g., *koat*). These studies (e.g., Ferrand & Grainger, 1992, 1993) show that target recognition (e.g., the word COAT) is speeded by the prior brief presentation of a masked pseudo-homophone prime (e.g., koat – COAT) relative to an orthographic control (e.g., poat – COAT). This literature has led a number of researchers (e.g., Frost, 1998) to suggest that phonological recoding is a mandatory automatic phase of print processing.

However, evidence for mandatory (sub-lexical) phonological activations during the processing of nonwords (pseudo-homophones like *koat* or pseudo-words like *poat*) do not necessarily entail that the recognition of familiar words always involves phonological activations. As noted earlier, according to the DRC model (e.g., Coltheart et al., 2001), the processing of familiar and unfamiliar letter strings is fundamentally different: while unfamiliar letter-strings (i.e., nonwords) are processed phonologically via the sub-lexical indirect phonological pathway, familiar words (i.e., letter-strings that are coded in our orthographic lexicon) are mainly recognised orthographically via the direct-lexical pathway. Thus, whereas both dual route and connectionist interactive models predict phonological effects during the processing of unfamiliar letter strings, only connectionist-interactive models predict prelexical phonological influences during the recognition of familiar written words. The aim of the present study, therefore, was to investigate the extent to which phonology mediates the recognition of *familiar* letter strings. To accomplish this aim, we utilised the unique characteristics of Hebrew. In particular, as detailed in the succeeding text, we focused on the recognition of acronyms.

Acronyms are words formed by combining the initial letters of a multiword name, such as BBC from British Broadcasting Corporation.[1] Although some acronyms in English can be read as regular words (e.g., NATO), most English acronyms are formed by a sequence of illegal letter strings that cannot be pronounced via the normal letter-to-sound translation (e.g., BBC), and are therefore pronounced as a sequence of letter names (bee-bee-cee). Research on the processing of acronyms (e.g., Brysbaert, Speybroeck, & Vanderelst, 2009; Laszlo & Federmeier, 2007a, 2007b; Slattery, Pollatsek, & Rayner, 2006) focused mainly on this group of acronyms, and showed that just like regular words, these familiar acronyms (e.g., BBC) have stored lexical orthographic, semantic and phonological representations. First, Laszlo and Federmeier (2007a) have demonstrated that similarly to familiar words, familiar acronyms can be accessed lexically via whole-word orthographic representations. Specifically, these researchers have shown that just like letters in familiar words (e.g., DID), letters in familiar acronyms (e.g., DVD) enjoy an identification benefit relative to illegal unfamiliar letter-strings (e.g., DYD). The idea that acronyms are processed like regular words is also evident from ERP studies. In particular, Laszlo and

Federmeier (2007b) have shown that just like words, acronyms elicit repetition effects on the N400 component – a functionally specific index of semantic activation processes. Similarly, Brysbaert et al. (2009) have shown that target words can be primed to the same extent with associatively related acronyms as with associatively related words. Finally, there is also evidence that familiar acronyms have stored lexical phonological representations, much as words do (e.g., Slattery et al., 2006). Specifically, in Slattery et al. (2006), participants' eye movements were monitored while they silently read sentences containing acronyms (e.g., FBI). Fixation durations were shorter when the acronym was paired with a phonologically consistent indefinite article (an FBI agent) than with a phonologically inconsistent indefinite article (a FBI agent), indicating that that acronyms like FBI are stored phonologically as sequences of letter names.

All of the aforementioned studies focused on orthographically illegal acronyms that cannot be recognised via the indirect phonological pathway (i.e., their pronunciation cannot be generated via the regular letter-to-sound translation). As a result, these studies mainly emphasised the direct-lexical pathway. The current study aimed to extend these previous studies by focusing on orthographically legal acronyms. In particular, we aimed to investigate the contribution of the sub-lexical phonological pathway to the recognition of familiar letter strings. Although Slattery et al. (2006) provide evidence for fast phonological activations during the processing of familiar acronyms, it is generally assumed that these phonological representations were activated via the direct-lexical pathway. Moreover, even if one assumes that these phonological codes were activated via a sub-lexical letter-naming rule (e.g., Izura & Playfoot, 2012), still this unusual correspondence between letters and letter names may require processes that are qualitatively different than those involved in the recognition of regular words (Slattery, Schotter, Berry & Rayner, 2011).[2]

Thus, to directly examine the role phonology plays in visual word recognition, we compared the processing of two types of orthographically legal Hebrew acronyms that differ only in terms of their pronunciation. In contrast to Indo-European languages, in Hebrew, most letters represent consonants, and vowels may be optionally added as diacritical points. Because Hebrew is generally written without the vowel marks, Hebrew readers often encounter consonant strings and supply the appropriate vowel sounds by themselves. Thus, although phonological recoding is extremely loose in Hebrew, the same phonological procedure can be applied to all letter strings. In other words, in Hebrew, all letter combinations are orthographically legal, and in principle pronounceable. Indeed, while many acronyms in English cannot be pronounced as a word, and are therefore read letter-by-letter (e.g., BBC, FBI), many acronyms in Hebrew are pronounced like regular words. That is, just like letters in words, letters in these acronyms represent phonemes (or syllables). Because their pronunciation can be generated via letter-to-sound translation, we refer to this group of acronyms as 'phonological' acronyms. Nevertheless, although Hebrew acronyms are always in principle pronounceable, not all of them are pronounced as regular words: some are pronounced as a sequence of letter names ('letter-by-letter' acronyms), however, most Hebrew acronyms that are not pronounced as regular words are pronounced according to their full multiword name. That is, each letter (or bigram) is pronounced as the word it stands for. We refer to this group of acronyms as 'lexical' acronyms.

To investigate the role phonology plays in visual word recognition, and more specifically to investigate whether phonology plays a role in the recognition of familiar letter strings, the present study compared the recognition process of 'phonological' (letters to sounds) and 'lexical' (letter to words) acronyms, which differ only in terms of their

pronunciation: 'phonological' acronyms are conventionally pronounced as single words via letter-to-sound translation (e.g., VOT pronounced as 'vot'), while 'lexical' acronyms are conventionally pronounced via their constituent words (e.g., VOT pronounced as 'Voice Onset Time'). To directly test recognition processes, a visual lexical decision task was utilised in which participants were asked to decide whether a letter string presented as an acronym (Hebrew acronyms consist of two apostrophes located between the two last letters of the string) is a real acronym in Hebrew, or not. The experimental stimuli were highly familiar 'phonological' and 'lexical' acronyms that were balanced in terms of their familiarity, frequency and length. Thus, any difference in their recognition process can only be attributed to their phonological status.

Specifically, given that the acronyms in both conditions are highly familiar, it is assumed that both types can be recognised orthographically via the direct lexical-orthographic pathway. However, only the 'phonological' acronyms can also be recognised phonologically via the indirect sub-lexical letter-to-sound translation. If familiar letter-strings (words or acronyms) are mainly recognised orthographically via the direct-lexical pathway, as predicted by the DRC model, then no difference is expected between these two types of acronyms. However, if phonological recoding contributes to visual word recognition, as predicted by interactive connectionist models such as the BIAM, then 'phonological' acronyms that can be accessed both orthographically and phonologically (i.e., via both pathways) should be recognised faster than 'lexical' acronyms that can only be accessed orthographically via the direct lexical pathway (i.e., their pronunciation is available only after the acronym has been lexically accessed).

Method

Participants

The participants were 29 students from Tel-Aviv University (mean age = 25.38, *SD* = 3.36, 11 males). All native speakers of Hebrew, who spoke Hebrew exclusively until age 6, free of cognitive disabilities and with normal or corrected to normal vision.

Materials

Experimental stimuli consisted of 40 Hebrew acronyms – 20 'phonological' and 20 'lexical'. Like regular words, acronyms in the 'phonological' condition are read as single words. That is each letter corresponds to a phoneme (or a CV syllable, as vowels are often deleted in Hebrew). For example, the Hebrew acronymש"ד (d"ʃ) is pronounced /da.esh;/. Alternatively, acronyms in the 'lexical' condition are read via their constituent words. That is, each letter (or bigram) corresponds to an entire word. For example, the Hebrew acronym א"ת)t"ʔ) is pronounced /tel/ /aviv/ (Table 1).

Stimuli were selected following a battery of pre-tests: First, to ensure that each acronym is indeed read according to its type classification (either 'phonologically' as a single word, or 'lexically' as a cluster of words), 24 students that did not participate in the main experiment were asked to read aloud a list of acronyms. Only acronyms that received at least 83.3% naming agreement were included in the experiment. Importantly, the two conditions did not differ in terms of 'accurate' naming percentage (Phonological: M = 0.96, SE = 0.01; Lexical: M = 0.95, SE = 0.01; $t(38) = 0.602$, $p = .551$). Next, to ensure that the two

Table 1. Examples for stimuli in the two experimental conditions.

Type of acronyms	Acronym print		Constituent words print		Meaning	Conventional pronunciation
	Hebrew	IPA	Hebrew	IPA	English	IPA
Phonological	ד"ש	d"ʃ	דרישת שלום	driʃt ʃlom	best regards	daʃ
Lexical	ת"א	t"ʔ	תל אביב	tl ʔviv	Tel-Aviv	tel ʔaviv

experimental conditions were balanced in terms of familiarity and subjective frequency, 11 additional students were asked to complete two tasks: (a) to determine whether or not each acronym is familiar to them, and then to name the words it stands for, and (b) to rate each acronym on a 5-point frequency scale ranging from 1 (never encountered) to 5 (highly frequent). Acronyms were selected if they were recognised correctly in terms of their constituent words by all of the judges (i.e., in both conditions acronyms were correctly recognised by 100% of the judges); and if they received an average frequency score of above 3. Importantly, the average rates on the frequency scale did not vary across conditions (Phonological: M = 4.13, SE = 0.13; Lexical: M = 4.25, SE = 0.13; $t(38) = 0.663$, $p = .511$).

In addition, 'phonological' and 'lexical' acronyms were balanced in terms of objective printed frequency, bigram frequency and length: First, printed frequency estimates were obtained by running the Google search engine. Specifically, the log transformation of the number of hits returned for each acronym was used as an index of printed frequency (for a similar procedure, see Playfoot & Izura, 2015). There was no significant difference in printed frequency between 'phonological' and 'lexical' acronyms (Phonological: M = 5.559, SE = .101; Lexical: M = 5.779, SE = .202; $t(38) = -0.972$, $p = .339$). Next, bigram frequencies were calculated based on a corpus of 12 million words (a collection of articles from the Hebrew newspaper Haaretz).[3] The two acronym types did not differ in bigram frequency (Phonological: M = .0012, SE = .0002; Lexical: M = .0018, SE = .0003; $t(38) = 1.463$, $p = .151$). Finally, there was no significant difference between the number of letters in the two conditions (Phonological: M = 3.2, SE = .138; Lexical: M = 2.9, SE = 0.191; $t(38) = 1.276$, $p = .210$).

Given that the 40 experimental acronyms always required a 'yes' response, 40 pseudo-acronyms were added as fillers. As mentioned earlier, Hebrew acronyms consist of two apostrophes located between the two last letters of the string. Thus, all stimuli (acronyms and pseudo-acronyms) were presented that way. In addition, all stimuli – acronyms and pseudo-acronyms – were in principle pronounceable (i.e., in Hebrew, all letter strings can be read as regular words). The 40 acronyms and the 40 pseudo-acronyms were matched in terms of length (Acronyms: M = 3.05, SE = .118; Pseudo-acronyms: M = 3.05, SE = .118; $t(78) = 0$, $p = 1$) and bigram frequency (Acronyms: M = .0015, SE = .00021; Pseudo-acronyms: M = .0012, SE = .00018; $t(78) = 1.084$, $p = .282$).

Apparatus

The experiment was constructed and run using E-prime software version 10.242, on an HP Compaq Elite 8300 Micro-tower desktop computer, screen resolution 1,280 × 1,024 pixels. Stimuli were presented centred on the screen, in black letters on a white background, in

Times New Roman Hebrew font, size 30, each letter extending approximately 0.5°–0.7° in height and 0.2°–0.4° in width. Response latencies (RTs) were collected using a PST Serial Response Box.

Design and procedure

Acronym type (phonological/lexical) was manipulated within-subject. Testing was conducted in a single session that lasted 15 min. Participants were tested individually in a sound-attenuated room, seated approximately 60 cm from the screen. Participants were asked to make a lexical decision (i.e., to decide whether each 'acronym' is a real acronym in Hebrew). The correct response for all experimental stimuli was 'Yes', and for the additional fillers 'No'. After participants read and understood the instructions, a practice session consisting of 10 letter-strings, half requiring a 'Yes' response and half a 'No' response, was conducted, during which a visual feedback for correct and incorrect responses was provided. The same list of 80 letter-strings (40 real acronyms and 40 pseudo-acronyms), divided into 4 blocks, was presented randomly to each participant. At the start of each trial, participants were presented with a central fixation marker for 500 ms. The offset of the marker was followed by a centrally presented letter string, which remained on the screen until participants responded, or until 2,000 ms. If a letter string expired without a response, a tone signified the move to the next trial. Tonal feedback was provided for incorrect decisions. RTs were measured from the onset of letter-string presentation, and accuracy in each trial was recorded.

Results

Phonological (letters to sounds) and lexical (letters to words) acronyms were compared in terms of both accuracy data (for 'yes' responses) and RT data (for correct 'Yes' responses) across subjects (t_1) and items (t_2). RT outliers above or below 2.5 standard deviations from the mean of each condition for each participant were excluded from the analyses (2.9%). As predicted, phonological acronyms were easier to recognise (Table 2). In terms of accuracy, the effect for type of acronym was significant in the subject analysis, $t_1(28) = 3.05$, $p = .005$, and marginally significant in the item analysis, $t_2(38) = 1.97$, $p = .056$, with 'phonological' acronyms (M = .98, SE = .01) being judged more accurately than 'lexical' acronyms (M = .93, SE = .01). In terms of RTs, the effect for type of acronym was significant in both analyses, $t_1(28) = 4.2$, $p < .001$; $t_2(38) = 2.15$, $p = .038$, indicating that 'phonological acronyms' (M = 686, SE = 20) were recognised significantly faster than 'lexical acronyms' (M = 731, SE = 23).

Table 2. Accuracy and mean RTs (SEs in parentheses) as a function of type of acronym.

Type of acronym	Mean RT	Accuracy
Phonological	686 (20)	.98 (.01)
Lexical	731 (23)	.93 (.01)

RTs, response latencies.

Discussion

Consistent with interactive connectionist models such as the BIAM (Grainger & Ferrand, 1994, 1996), we found that equally familiar letter strings – 'lexical' and 'phonological' acronyms – are recognised differently, as a function of their phonological status. In particular, acronyms that can be accessed phonologically, via letter-to-sound conversion, were recognised faster and more accurate than equally familiar acronyms, which can only be recognised via the direct lexical route. These results suggest that sub-lexical phonological information is indeed automatically and rapidly activated. Moreover, when the pronunciation of the acronym can be computed via the sub-lexical phonological pathway, as in the case of 'phonological' acronyms, recognition is facilitated. Our results are therefore consistent with the prominent role of phonology in visual word recognition, even in the case of familiar letter strings, such as the acronyms used in the present study (e.g., Frost, 1998).

These findings are consistent with previous studies in English indicating that acronyms automatically activate their corresponding phonological representations (e.g., Playfoot & Izura, 2015; Slattery et al., 2006; Slattery et al., 2011). In particular, our findings replicate and extend those reported by Playfoot and Izura (2015), who also showed that the recognition of a printed acronym is influenced by the way its orthographic representation is mapped onto its phonological representation. Specifically, they observed that 'phonological' acronyms (NASA) were recognised faster than 'letter-by-letter' acronyms, irrespective of whether the 'letter-by-letter' acronym was orthographically legal (HIV) or not (BBC). Thus, English acronyms, like Hebrew acronyms, are easier to recognise when their pronunciation can be computed via the normal sub-lexical phonological pathway. However, while in English, most acronyms are formed by a sequence of illegal letter strings, and may therefore require processes that are qualitatively different from those involved in the recognition of regular words, in Hebrew, all acronyms are in principle pronounceable (i.e., all acronyms can be treated as regular words).

In particular, Hebrew offers an opportunity to compare two types of orthographically legal acronyms: 'phonological' (letters to sounds) acronyms that are read as regular words (ד"ש (d"ʃ) = /daʃ/), and 'lexical' (letters to words) acronyms that are read according to their full multiword name ((ת"אt"ʔ) = Tel Aviv). Importantly, phonological recoding (letter-to-sound translation) is possible in both cases, however, in the case of 'phonological' acronyms, this process may contribute to the recognition process (ד"ש (d"ʃ) = /daʃ/), whereas, in the case of 'lexical acronyms' this process does not yield the correct pronunciation ((ת"אt"ʔ) ≠ taʔ/). Comparing these two types of acronyms enabled us to directly examine the contribution of the indirect phonological pathway to the recognition process: If familiar letter strings are accessed mainly orthographically, as assumed by dual route models (e.g., Coltheart et al., 2001), then no difference is expected between these two types of acronyms. However, if the two pathways interact, as assumed by interactive-connectionist models (e.g., Grainger & Ferrand, 1994; Seidenberg & McClelland, 1989), then 'phonological' acronyms should be easier to recognise. Indeed, consistent with the interactive-connectionist assumption, responses were faster and more accurate in the 'phonological' than in the 'lexical' condition, indicating that the recognition of these acronyms was shaped by information concerning their pronunciation.

Moreover, given that the acronyms we used were orthographically legal, these results highlight the role phonology plays not only in the recognition of acronyms, but also in the recognition of regular words. Such results replicate and extend previous studies in Hebrew that investigated the role phonology plays in the extraction of meaning from print by

comparing the disambiguation process of two types of Hebrew homographs: homophonic homographs in which both meanings have the same sounds, and heterophonic homographs in which the two meanings have different sounds (e.g., Bitan, Kaftori, Meiri-Leib, Eviatar, & Peleg, 2017; Peleg & Eviatar, 2009, 2012; Peleg, Markus, & Eviatar, 2012). These studies have repeatedly shown that heterophonic homographs (which are phonologically ambiguous) are processed differently than homophonic homographs (which are phonologically unambiguous). The novelty of the current study is showing this prominent role of phonology even in a task that emphasises recognition rather than comprehension processes.

While the results of the current study clearly demonstrate phonological effects in visual word recognition, as reflected by the lexical decision task, one may still argue that the locus of the effect is at the lexical rather than at the sub-lexical level. As mentioned earlier, comparing 'phonological' acronyms that can be accessed via both the sub-lexical indirect pathway and the lexical direct pathway with 'lexical' acronyms that can only be accessed via the direct-lexical pathway enabled us to directly examine whether sub-lexical links between orthography and phonology influence the recognition of familiar letter-strings – links that contribute in the case of 'phonological' acronyms, but interfere in the case of 'lexical' acronyms. However, these two types of acronyms also differ in terms of their orthographic–phonological links at the lexical level. Specifically, while 'phonological' acronyms are associated with a single phonological-lexical form, 'lexical' acronyms are associated with multiple phonological-lexical forms (and are therefore always phonologically longer). Thus, the phonological effects obtained in the present study may reflect orthographic–phonological interactions at the sub-lexical level, the lexical level or (most probably) at both levels.

Importantly, however, irrespective of the specific level(s) of phonological activation, our results are consistent with the idea that the recognition of a familiar letter string is modulated by the way its orthographic representation is mapped onto its phonological representation. In particular, interactive connectionist models, such as the BIAM, permit orthographic–phonological interactions at both the sub-lexical and the lexical level, as both orthographic and phonological sources of information are continuously taken into account until the recognition process is completed. Thus, even if the locus of the effect is mainly at the lexical level, still we show that familiar letter strings automatically activate not only their lexical orthographic representations, but also their lexical-phonological representations, and these phonological representations, once activated, influence the recognition process. Such results indicate that phonology may play a much more important role in visual word recognition than dual route models (e.g., Coltheart et al., 2001) have assumed.

To conclude, the results of the present study provide compelling evidence for phonological effects in visual word recognition. Importantly, these phonological effects were obtained under conditions that do not provide any processing advantage to phonology (i.e., in the context of a lexical decision task that does not require phonological codes), and with highly familiar letter strings that can be recognised orthographically. Future research is needed in order to shed light on the specific locus and time course of these phonological processes.

Notes

1. Originally, the term acronym was limited to pronounceable abbreviations (e.g., NATO), whereas illegal letter sequences (e.g., BBC) were called initialisms. Gradually, however, the term came to be used to describe any abbreviation that is formed from initial letters (Brysbaert et al., 2009).

2. In general, it has been shown that English readers have a tendency to process acronyms as a sequence of letter names. For example, in an eye movement study, Slattey et al. (2011) had participants read sentences that contained either legal acronyms that exhibit the regular letter to sound correspondence (NASA), or illegal acronyms that are pronounced letter-by-letter (NCAA). Results indicated that readers were able to use the distinct capitalisation as a cue to alter their phonological processing. Specifically, when the acronyms were presented in all-capital sentences, and were therefore orthographically indistinguishable, readers decoded them as words and used the legality of the upcoming letter string to guide orthography-to-phonology mappings. Importantly, however, when the same acronyms were presented in normal lowercase sentences, and were therefore visually distinct, readers were biased to process them as a sequence of letter names. This suggests that, in languages where most of the acronyms are orthographically illegal, the processing of printed acronyms may involve prelexical phonological processes that are different from those involved in reading regular words.
3. We greatly thank Ella Rabinovich and Shuly Wintner for providing the bigram frequency counts.

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Received 7 June 2017; revised version received 25 January 2018.

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