Form priming by discontinuous consonant letter strings in visual masked priming

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Introduction

- **Subset priming** (Duñabeitia and Carreiras, 2011; Grainger, Granier, Farioli, Van Assche, and van Heuven, 2006; Peressotti and Grainger, 1999)
- Duñabeitia and Carreiras (2011) observed a **consonant advantage** in subset priming:
  - Consonant-only substrings result in priming.
  - Vowel-only substrings do not.

		Prime	Target
Consonants	✓	*csn*	*casino*
Vowels	X	*aia*	*animal*

- **The consonant advantage is NOT due to:**
  - Letter frequency.
  - The tendency for more repetition of graphemes in the vowel-only primes.
  - Phonological processing -- effect persists at short (30 ms) prime duration.

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Introduction

- **The Lexical Constraint Hypothesis** (Duñabeitia and Carreiras, 2011):
  - Most languages have more consonants than vowels -->
  - There are fewer possible combinations of vowels -->
  - More words share vowel substrings than consonant substrings -->
  - Consonant information constrains lexical competitors more than does vowel information, allowing a subset priming effect by consonants but not vowels.

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Introduction

- In Semitic languages (e.g. Maltese, Hebrew), consonantal letter strings likewise facilitate word recognition (Frost, Forster, and Deutsch, 1997; Geary and Ussishkin, 2018), though only when such strings comprise a morpheme.
- Native Semitic word stems consist of two discontinuous morphemes:
  - a (tri)consonantal **root** (e.g. *ktb* 'WRITING');
  - a vocalic and consonantal **word pattern**.

ktb

kiteb	*kittieb*	*kitba*	*ktieb*
'to write'	'writer'	'writing'	'book'

Maltese words containing the root *ktb* 'WRITING'

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Introduction

- Maltese possesses a lexicon comprised roughly half of words borrowed from Sicilian, Italian, and English (Bovingdon and Dalli, 2006; Comrie and Spagnol, 2016), which do not consist of **roots** and **word patterns**.
- Using visual masked priming, Geary and Ussishkin (2018) found that triconsonantal letter strings facilitate the recognition of native Maltese words, for which such strings comprise the word's **root morpheme**, but not non-native words, for which such strings are **non-morphemic**.

Prime-Target Pairs (Geary and Ussishkin, 2018)

	Prime	Target	
✓ **Native**	*frx*	*FIREX*	'to spread'
✗ **Non-Native**	*pnġ*	*PINĠA*	'to paint'

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Introduction

- These results suggest that the role of consonant letter substrings in word processing may depend on **language-specific morphological patterns** in addition to combinatorial properties.
- We test whether consonant letter substrings will elicit a greater subset priming effect for **irregular verbs** in English compared to **regular verbs**, because for irregular verbs consonant letter substrings are the typical source of stability across **inflectional paradigms**.
  - Finding such a difference would be analogous to finding subset priming for native Maltese words but not non-native Maltese words (except that in the Maltese case such strings comprise part of the derivational morphology).

Participants and Materials

- Data from 48 native monolingual English speakers (M_{age} = 21.5 years; 12 participants identified as Male) was analyzed.
- Participants judged the lexicality of 120 visual targets, including:
- 60 real English verbs, half regular (e.g. *burn*) and half irregular (e.g. *grow*).
  - Targets were 3-6 letters long and contained 2-4 consonant graphemes.
- 60 non-words: For each real word, a non-word counterpart was built by replacing some of its consonant graphemes.
  - e.g. *burn* + *blf* > *bulf*; *grow* + *clw* > *clow*
  - Real and non-words were matched for orthographic neighborhood density.

Materials

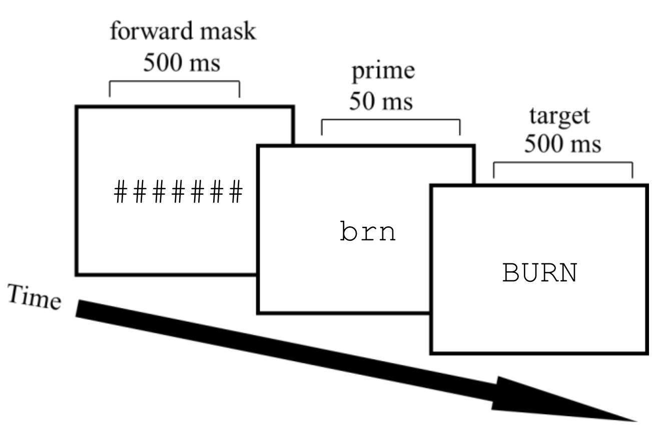
- Each **real-word** target was matched with three primes:

	Regular Verb		**Irregular Verb**	
Identity	*burn*	*BURN*	*grow*	*GROW*
Related	*brn*	*BURN*	*grw*	*GROW*
Unrelated	*tly*	*BURN*	*ctd*	*GROW*

- **Unrelated** primes consisted of a consonantal letter string matched with the **related** primes in number of letters but containing no overlapping letters.
- Each **non-word** target was matched with a **related** prime (e.g. *blf* ~ *BULF*).

Procedures

- The experiment was conducted in DMDX (Forster and Forster, 2003) using the **visual masked priming paradigm** (Forster and Davis, 1984).



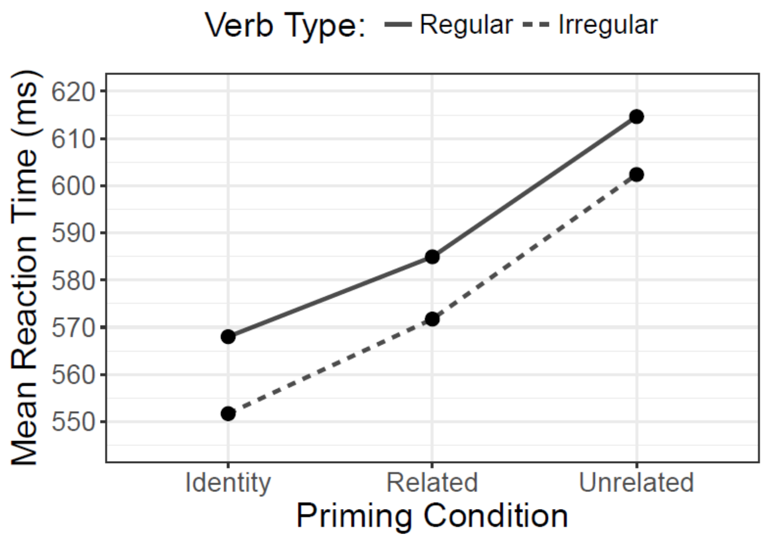
Analysis

- RTs to real-words were analyzed using a REML-fitted linear mixed effects regression (lmer) analysis in R using the lme4 package (Bates et al. 2015).
  - m <- lmer(-1/RT ~ **prime * regularity** + frequency + neighbors + (1|subject) + (1|target))
  - **prime**, 3 levels: Identity, Related, Unrelated.
  - **regularity**, 2 levels: Regular, Irregular.
  - **frequency**: SUBTLEX-US $\log_{10}$ contextual diversity (Brysbaert and New, 2009).
  - **neighbors**: Number of neighbors at edit distance 1 (Keuleers and Brysbaert, 2010).
- Satterthwaite approximations for degrees of freedom were simulated using the lmerTest package (Kuznetsova et al., 2016) in order to compute *p*-values.

Predictions

1. Following previous studies that have used the subset priming paradigm (Duñabeitia and Carreiras, 2011; Grainger, Granier, Farioli, Van Assche, and van Heuven, 2006; Peressotti and Grainger, 1999), we anticipate faster RTs in both the **identity** and **related** conditions than in the **unrelated** condition.
2. If the subset priming effect is influenced by patterns of consonant stability across morphologically related forms, we anticipate a larger effect in the **related** condition for **irregular verbs than for regular verbs**.

Results



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Results

- Significant effect of **priming** at the **Identity** ($t(3503) = -7.4$, $p < 0.001$) and **Related** ($t(3504) = -4.0$, $p < 0.001$) levels.
  - Participants were faster to judge target lexicality when primed by an **identity** (*M* = 560ms; net priming = 48ms) or **related prime** (*M* = 578ms; net priming = 30ms) than by an unrelated prime (*M* = 608ms).
- Non-significant effects of **regularity** ($t(113) = -0.5$, *n.s.*) and of the **priming by regularity interaction** at both the **Identity** ($t(3503) = -1.2$, *n.s.*) and **Related** levels ($t(3503) = -0.7$, *n.s.*).
  - No difference between regular (*M* = 589ms) vs. irregular verbs (*M* = 575ms).
  - No difference between priming effects for regular vs. irregular verbs.

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Predictions (revisited)

✓ 1. Following previous studies that have used the subset priming paradigm (Duñabeitia and Carreiras, 2011; Grainger, Granier, Farioli, Van Assche, and van Heuven, 2006; Peressotti and Grainger, 1999), we anticipate faster RTs in both the **identity** and **related** conditions than in the **unrelated** condition.

X 2. If the subset priming effect is influenced by patterns of consonant stability across morphologically related forms, we anticipate a larger effect in the **related** condition for **irregular verbs than for regular verbs**.

Summary

- Using visual masked priming with lexical decision, we obtained facilitation for English verbs when primed by letter strings containing the consonants of the target (e.g. *brn* priming *BURN*), replicating the subset priming effect.
- We hypothesized that the size of this priming effect might be influenced by the stability of consonant letters across inflectional forms.
  - For irregular verbs, for which only consonants are consistent across paradigms, we might expect that consonant letters better constrain lexical competitors and so find a greater priming effect for irregular verbs than for regular verbs.
- We compared this priming effect for regular verbs (e.g. *brn* priming *BURN*) vs. irregular verbs (e.g. *grw* priming *GROW*), but failed to find a difference.