Morphology in Language Processing

DAY 4: LEXICAL ACCESS IN MALTESE
Background: Malta and Maltese
And a really recent image...

https://lovinmalta.com/lifestyle/technology/malta-used-for-first-test-shot-by-new-international-space-satellite
What does the language look like?

Earliest written Maltese

• The earliest known written Maltese comes from a literary text (a poem) attributed to Pietru Caxaro known as *Il-Kantilena*, probably from the 1470s.

**Original orthography:**
Xideu il cada ye girenī tale nichadithicum
Mensab fil gueri ule nisab fo homorcom
Calb mehandihe chakim soltan u le mule
Bir imgamic rimitne betiragin mucsule
Fen hayran al garca nenzel fi tirag minzeli
Nitla vu nargia ninzil deyem fil bachar il hali.

**Modern orthography:**
Xidew il-qada, ja ġirien, talli nhadditkom,
Ma nsab fil-weri u la nsab f’ghomorkom
Qalb m’għandha ħakem, sultan u la mula
Bir imghammiq ġirmietni, b’turgien muħsula,
Fejn ħajran għall-gharqa, ninżel f’taraq minżeli
Nitla’ u nerġa’ ninżel dejjem fil-baħar il-ġholi.

**English translation:**
Witness my predicament, my friends (neighbours), as I shall relate it to you:
[What] never has there been, neither in the past, nor in your lifetime,
A [similar] heart, ungoverned, without lord or king (sultan),
That threw me down a well, with broken stairs
Where, yearning to drown, I descend the steps of my downfall,
I climb back up and down again, always faced with high seas.

What does the language sound like?

So why did the authorities accuse the story of discriminating against woman?

Interview with Clare Azzopardi, Maltese writer
Background: Maltese

- Maltese is a Semitic language descended from Siculo-Arabic and is one of two official languages of Malta (the other is English); Maltese became an official language in 1934.
- Maltese is spoken by roughly 400,000 people in Malta.
- Maltese is unique among Semitic languages in a number of ways.
Background: Maltese

• The overwhelming majority of Maltese speakers are bilingual (Maltese and Maltese English). In the 2005 census, over 90% of respondents over age 10 reported Maltese as the language they speak most often in their home.

• Maltese has had virtually no contact with other Semitic languages for almost 1000 years.

• Due to language contact, the vocabulary of Maltese is roughly evenly split between Semitic and Indo-European (primarily Italian and English; e.g., Aquilina 1987/1990, Mifsud 1995).

• Maltese orthography uses the Latin alphabet; it is the only Semitic language to do so (this will become more relevant later on...).
## Semitic Maltese

Root: /l s n/ (data from Fabri 2010)

<table>
<thead>
<tr>
<th>Form</th>
<th>Structure</th>
<th>Meaning</th>
<th>Binyan</th>
</tr>
</thead>
<tbody>
<tr>
<td>lisen</td>
<td>CVCVC</td>
<td>‘talk’</td>
<td>1</td>
</tr>
<tr>
<td>lissen</td>
<td>CVCCVC</td>
<td>‘utter/say’</td>
<td>2</td>
</tr>
<tr>
<td>tlissen</td>
<td>t-CVCCVC</td>
<td>‘be uttered’</td>
<td>5</td>
</tr>
<tr>
<td>(i)lsien</td>
<td>CCVVC</td>
<td>‘tongue/language’</td>
<td></td>
</tr>
<tr>
<td>(i)lsn-a</td>
<td>CCC-a</td>
<td>‘tongues/languages’</td>
<td></td>
</tr>
<tr>
<td>tlissin-a</td>
<td>t-CVCCV-a</td>
<td>‘utterance’</td>
<td></td>
</tr>
<tr>
<td>tlissin</td>
<td>t-CVCCVC</td>
<td>‘uttering’</td>
<td></td>
</tr>
<tr>
<td>lissien</td>
<td>CVCCVVC</td>
<td>‘utterer’</td>
<td></td>
</tr>
<tr>
<td>milsen</td>
<td>m-VCCVC</td>
<td>‘dictionary’</td>
<td></td>
</tr>
</tbody>
</table>
## Indo-European Maltese

Stem: /lingw-/ (data from Fabri 2010)

<table>
<thead>
<tr>
<th>Form</th>
<th>Gender</th>
<th>Case</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>lingw-a</td>
<td>f.sg.</td>
<td></td>
<td>‘language’</td>
</tr>
<tr>
<td>lingw-i</td>
<td>pl.</td>
<td></td>
<td>‘languages’</td>
</tr>
<tr>
<td>lingw-a-ġġ</td>
<td>f.sg.-nom.</td>
<td></td>
<td>‘parlance/diction’</td>
</tr>
<tr>
<td>lingw-ist-a</td>
<td>nom.-f.sg.</td>
<td></td>
<td>‘linguist’</td>
</tr>
<tr>
<td>lingw-ist-i</td>
<td>nom.-pl.</td>
<td></td>
<td>‘linguists’</td>
</tr>
<tr>
<td>lingw-ist-ik-a</td>
<td>nom.-adj.-f.sg.</td>
<td></td>
<td>‘linguistics’</td>
</tr>
<tr>
<td>lingw-ist-ik-u</td>
<td>nom.-adj.-m.sg.</td>
<td></td>
<td>‘linguistic’</td>
</tr>
<tr>
<td>lingw-ist-iċ-i</td>
<td>nom.-adj.-pl.</td>
<td></td>
<td>‘linguistic (pl)’</td>
</tr>
<tr>
<td>bi-lingw-i</td>
<td>adj.-tongue-adj.</td>
<td></td>
<td>‘bilingual’</td>
</tr>
<tr>
<td>mono-lingw-i</td>
<td>adj.-tongue-adj.</td>
<td></td>
<td>‘monolingual’</td>
</tr>
</tbody>
</table>
Are Maltese roots and patterns productive? YES

• Hoberman and Aronoff (2003) questioned the productivity of Semitic morphology in Maltese, but Twist (2006) counters with convincing data showing a role for the root in production in a nonce-verb elicitation task:
  • Nonce nouns resembling Indo-European resulted in Indo-European (concatenative) morphology.
  • Nonce nouns resembling Semitic resulted in Semitic (nonconcatenative) morphology.
• See Drake (to appear, *Morphology*) for a parallel conclusion regarding Semitic diminutives in Maltese. Drake will also be presenting a poster at Roots further investigating this from a learning perspective.
• See my talk at Roots for more evidence that Hoberman and Aronoff (2003) got it wrong.
Twist (2006): Maltese visual masked priming

• **Alina Twist’s (2006) dissertation** included the first masked visual priming experiment ever conducted on Maltese.

• In Twist’s (2006) study, 64 participants responded to stimuli that each consisted of a masked visual prime followed by a target.

• Prime-target pairs fell into four different conditions:
  • Identity: both the prime and target are identical items.
  • Root: both the prime and the target share the same consonantal root.
  • Pattern/binyan: both the prime and the target share the verbal binyan.
  • Unrelated: the prime and the target share neither their root nor their verbal form.
Twist (2006): Maltese visual masked priming

• Targets consisted of Maltese verbs in Binyans 1 and 2, arranged among four priming conditions:
  • identical to the target: *kiser* ‘to break’ – *Kiser* ‘to break’
  • morphologically root-related to the target: *kisser* ‘to smash’ – *Kiser* ‘to break’
  • morphologically pattern-related to the target: *dilek* ‘to lick’ – *Kiser* ‘to break’
  • completely unrelated to the target: *ftakar* ‘to remember’ – *Kiser* ‘to break’
Twist (2006): Results

- A significant effect of identity priming (by-subjects only).
- A significant effect of root priming.
- No significant effect for word pattern priming.
  - *Translation*: when the prime and target belong to the same word pattern, lexical access is not facilitated.
Twist (2006): Results

• And finally, Twist also found that Maltese verbs in Binyan 1 had significantly faster RT’s than verbs in Binyan 2 (by-subjects only)

• This effect is interesting and was not anticipated, but could reflect facts about the relative frequencies of Binyan 1 vs. Binyan 2 verbs.
Twist (2006): Results

• Based on the root priming effects, Twist (2006) concludes that the consonantal root is lexically represented in Maltese.

• What about verbal forms?
  • The lack of a priming effect for the word pattern seems to indicate that it does not have lexical status, but...
  • The fact that Binyan 1 was faster than Binyan 2 might be indicative of whole-form storage; this could follow from the fact that verbs in Binyan 1 occur more frequently than verbs in Binyan 2.
  • Some of these questions were investigated by Galea (2011) in his MA thesis at the University of Essex.
Galea (2011)

• Due to historical sound changes, verbs in a given Maltese binyan do not necessarily share the same vowel pattern. For instance, Binyan 1 verbs appear with the following vowel melodies: $a-a$, $a-e$, $e-a$, $e-e$, and $i-e$, and $o-o$.

• Twist (2006) did not control for this, resulting in prime-target pairs in the binyan-related condition such as:

<table>
<thead>
<tr>
<th>prime</th>
<th>target</th>
</tr>
</thead>
<tbody>
<tr>
<td>talab</td>
<td>KISER</td>
</tr>
<tr>
<td>(Binyan 1)</td>
<td>(Binyan 1)</td>
</tr>
</tbody>
</table>

• This might explain the lack of priming effects for binyan-related pairs in Twist (2006).
Galea (2011)

- Galea tested whether this might account for the lack of priming effects for binyan-related pairs in Twist (2006), and ran a masked visual priming experiment in which this potential confound was teased apart.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Condition 1</strong></td>
<td>Prime and target share the vocalic melody, but not the CV-structure.</td>
</tr>
<tr>
<td>[+vowel]</td>
<td>teraq – MERRAQ</td>
</tr>
<tr>
<td></td>
<td>CeCaC-CeCCaC</td>
</tr>
<tr>
<td></td>
<td>to divide – to liquify</td>
</tr>
<tr>
<td><strong>Condition 2</strong></td>
<td>Prime and target have a common CV-structure, but different vocalic melodies.</td>
</tr>
<tr>
<td>[+CV-structure]</td>
<td>nasab – GIREF</td>
</tr>
<tr>
<td></td>
<td>CaCaC-CiCeC</td>
</tr>
<tr>
<td></td>
<td>to entrap – to scratch</td>
</tr>
<tr>
<td><strong>Condition 3</strong></td>
<td>Prime and targets shared the same word-pattern. The vocalic melody and CV-structure were in the same in both prime and target.</td>
</tr>
<tr>
<td>[word pattern]</td>
<td>gerrex – XEKKEL</td>
</tr>
<tr>
<td></td>
<td>CeCCeC-CeCCeC</td>
</tr>
<tr>
<td></td>
<td>to scare away – to impede</td>
</tr>
</tbody>
</table>
Galea (2011)

• All three test conditions yield significant priming effects in the by-subjects analysis, but in by-items analysis only the CV-structure and word pattern conditions yield significant priming.

• Galea’s interpretation: morphology. That is, facilitation for CV-structure and word patterns is interpreted as a morphological effect.

• This mirrors results from Boudela and Marslen-Wilson’s work, showing the relative fragility of vowel pattern priming compared with the more robust nature of root priming in visual word recognition in Semitic.

• For an auditory replication...well, we’ll get there later today hopefully.
Review of Ussishkin et al. 2015

Review of Ussishkin et al. 2015

• Auditory lexical decision task: subjects listened to pre-recorded pairs of primes and targets, and decided whether the target is a word of Maltese.

• In these prime-target pairs, primes were either:
  • identical to the target (hypothesis: facilitatory)
  • morphologically related to the target (hypothesis: potentially facilitatory)
  • or completely unrelated to the target (hypothesis: no effect)

• Two kinds of priming: audible primes and masked primes.
Review of Ussishkin et al. 2015

- Exp 1: audible priming with roots
- Exp 2: auditory masked priming with roots
- Exp 3: audible priming with word patterns
- Exp 4: auditory masked priming with word patterns
Procedure: Experiments 1 and 2

• Exp 1: 68 subjects; Exp 2: 66 subjects
• No subject participated in more than one experiment.
• Experiments were conducted at the University of Malta Institute of Linguistics, using desktop computers and E-Prime v. 1.x software to present stimuli and record responses.
• Subjects wore headphones to hear stimuli and performed a lexical decision on the target in each prime-target stimulus pair by pressing a button marked IVA (yes) or LE (no) on a serial response box.
• Subjects were instructed to respond as quickly and as accurately as possible to each target, with a time-out of 1500 ms.
• Dependent measures: Reaction time (RT) from target onset in ms, and accuracy
Materials

• Primes and targets were evenly divided and matched between:
  • Real words and nonwords.
  • Each of four binyans (1, 2, 5, 7: those identified by Francom et al. 2010 as the most populated binyans of Maltese).
  • The three priming conditions (counterbalanced, Latin square, repeated measures design).
  • 12 real word-real word prime-target pairs per condition per subject.

• All real words were taken from Aquilina (1987/1990), were rated at least 50% familiar in a Maltese subjective familiarity study (Francom et al. 2010), and were vetted three times by a native speaker of Maltese.
Materials

• Nonwords were created from nonce roots in licit binyans, vetted three times by a native speaker to prevent false positives based on dialectal forms; nonword-nonword prime-target pairs also in three priming conditions.

• Fillers also included real word-nonword and nonword-real word prime-target pairs.

• Prime-target pairs were matched using a Perl script.
  • Automates prime-target pairing
  • Allows for specifications; e.g., in unrelated pairs, prime and target share no consonants in the same position
Materials

• All items were recorded by a male native speaker of Maltese.
• Recordings were made in a sound-attenuated booth (Whisper Room) at the Douglass Phonetics Lab at the University of Arizona:
  • Omnidirectional head-mounted Isomax microphone (Countryman Associates)
  • Symetrix Audio 302 pre-amplifier
  • Alesis Masterlink 9600.
• Each item was recorded three times; the best token was chosen by a trained research assistant, manually spliced and labeled using Praat, and extracted with a Praat script.
• Prime-target pairs were concatenated using a Praat script.
• In Experiment 1, primes and targets were separated by a 150 ms-ISI (Marslen-Wilson and Zhou 1999).
Experiment 1: Audible priming with roots

Prime-target pairs in the related priming condition share a consonantal root. Examples:

<table>
<thead>
<tr>
<th>Prime</th>
<th>Identity</th>
<th>Related</th>
<th>Unrelated</th>
</tr>
</thead>
<tbody>
<tr>
<td>nqafel</td>
<td>qafel</td>
<td>fileğ</td>
<td></td>
</tr>
<tr>
<td>‘to be closed’</td>
<td>‘to close’</td>
<td>‘to paralyze’</td>
<td></td>
</tr>
<tr>
<td>Target</td>
<td>nqafel</td>
<td>nqafel</td>
<td>nqafel</td>
</tr>
<tr>
<td>‘to be closed’</td>
<td>‘to be closed’</td>
<td>‘to be closed’</td>
<td></td>
</tr>
</tbody>
</table>
Experiment 1: Audible priming with roots

Results (RT; real word prime-real word target)

*Priming condition Mean RT from target onset in ms*

<table>
<thead>
<tr>
<th>Prime Type</th>
<th>Mean RT (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity</td>
<td>892</td>
</tr>
<tr>
<td>Root-related</td>
<td>915</td>
</tr>
<tr>
<td>Unrelated</td>
<td>1047</td>
</tr>
</tbody>
</table>

* indicates significant difference.
### Experiment 1: Audible priming with roots

**Results (RT; nonword prime-nonword target)**

<table>
<thead>
<tr>
<th>Priming condition</th>
<th>Mean RT from target onset in ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity</td>
<td>935</td>
</tr>
<tr>
<td>Root-related</td>
<td>1118</td>
</tr>
<tr>
<td>Unrelated</td>
<td>1112</td>
</tr>
</tbody>
</table>

![Bar chart showing priming condition results](image)
Experiment 2

• Experiment 2 is identical to Experiment 1 except for the method of prime presentation.
• Experiment 2 uses the subliminal speech priming technique (Kouider and Dupoux 2005), also known as auditory masked priming.
Experiment 2: Masked priming with roots

Prime-target pairs in the related priming condition share a consonantal root. Primes are compressed to 35%. Examples:

<table>
<thead>
<tr>
<th>Prime</th>
<th>Identity</th>
<th>Related</th>
<th>Unrelated</th>
</tr>
</thead>
<tbody>
<tr>
<td>nqafel</td>
<td>qafel</td>
<td>fileğ</td>
<td></td>
</tr>
<tr>
<td>‘to be closed’</td>
<td>‘to close’</td>
<td>‘to paralyze’</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target</th>
<th>nqafel</th>
<th>nqafel</th>
<th>nqafel</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘to be closed’</td>
<td>‘to be closed’</td>
<td>‘to be closed’</td>
<td></td>
</tr>
</tbody>
</table>
Experiment 2: Masked priming with roots

Results (RT; real word prime-real word target)

**Priming condition Mean RT from target onset in ms**

- Identity: 959
- Root-related: 955
- Unrelated: 996

![Bar chart showing mean RT for different priming conditions.](image)
### Experiment 2: Masked priming with roots

**Results (RT; nonword prime-nonword target)**

<table>
<thead>
<tr>
<th>Priming condition</th>
<th>Mean RT from target onset in ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity</td>
<td>1076</td>
</tr>
<tr>
<td>Root-related</td>
<td>1079</td>
</tr>
<tr>
<td>Unrelated</td>
<td>1078</td>
</tr>
</tbody>
</table>

![Graph showing priming effect](#)
Did our Maltese subjects hear the masked primes?

• No: Post-experiment debriefing indicates that subjects were not aware of the primes.
  • Consistent with Kouider and Dupoux (2005).
Did our Maltese subjects hear the masked primes?

• No. In nonword-nonword prime-target pairs, items in the identity condition show no priming, unlike in Experiment 1.
Experiment 3: Audible priming with patterns

• 68 native Maltese speaking participants, experiment conducted at the Institute of Linguistics at the University of Malta.

• Task: auditory priming with lexical decision.

• 36 real word targets (all verbs, 4 word patterns), plus nonword targets and fillers.

• Subjects were instructed to respond as quickly and as accurately as possible to each target, with a time-out of 1500 ms.

• Dependent measures: Reaction time (RT) from target onset, and accuracy.
Experiment 3: Audible priming with patterns

Prime-target pairs in the related condition share a word pattern. Examples:

<table>
<thead>
<tr>
<th>Prime</th>
<th>Identity</th>
<th>Related</th>
<th>Unrelated</th>
</tr>
</thead>
<tbody>
<tr>
<td>siket</td>
<td>kiber</td>
<td>xebbah</td>
<td></td>
</tr>
<tr>
<td>‘to be silent’</td>
<td>‘to grow’</td>
<td>‘to assimilate’</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target</th>
<th>Identity</th>
<th>Related</th>
<th>Unrelated</th>
</tr>
</thead>
<tbody>
<tr>
<td>siket</td>
<td>siket</td>
<td>siket</td>
<td></td>
</tr>
<tr>
<td>‘to be silent’</td>
<td>‘to be silent’</td>
<td>‘to be silent’</td>
<td></td>
</tr>
</tbody>
</table>
Experiment 3: Audible priming with patterns

Results (RT; real word prime-real word target)

<table>
<thead>
<tr>
<th>Priming condition</th>
<th>Mean RT from target onset in ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity</td>
<td>887</td>
</tr>
<tr>
<td>Binyan-related</td>
<td>1047</td>
</tr>
<tr>
<td>Unrelated</td>
<td>1052</td>
</tr>
</tbody>
</table>
Experiment 4: Masked priming with patterns

• 66 native Maltese speaking participants, experiment conducted at the Institute of Linguistics at the University of Malta.

• Task: auditory masked priming with lexical decision.

• 36 real word targets (all verbs, 4 word patterns), plus nonword targets and fillers.

• Subjects were instructed to respond as quickly and as accurately as possible to each target, with a time-out of 1500 ms.

• Dependent measures: Reaction time (RT) from target onset, and accuracy.
Experiment 4: Masked priming with patterns

Prime-target pairs in the related condition share a word pattern. Examples:

<table>
<thead>
<tr>
<th>Prime</th>
<th>Identity</th>
<th>Related</th>
<th>Unrelated</th>
</tr>
</thead>
<tbody>
<tr>
<td>siket</td>
<td>‘to be silent’</td>
<td>kiber ‘to grow’</td>
<td>xebbah ‘to assimilate’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target</th>
<th>siket</th>
<th>siket</th>
<th>siket</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘to be silent’</td>
<td>‘to be silent’</td>
<td>‘to be silent’</td>
<td></td>
</tr>
</tbody>
</table>
Experiment 4: Masked priming with patterns

* Priming condition  Mean RT from target onset in ms *

Identity          * 901
Pattern-related    931
Unrelated          950

![Bar chart showing mean RT for different priming conditions]
Discussion

• Roots facilitate lexical access. Patterns do not. (Mirrors results from Hebrew presented yesterday.)

• Lexical retrieval is mediated by the consonantal root.

• Models with a decompositional route for the root are supported.
Discussion

• Some caution is warranted here, as our design did not separate:
  • Semantics
  • Morphology
  • Phonology

• All three of these are wrapped up in the consonantal root, and more work needs to be done to determine if one of these bears primary responsibility for our priming results.

• More on this at Roots!
Discussion

• In most of these studies, care was taken to ensure that priming resulted truly from morphological factors, independent of semantics and phonology.
• In fact, Frost et al. 1997 (Experiment 5) tested Hebrew prime-target root-related pairs, half of which were semantically related (M+S+) and half of which were not (M+S-), and in both conditions found equivalent priming.
• Sample items, root = klt:

<table>
<thead>
<tr>
<th>Priming condition</th>
<th>Example (prime – target)</th>
<th>Mean RT</th>
</tr>
</thead>
<tbody>
<tr>
<td>M+S+</td>
<td>haklata ‘a recording’ – taklit ‘a record’</td>
<td>568 ms</td>
</tr>
<tr>
<td>M+S-</td>
<td>klita ‘absorption’ – taklit ‘a record’</td>
<td>572 ms</td>
</tr>
<tr>
<td>Control</td>
<td>takala ‘malfunction’ – taklit ‘a record’</td>
<td>583 ms</td>
</tr>
</tbody>
</table>

*
Discussion

• Experiments 1 and 2 revealed priming for prime-target pairs sharing a consonantal root.

• Alternative interpretation: this priming effect was due to semantics (since words sharing a root tend to be semantically related) or to phonology (since words sharing a root have significant phonological or form overlap) – see Frost et al. 1997, Experiment 5 discussed above.

• Experiments 1 and 2: when post-hoc tests for degree of phonological overlap were run, no differences were found, so the priming likely is not due to phonological overlap (see Ussishkin et al. 2015 for extended discussion).

• I’ll be talking on Saturday about further ways we address this issue.
Experiment 5: Maltese vowels and syllables

- In 2013, I needed a reason to go to Malta.
- Idea: Let’s replicate Galea (2011) in the auditory modality!
Experiment 5: Maltese vowels and syllables

• “Why are you obsessed with replicating previous visual studies in the auditory domain?”

• Don’t get me started...OK, too late...

1. There’s less work in the auditory domain, so replication is an important tool for making sure our understanding of spoken language catches up with the existing work on processing of written language.

2. As we’ve seen, visual and auditory processing are far from identical, so replicating a study in a different modality won’t necessarily produce a parallel pattern of results. In fact, in some cases, studying auditory processing can answer questions that visual processing can’t handle.
Experiment 5: Maltese vowels and syllables

• In this particular case, recall that Galea (2011) found that prime-target pairs sharing CV structure (naħar - NIBEX) or sharing the whole word pattern (libet - NIBEX) were faster than those in the control condition (aħdar - NIBEX).

• In visual processing, facilitation is typically found both in morphological priming and in form priming – therefore, teasing apart whether an effect is due to morphology or due to form is challenging.

• In auditory processing, however, morphological priming is typically facilitatory, but form priming can be inhibitory (Radeau, Morais, & Dewier 1989; Slowiaczek & Hamburger 1992) because of lateral competition among phonologically similar lexical items.
Experiment 5: Maltese vowels and syllables

• Therefore, in this case, an auditory replication might be able to tease apart whether Galea’s effects were due to morphology or to form.

• And there’s already an existing debate in the formal literature as to whether Maltese vowel patterns are morphological (Spagnol, 2011) or phonological (Fabri, 2009).
Experiment 5: Maltese vowels and syllables

- Experiments 3 and 4 showed no facilitation for pattern-related words; Experiment 5 is designed to examine whether vowels and syllable structure can facilitate lexical access.
- Experiment 5 is an auditory masked priming replication of Galea (2011).
- In Experiment 5, we used four priming conditions:
  - CV: prime-target pairs share syllable structure (4 structures: CVCVC, CVCCVC, tCVCCVC, nCVCVC)
  - V: prime-target pairs share vowels (6 vowel patterns: i e, a a, e a, o o, a e, e e)
  - W: prime target pairs share both syllable structure and vowels.
  - Unrelated: prime-target pairs share neither vowels nor syllable structure.
- Note: this experiment is currently in progress, so results are tentative.
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Experiment 5: Maltese vowels and syllables

• 83 native Maltese speaking participants, experiment conducted at the Institute of Linguistics at the University of Malta.

• Task: auditory masked priming with lexical decision.

• 44 real word targets, plus nonword targets and fillers.

• Subjects were instructed to respond as quickly and as accurately as possible to each target, with a time-out of 1500 ms.

• Dependent measures: Reaction time (RT) from target onset, and accuracy.

• Collaborators: Luke Galea, Jon Geary, Andy Wedel, Samantha Wray
Experiment 5: Maltese vowels and syllables

Sample stimuli:

<table>
<thead>
<tr>
<th>Prime</th>
<th>CV</th>
<th>V</th>
<th>W</th>
<th>Unrelated</th>
</tr>
</thead>
<tbody>
<tr>
<td>naħar</td>
<td>tfissed</td>
<td>libet</td>
<td>aħdar</td>
<td></td>
</tr>
<tr>
<td>‘to snore’</td>
<td>‘to cuddle’</td>
<td>‘to calm’</td>
<td>‘green’</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target</th>
<th>nibex</th>
<th>nibex</th>
<th>nibex</th>
<th>nibex</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘to tease’</td>
<td>‘to tease’</td>
<td>‘to tease’</td>
<td>‘to tease’</td>
<td></td>
</tr>
</tbody>
</table>
Experiment 5: Maltese vowels and syllables

<table>
<thead>
<tr>
<th>Priming condition</th>
<th>Mean RT from target onset in ms</th>
</tr>
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<tbody>
<tr>
<td>CV</td>
<td>1260</td>
</tr>
<tr>
<td>V</td>
<td>1272</td>
</tr>
<tr>
<td>W</td>
<td>1241</td>
</tr>
<tr>
<td>Unrelated</td>
<td>1233</td>
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*Samantha, Andy and me in our apartment in Floriana in March 2013: “Wait, wtf?”*
Experiment 5: Maltese vowels and syllables

• No facilitation anywhere = morphological effect unlikely here.

• Significant inhibition in the V condition interpreted as a phonological effect (e.g., Radeau, Morais, & Dewier 1989; Slowiaczek & Hamburger 1992), possibly due to cohort overlap or phonological similarity (Luce & Pisoni 1998).

• Consistent with formal analysis of Maltese word patterns by Fabri (2009): “…the function of the vowel melody in Maltese...is phonological, not morphological.”
For tomorrow

• If you would like to try your hand at creating auditory masked priming stimuli, you can have some hands-on experience during tomorrow’s class if you come prepared:

• Bring your laptop and headphones.

• Install *the latest version of Praat* ([http://www.fon.hum.uva.nl/praat/](http://www.fon.hum.uva.nl/praat/)) – older versions will not work and you will be frustrated.

• Be able to connect to the internet.