Number marking in Maltese nouns: effects of frequency and structure

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This talk

Nieder, Jessica, Holger Mitterer & Ruben van de Vijver. 2021. Priming Maltese Plurals: Representation of sound and broken plurals in the mental lexicon. To appear in *The Mental Lexicon* 16(1).

Introduction

- how are complex words stored and processed in the mental lexicon?
  - ...via different mechanisms for different types of words (e.g. regular vs. irregular, concatenative vs. non-concatenative...)?
  - ...via the same mechanism?

Dual-Mechanism Accounts

(e.g. Pinker, 1991, 1998; Pinker & Ullmann, 2002)

- two distinct mechanisms for processing complex word forms
- rule-based system: regular word forms
- whole word storage of irregular word forms

vs.

Single-Mechanism Accounts

(e.g. Daelemans, 2002; Rumelhart & McClelland, 1986; Skousen, 1992)

- irregular and regular complex word forms are processed within the same single mechanism

Maltese

Number marking in nouns

- 2 main strategies for noun pluralization:

  Sound Plural: concatenative

  annimal - *annimali* 'animal(s)'

  Broken Plural: non-concatenative

  ballun -*blalen* 'ball(s)'

Sound Plural Suffix	Example	Translation
-n	*baħri - baħrin*	'sailor'
-in	*Malti - Maltin*	'Maltese'
-jin	*ħati - ħatjin*	'guilty'
-iet	*rixa - rixiet*	'feather'
-at	*triq - triqat*	'street'
-ijiet	*omm - ommijiet*	'mother'
-s	*kuxin - kuxins*	'cushion'
-ejn/ajn	*spalla - spallejn*	'shoulder'
-ien	*sid - sidien*	'owner'
-an	*qiegħ - qiegħan*	'bottom'
-a	*giddieb - giddieba*	'liar'
-i	*karta - karti*	'paper'

Table 1: Maltese sound plural suffixes

Maltese

Number marking in nouns

Plural Type	Example	CV Pattern
Type A	*fardal - fradal* 'apron'	CC'VVCVC
Type B	*birra - birer* 'beer'	(C)C'VCVC
Type C	*bejt - bjut* 'roof'	CC'VVC
Type D	*btala - btajjel* 'holiday'	CCVjjVC
Type E	*sala - swali* 'hall'	CCVVCV
Type F	*seqer - isqra* 'falcon'	VCCCV
Type G	*ktieb - kotba* 'book'	CVCCV
Type H	*għodda - għodod* 'tool'	(għ)VCVC
Type I	*elf - eluf* 'thousand'	VCVC
Type J	*għaref - għorrief* 'wise man'	CVCCVVC(V)
Type K	*għama - għomja* 'blind person'	(għ)VCCV

Table 2: Schembri's (2012) patterns of distribution of broken plural forms

Maltese

Number marking in nouns

- great amount of variation
- some words have a sound AND a broken plural form:

bandiera (sg.) *bnadar* (broken pl.) vs. *bandieri* (sound pl.) 'flag'
tapit (sg.) *twapet* (broken pl.) vs. *tapiti* (sound pl.) 'carpet'

Number marking in nouns: The "problem"

Maltese speakers are faced with a dichotomy in their morphological system:

- sound plurals are built concatenatively by adding a suffix to the singular
- broken plurals are formed non-concatenatively by changing the prosody of the singular stem

Reaction Time Experiment

Research Question

How are broken and sound plural forms represented in the Mental Lexicon?

- one possibility to test this: reaction time study with priming task

Reaction Time Experiment

Reaction time studies

- RT is collected through simple tasks: lexical decision (simple yes/no questions: is *plimpa* a real word or not?)
- priming: experiments that involve the presentation of a related or unrelated prime (e.g. a word) before a target word
- different types of priming: intra-modal vs. cross-modal (see Justus, Yang, Larsen, et al., 2009, for an overview)

Reaction Time Experiment

Reaction time studies

- Sonnenstuhl, Eisenbeiss, and Clahsen (1999) RT study on German: comparison of regular -s plurals, e.g. *Kino* - *Kinos*, to irregular -er plurals, e.g. *Mann* - *Männer*
  - they found differences in processing, data supports dual-mechanism account
- Meunier and Marslen-Wilson (2004) RT study on French regular and irregular verbs: *amener-amène* 'to bring - I bring' vs. irregular forms *peindre-peignent* 'to paint-they paint'
  - similar priming, data supports single-mechanism account
- Kielar, Joanisse, and Hare (2008) RT study on English past tense forms
  - regular past tense forms and irregular past tense forms show consistent priming effects, data supports single-mechanism account

Maltese Reaction Time Experiment

Method

- reaction time experiment with cross-modal priming: auditory presentation of primes, visual presentation of targets
- 144 target items, two types of primes: Corresponding plural primes and phonologically and semantically unrelated control primes with the same plural suffixes or pattern like the corresponding plural word
- 2 frequent and 2 infrequent sound plural suffixes, 2 frequent and 2 infrequent broken plural patterns
- 144 nonce words as filler items
- 59 adult native speakers of Maltese (34 women and 25 men) performed a lexical decision task

Reaction Time Experiment

Stimuli

Table 3: *Example of items that were used in the present reaction time study.*

	PrimeType			
Target	Related Plural	Control Plural	Frequency	Plural Type
kappella	*kappelli*	*politiki*	high	sound
patri	*patrijiet*	*universitajiet*	high	sound
alla	*allat*	*triqat*	low	sound
qattiel	*qattiela*	*halliema*	low	sound
farfett	*friefet*	*xwabel*	high	broken
tifel	*tfal*	*swieq*	high	broken
storja	*stejjer*	*ktajjen*	low	broken
banda	*bnadi*	*ċrieki*	low	broken
vilnu	*vilel*	-	(*filler*)	(*filler*)

Note. The last row displays fillers (target = nonce words, prime = existing plural)

Reaction Time Experiment

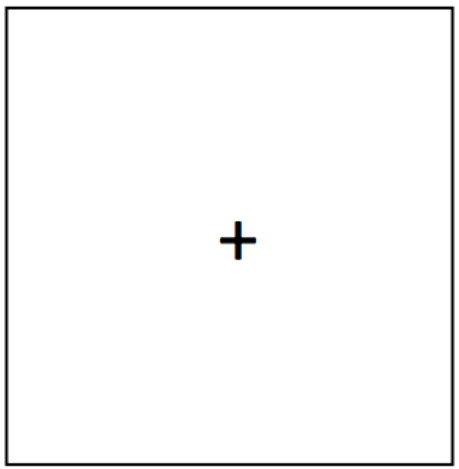
Predictions

Dual-Mechanism Hypothesis:
different frequency effect, difference in speed of processing

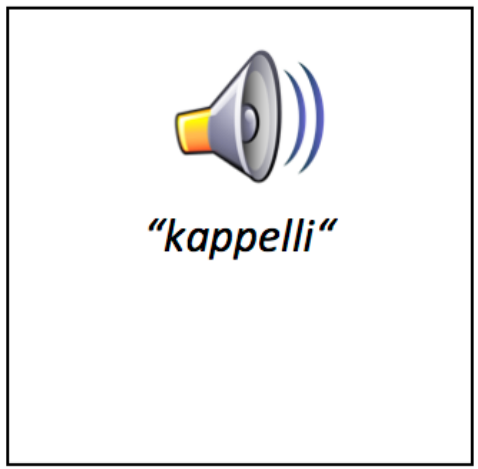
Single-Mechanism Hypothesis:
same frequency effect for both plural types, no difference in speed of processing

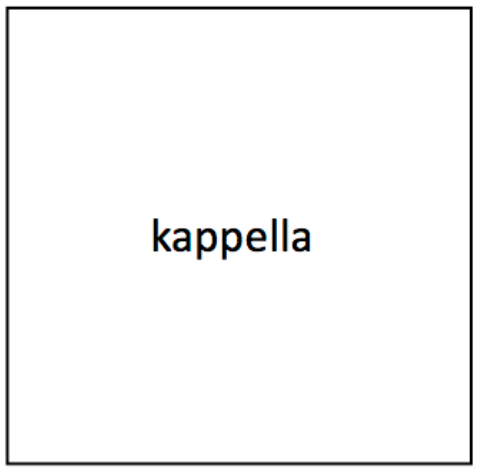
Reaction Time Experiment

Procedure



500ms





2000ms

Is it a real word? If yes, click the green button. If not, click the red button

Table 4: *Mean reaction times*

Condition	Example	Mean RT
broken, plural prime	*qattus - qtates*	635
sound, plural prime	*omm - ommijiet*	641
broken, control prime	*ballun - fkieren*	680
sound, control prime	*vjaġġ - kuluri*	720
filler	*kapla - kapep*	805

Reaction Time Experiment

Results

- we fitted several linear mixed effect regression models using the `lme4` package (Bates, Mächler, Bolker, & Walker, 2015) in the R environment (R Core Team, 2019)
- dependent variable: log-transformed RT
- independent variables: PluralType (broken vs. sound), PrimeType (control vs. plural), PatternFrequency (frequent pattern vs. infrequent pattern), Origin (Semitic vs. non-Semitic), TargetFrequency (singular corpus frequency), PrimeFrequency (plural corpus frequency), Syllable (number of syllables)
- random effects: Participant and Item

Reaction Time Experiment

Results: First Model

- first model tests assumptions of a dual-mechanism account: strong frequency effect for broken plurals but not for sound
- interaction of PrimeFrequency (plural corpus frequency) and PluralType (broken vs. sound)

Reaction Time Experiment

Results: First Model

- no significant interaction of PrimeFrequency and PluralType ($p = .9$) = no frequency effect
- our data supports a single-mechanism model of morphological processing
- question: What factors determined the observed reaction times for sound and broken plurals in Maltese?

Reaction Time Experiment

Results: Second Model

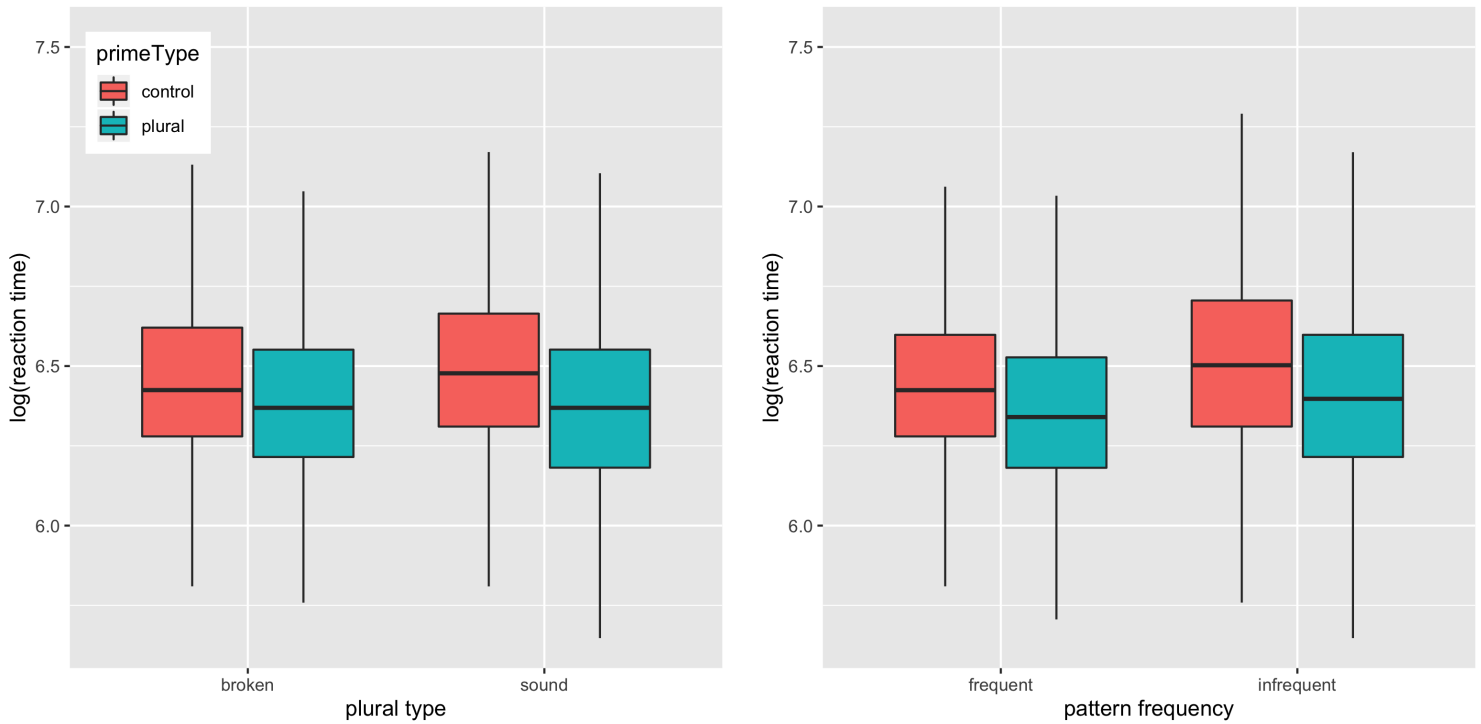


Figure 1: Effect of prime and plural type on RT (left); Effect of frequency of patterns and prime on RT (right)

Reaction Time Experiment

Results: Second Model

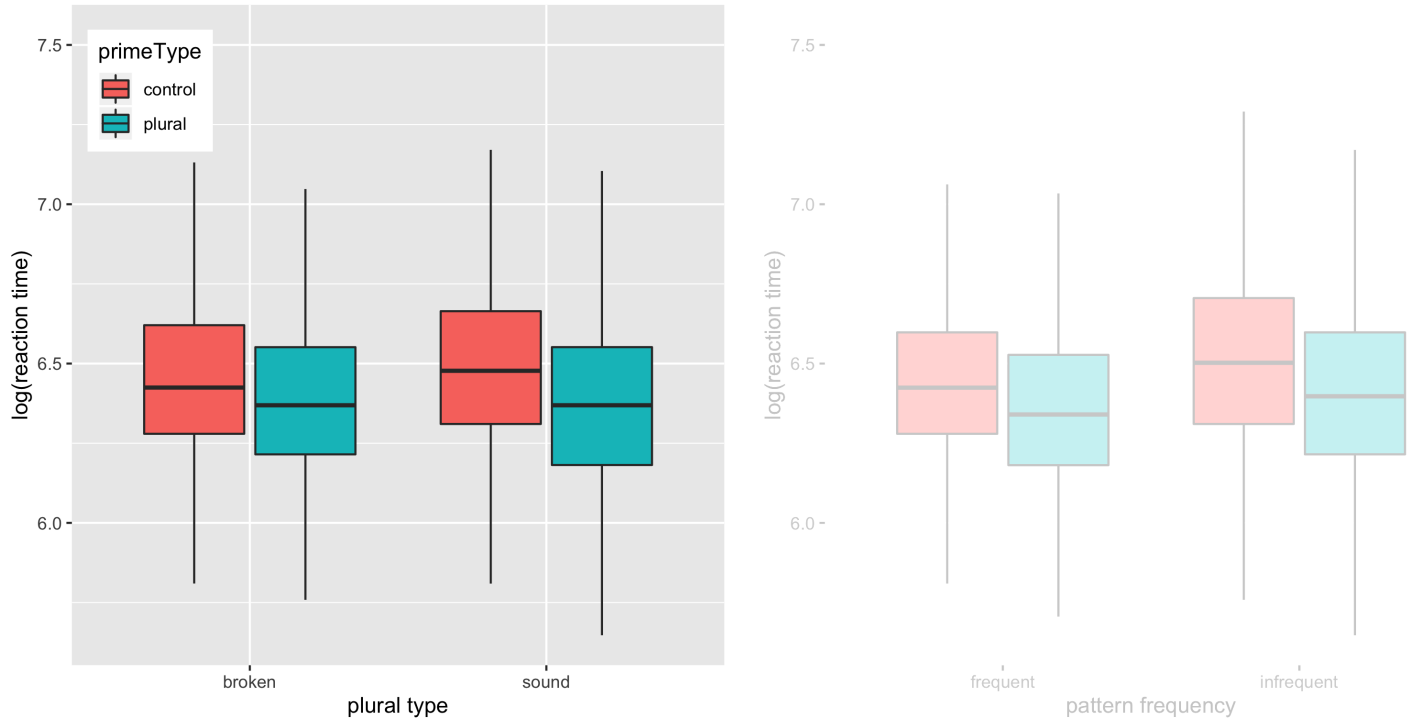


Figure 2: Effect of prime and plural type on RT (left); Effect of frequency of patterns and prime on RT (right)

- significant interaction between PrimeType and PluralType

Reaction Time Experiment

Results: Second Model

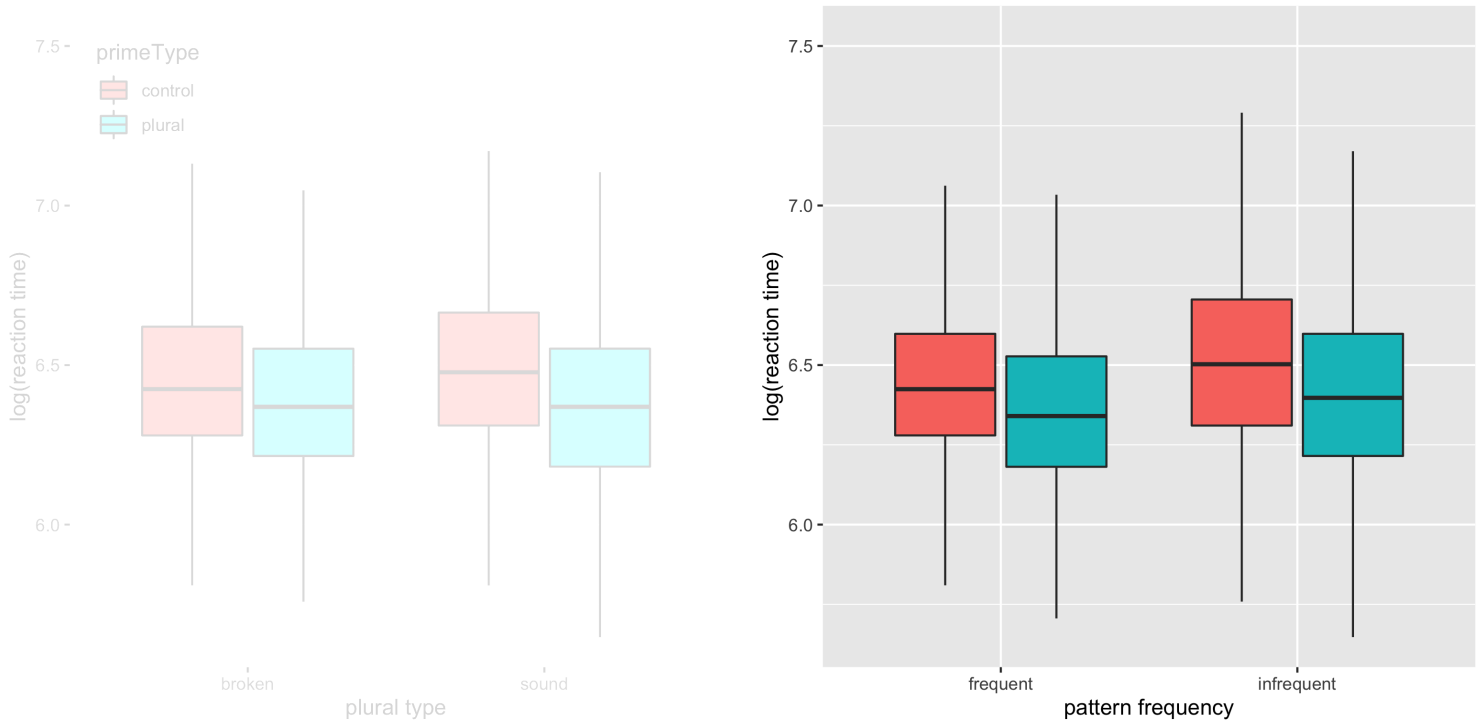


Figure 3: Effect of prime and plural type on RT (left); Effect of frequency of patterns and prime on RT (right)

- significant interaction between PrimeType and PatternFrequency
- low frequency patterns elicited longer rt (Estimate: -0.047), decrease of rt the higher the frequency of the target words (Estimate: -0.035)

Reaction Time Experiment

Results: Second Model

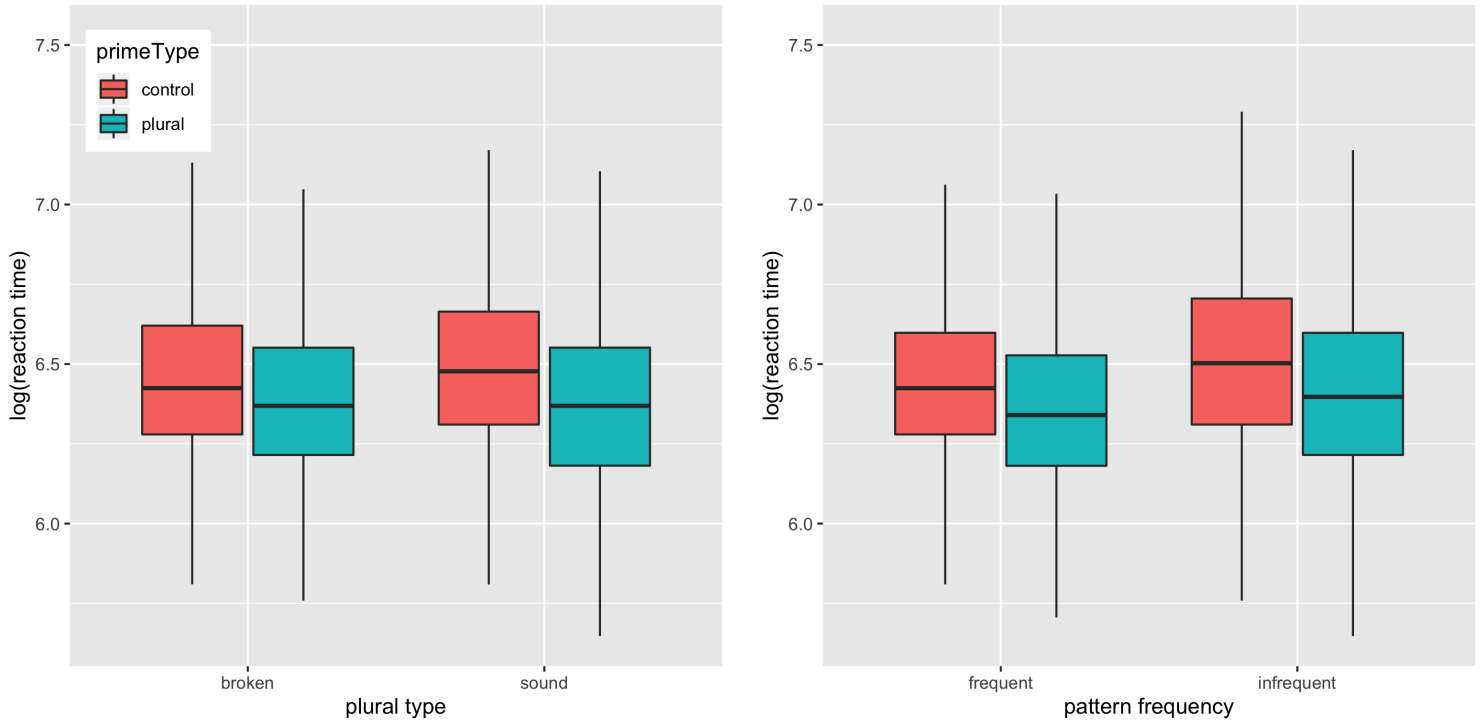


Figure 4: Effect of prime and plural type on RT (left); Effect of frequency of patterns and prime on RT (right)

- significant interaction between PrimeType and PluralType, significant interaction between PrimeType and PatternFrequency
- low frequency patterns elicited longer rt (Estimate: -0.047), decrease of rt the higher the frequency of the target words (Estimate: -0.035)

Reaction Time Experiment

Conclusion

- results indicate that Maltese broken and sound plurals are processed in the same way = single-mechanism account
- no difference in processing, no different word frequency effect; but: different priming effect!
  - greater priming for sound plurals due to phonological overlap of singular targets with their sound plural form
  - phonological overlap facilitates response latencies (Pastizzo & Feldman, 2002)
- instead of morphological regularity: frequency of patterns and the morphophonological similarity to related word forms are important factors for processing Maltese plurals

Discussion & Conclusion

The variation found in the nominal system influences the intuitions of native speakers about Maltese plural forms:

- Maltese native speakers are more certain about sound plural forms and use these forms more frequently (Nieder, van de Vijver, & Mitterer, 2020).
- frequency effect: certain suffixes and patterns are more frequent than others and are thus faster to access in the mental lexicon (this talk).
- Maltese broken and sound plurals are processed in the same way (this talk and Nieder, Tomaschek, Cohrs, & van de Vijver, 2020)

Grazzi ħafna!

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