Mental Representation of Multiple Default Plurals: Evidence from the Adaptation of English Loanwords in Arabic

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Abstract: The present work argues for the existence of multiple default regularities of plural formation in Arabic. As evidenced in the corpus of loanword adaptation in Jordanian Arabic, this study calls for a reassessment of the treatment of idiosyncratic plural forms in the mental lexicon. This investigation is in line with the dual mechanism theory where both memory and rule are active, but with more reliance on the default rule (feminine sound plural –aat) over memory (broken plural patterns). This avoidance of broken plural, which is less predictable and less transparent, is explained by a limited mental lexicon that defines such loanwords and thus blocks a successful mapping of the broken plural's inflection in the memory. The failure of broken plural retrieval, especially with words that do not match the canonical root system (tri-consonantal), calls for the application of the default feminine sound plural, the most productive, transparent, and regular formation. As a result, frequency and memory association predicted by prosodic similarity between loanwords and the broken plural patterns do not contribute to avoiding the default -aat overgeneralization in the short term.

1. Introduction

In the nominal system of Arabic (Modern Standard Arabic and modern Arabic varieties, including Jordanian Arabic (JA),[1] the main concern of this study),[2] pluralization is achieved through two different inflectional modes: linear concatenation, the so-called *sound plural* (SP) and non-linear internal stem modification, the so-called *broken plural* (BP). SP concatenates suffixes to the nominal stem depending on the nouns' gender: the masculine sound plural (MSP) is marked by the suffix *-iin*, e.g., *ṭabbaax* 'cook M' > *ṭabbaax-iin* 'cooks M'; and the feminine sound plural (FSP) is marked by the suffix *-aat*, e.g., *ṭabbaax* 'cook' > *ṭabbaax-aat* 'cooks F' (e.g., Laks 2014; Albirini 2015; Mashaqba and Huneety 2017). BP involves interdigitating the root with a specific plural pattern, e.g., CCaaC *ktaab* 'book' > CuCuC *kutub* 'books', but CCaaC *ḥmaar* 'donkey' >

CaCiiC *ḥamiir* 'donkeys' (Mashaqba, Al-Khawaldeh, AlGweirien and Al-Edwan 2020).

Over the past four decades, several major phonological, morphological, and semantic accounts have emerged to examine the puzzling behaviour (as will be exemplified later on) of plural formation in Arabic: (i) the morphological correlates of BP patterns and their non-concatenative idiosyncrasies (e.g., Levy 1971; Ratcliffe 1990, 1998; Albirini and Benmamoun 2014), (ii) the prosodic mapping of BP forms onto different predictable templates (e.g., McCarthy and Prince 1990; Idrissi 1997; Watson 2002; Laks 2014), (iii) Root-and-Site Morphology (Kihm 2006),[3] (iv) PRIM, a computerized model of encoding BPs which gives only one plural of a given lexical entry (Neme and Laporte 2013), (v) the OT BP model (Sakarna 2013; Mashaqba, Huneety, Abu Guba and Al Khalaf 2023), and (vi) the Moraic Condition on Plurality where only nominals weighting 2-5 moras are mapped onto BP patterns (Jarrah, Al-Jarrah and Abu-Dalu 2018).[4]

Based on the clear sound-broken plural asymmetries for Classical Arabic/Modern Standard Arabic (i.e., SP is derived by suffixation while BP involves the application of well-defined patterns based on internal stem change), McCarthy and Prince (1990) and Idrissi (1997) managed to account for a large portion of BPs (namely the most regular ones) by having the plural form derived (by some rule) from its corresponding singular form. In his morphophonological and semantic approach, Laks (2014) demonstrated that the selection of a plural type is based on faithfulness constraints (including stem stress type, the number of syllables, and the prosodic structure of the word) and [+/-animate] restriction on the singular base. Laks concluded that preference of plural mode selection is given to the FSP which allows for the singular base to remain intact and faithful to the base. BP patterns are selected almost exclusively with monosyllabic or bisyllabic base words and words that mark [+human]; this selection is also motivated by preserving the ultimate-syllable stress type. However, the proposed accounts do not fit a model which comprehensively accounts for BP-SP asymmetry. Each account was able to construct elaborate hypotheses but with little empirical evidence that covers all/most Arabic BP patterns. As for JA, none of such generalizations, the features proposed in the morphological model or the moraic conditions on plurality, is able to predict all plural formations. Many examples are resisting these predictions. For instance, we observe that previous models could not answer why words like *xaruuf* 'lamb' CaCuuC inflects *xirfaan* CiCCaaC and *xawariif* on the one hand, nor do they answer why nominals like *raġiif* 'loaf of bread' CaCiiC inflects *riġfi* CiCCi in rural JA, but *ruġfaan* CuCCaaC in urban and Bedouin JA, on the other hand (cf. Mashaqba et al. 2023 for the variant probability prediction model for cases of plurals free variation).

Another challenge to the previous models stems from examples of plural formation in the corpus of the present work. Such examples do not conform to the argumentations proposed in recent work (e.g., McCarthy 2008:303; Kihm 2006:103) which concluded that the selection of SP-BP of nominals depends on their stems. Many examples have been reported where the stem generates

multiple plural variations in JA, also called 'polymorphy' (Laks 2014), as in the stem *ʃaahid* {ʃ-h-d} 'witness', which generates several plural doublets including *ʃuhuud*, *ʃuhhad*, *ʃuhhaad*, *ʃahada*, *ʃawaahid*, and *ʃaahdiin*. In JA, plural words like *ṭullaab ~ ṭalaba* 'students', *ṭalabaat* 'orders', *ṭaalbaat* 'female students', *ṭaalbiin* 'people who are asking for', *maṭaalib* 'demands', *ṭalaajib ~ ṭlabb* 'needs', *maṭaaliib ~ maṭluubiin* 'wanted/legally perused criminals', *ṭulbaat* 'acts of asking for the bride's hand' share one root: {ṭ-l-b}. One more challenge is that in many dialects of Arabic, there have also emerged new plural patterns. For example, Yemeni dialects developed the pattern CuCwaC as in *tarīg* 'road' > *turwag* (Diem 1979:64-75) and the pattern aCCūC as in *ʕamm* 'uncle' > *aʕmūm* (Fischer and Jastrow 1980, eds: 91).

Cross-linguistically, pluralization of English loanwords operates in the grammar of the target language via different morphological processes, as in (1):

(1) a. Urdu   *glas* 'glass'   *glas-æ̃*
     b. Sindhi   *glas*   *glas/glasũ*
     c. Pushto   *gɪlas*   *gɪlas-una*   (Islam 2012:14)
     d. German   *ɪnvestoːɐ* 'investor' *ɪnvestoːr-en*   (Seidel 2010:74)
     e. Armenian   *dʒiːnz* 'jeans'   *dʒiːnz-er*   (Stepanyan 2018:78)
     f. Kinyarwanda   *i-korone* 'corner'   *a-ma-korone*   (Kayigema and Mutasa
                                                                  2015:134)
     g. Kikuyu   *e-βukũ* 'book'   *ma-βuku*   (Karũrũ 2013:4)
     h. JA   *bank* 'bank'   *b(u)nuuk*   Data from this work
     i. JA   *dʒiniraal* 'general'   *dʒiniraal-aat*   Data from this work

Data in (1) shows that English loanwords are readily adapted into the borrowing language morphological system. Generally, pluralization of English loanwords is mainly based on suffixation by adopting the plural marker of the borrowing language, such as the three South Asian languages (data in 1a-c), German (data in 1d), Armenian (data in 1e), and JA (data in 1i). Other ways of pluralization of English loanwords are prefixation, as in Kinyarwanda and Kikuyu (data in 1f-g), and internal vowel change as in JA (data in 1h).

To this end, the present article considers language contact as a trigger of new modes of plural formation. It argues for mechanisms of multiple modes of plural inflection as evident from the adaptation of English loanwords in Bedouin JA. The empirical data examined in the present work are of interest because the topic of loanwords adaptation has received much attention, particularly in phonology and morphology (Abu Guba 2016, 2021; Huneety and Mashaqba 2016; Zibin 2019). During the journey of our data collection, we noticed that loanwords which allow for easy retrieval of a consonantal root are assigned to one of the BP patterns (e.g., *bank > b(u)nuuk* 'bank(s)'), whereas loanwords whose phonological shape makes such a retrieval impossible are given the FSP suffix *-aat*: (e.g., *dʒiniraal > dʒiniraal-aat* 'general(s)'). Loanwords thus appear to be crucial in deciding about the disputed issue of the cognitive reality of pluralization in Arabic and consequently in determining the proper mechanisms that generate loanwords pluralization. Bearing this in mind, two of the main goals of this work are to explore whether pluralization of English loanwords in JA

relies on the application of rule or memory (or both) when used by native speakers of JA, and whether phonological properties (e.g., count of moras/syllables, phonological similarity) matter in the selection of the plural mode.

2. Factors contributing to plural formation

Several factors may contribute to the selection of the plural type including productivity, regularity, defaultness, openness, frequency, and predictability (Albirini 2015). Productivity of a plural form involves a broad application of the process over different kinds of nominals regardless of inherent features (e.g., gender and [+/-animate]).[5] It also measures the extent to which a morpheme (e.g., -*aat*) can be extended to foreign words and neologisms (Dressler 2003). Regularity is often associated with productivity and defaultness; however, this is not necessarily the case in Arabic pluralization when it comes to MSP (for a detailed explanation, refer to §5 and §6). Openness predicts the way the plural formation (e.g., FSP) is applicable to new forms regardless of any phonological constraints. Predictability involves the degree to which a plural form is automatically chosen because of the phonological, semantic, and structural features of its singular base (e.g., Gregory, Raymond, Bell, Fosler-Lussier and Jurafsky 2000).

In terms of defaultness and productivity of plural forms, three conflicting points of view have been noted. On the one hand, some argue that BP is the most frequent, the most productive, and the default pattern (the 'norm' in their words), although sound plurals (FSP and MSP) depart from the norm (McCarthy 1983; Jarrah et al. 2018). On the other hand, others reported that FSP is the minority case and the BPs are the majority (e.g., Ravid and Farah 1999). Finally, others found that FSP and MSP are quantitatively (in terms of token frequency) more productive and apply to more nominal forms than BP. Where FSP seems to be the default pattern, MSP is limited to a certain set of deverbal nominals (e.g., Boudelaa and Gaskell 2002; Laks 2014).

3. An overview of cognitive approaches on plural inflection

In terms of cognitive approaches to the mental representation of plural inflection, two major theories are proposed: (i) the single mechanism theory (e.g., Rumelhart and McClelland 1986) and (ii) the dual mechanism theory (e.g., Pinker 1991). The former calls for the use of one faculty when processing the plural form within a rule-based or memory-based mechanism. Eliminating memory, the rule-based mechanism (adopted by generative grammar, e.g., Chomsky and Halle 1986; Halle and Mohanan 1985) indicates that the language user memorizes the base instead of memorizing both the base and its inflected forms. For example, the English plural noun *dogs* is formed by applying this rule: nominal base + the plural suffix –s. However, the rule-based approach fails to account for BP patterns as they have to be listed in the lexicon/memory ignoring the similarity of pattern change between some BPs, irregular plural forms in English linguistics, (e.g., goose > geese, foot > feet, tooth > teeth) (McClelland

and Patterson 2002). In comparison, the memory-based mechanism (also referred to as a connectionist model) eliminates rules and involves storing and processing the SPs and BPs through a network of associations in the memory (Rumelhart and McClelland 1986; Pinker 2015; Clahsen, Gerth, Heyer and Schott 2015). This entails regular and irregular plurals being mapped using a pattern associator without the need for a separate default process that produces the regular form.[6] On this view, the selection of the SP or BP depends on factors like (i) pattern frequency (where the more frequent the words, the easier they are to retrieve), and (ii) some phonological neighbourhood similarities between the item and the stored pattern (where the phonological similarity between a new item and an existing word calls for a better generalization of the plural pattern) (Pinker 2015; Al-Shboul, Huneety, Mashaqba, Zuraiq and Al-Omari 2020).

By contrast, in the dual mechanism theory, both rule and memory are present in processing words. Rules are productive mental processes that are applied to language components as default patterns in a combinational sense regardless of the phonological similarities (Clahsen 2006). Dual mechanism theory suggests that SP undergoes the application of well-defined rules, and BP is generated via the memory network associations between bases and their inflected forms, and productively generate these stored morphological patterns to new words based on the phonological/prosodic similarities which are already applied to existing words stored in the lexicon (*gool* 'goal' > *gwaal* 'goals') (Pinker 2015).[7] Processing, therefore, takes place as follows: if a word does not have the BP form stored in the lexicon, (e.g. the word *ṭaaba* 'football'), the default pattern (base + -*aat*) is immediately retrieved to produce the plural (*ṭaab-aat)*. To form the plural pattern of words like *ktaab* 'book', the stored form *kutub* 'books' is immediately retrieved and the overgeneralized rule (base + -*aat*) is blocked. With novel nouns, e.g., *gool* 'goal', it is assumed that memory retrieval productively extrapolates the plural pattern to be *gwaal* 'goals' in the sense that it maps phonological features and word-to-word association in the form of pairs as in *zool* > *zwaal* 'moving body' (cf. §5 & §6). It is therefore interesting to draw attention to the role of similarity factors (and any other effects such as asymmetrical distribution) in triggering the ability of the BP to be introduced as the preferred plural form for loanwords.

4. Methods and procedure
4.1 Methods
A total of 40 JA-speaking participants representing Bedouin JA, 20 males and 20 females, were chosen as volunteers for this investigation adopting convenience sampling. Based on a metadata sheet, participants' level of education ranged from primary (30 participants) to secondary (10). All the participants had a low degree of literacy in English, and none has a speech impairment. Their ages ranged between 55 and 70 years, with an average age of 64. The age of the participants is a very important variable that must have had direct consequences on the participants' speech. A pilot study was run with data being taken from older and younger speakers (18-70 years old). One of the findings of that pilot

study was that younger speakers treated (produced) loanwords differently from older people. This can be attributed to the fact that the education system has improved significantly in the region recently; the number of schools has increased rapidly, and new universities have been established near the region. This would influence the morphological system of the language (including pluralization) because the dialect of the younger generation of Bedouin JA has been in a state of rapid change during the past 10-15 years towards the urban dialect –the prestigious dialect in Jordan in which code switching ad code-mixing are highly used; this is due to the continuous and increasing influence of the media, tourism, Internet, social networks, and university life; for supporting evidence, see for example, Huneety (2015) and Mashaqba (2015). To get reliable results and avoid the undesirable effects of these external factors, younger generations were not recruited in this study. The older people are speakers of merely their local Bedouin dialect whereas the younger generation lives in a diglossic situation using less and less their local dialect (and its specific morphology) and more and more the urban variety of JA that is much richer in loanwords. Noteworthy, no differences according to gender were attested and therefore gender was not considered.

The loanwords were collected between October 2015 and December 2021 from five sources: (i) lists of English loanwords published in previous work (Abu Guba 2016; Huneety and Mashaqba 2016; Issa 2018), (ii) *Forgotten Jordanian Words*, a Facebook page for native Jordanian words and old expressions (https://web.facebook.com/forgottenaccent/?ref=br_rs), (iii) the *Foog is-Saada* TV program (https://web.facebook.com/fooqalsada), which regularly discusses current issues in the Jordanian community including old Jordanian dialects, (iv) the official Facebook page of Mahmoud Zyoudi, a famous Bedouin writer who received King Abdullah II ibn Al Hussein Order for Distinction of the Third Degree for his great efforts in the preservation of Jordanian heritage (https://web.facebook.com/mahmood.zyoudi), and (v) daily interaction between the researchers and the local community covering all Bedouin regions in Jordan. For ethical considerations, the researchers requested official permission from the administrators of these pages/programs and Mahmoud Zyoudi to consider their posts and documents in this study. The researchers confirmed that the data would remain confidential and would be deleted after the completion of the study if requested.

4.2 Procedure

A corpus of 580 loanwords was surveyed, considering all possible syllable structures. All loanwords used in this study were common to the participants and were part of their active vocabulary. The participants were not aware that these words were loanwords, and this was not discussed with them in order not to affect the results of the study. The participants were asked to generate plural forms of singular items. The participants performed a simple production task. When a participant did not give any answers, s/he was given options. The stimuli were presented orally, recorded and transcribed. To examine the influence of the

number of syllables and moras of the singular nominal on the plural mode, words were verified and tested according first to the number of syllables (monosyllabic, bisyllabic, etc.), and second to the number of moras (monomoraic, bimoraic, trimoraic, etc.).

The participants' selection of the plural form of loanwords was a key indicator of the amount of reliance on rule or memory when processing Arabic singular–plural inflection. Thus, we hypothesize that the rule-based SP would not be affected by phonological or morphological similarity, whereas the memory-based BP would be very sensitive to such similarity. By eliciting Arabic words that share phonological similarity, we tested the extent to which the phonological similarity with other words in the mental lexicon pertains to the choice of the type of plural formation. Thus, a list of 120 loanwords together with lexical Arabic words that share the same/near phonological similarities and the same vowel melody had been prepared (e.g., *galan* 'gallon' vs *galam* pen', *giir* 'gear' vs *biir* 'well', *bank* 'bank' vs *band* 'item', *gool* 'goal' vs *zool* 'moving body', *maatuur* 'motor/engine' vs *naaṭuur* 'guard/concierge').

In the first session, participants were asked to provide the plural form of the target loanwords, without being informed about the Arabic translation equivalent. All loanwords that take one of the BP patterns were re-tested with reference to Arabic words of similar patterns. The loanwords were presented first and then the native words (instead of some form of alternation) to (i) guarantee not to orient data elicitation so that the participants do not try to intentionally imitate/produce similar plural forms, and (ii) to check the degree of consistency of pattern association between the singular and plural correspondents, with reference to their Arabic counterparts. The participants provided the data in three rounds, with a one-week interval between every two rounds. This repetition task was performed to check whether producing the plural form of the entry will simulate the native words while repeating, and thus their recognition, over the second and the third rounds. The frequency of the plural forms of the loanwords in correlation with Arabic words comprising identical/similar consonants was also calculated. All plural tokens were rated on a two-point scale of pattern production: native Arabic plural (1 point) and any other patterns (0).

5. Results

The behaviour of the collected loanwords divides as follows: bases that take the FSP (e.g., *mudeel* 'model' > *mudeel-aat* 'models'), bases that take one of the BP patterns (e.g., *ʔantiil* 'antenna' > *ʔanatiil* 'antennas'), and bases that take both forms alternated by the same participant (FSP and BP) (e.g., *keebil* 'cable' > *keebl-aat* and *kawaabil* 'cables') in which case FSP form is used most. MSP, by contrast, is completely absent (cf. Table 1).

Table 1. Proportion of plural patterns

Plural Pattern	BP	FSP	FSP & BP	MSP
Percentage	29%	63%	8%	0%

Table 1 illustrates the relative frequency of each plural type. A careful examination of the loanwords in the corpus shows that 63% of our data cannot select a BP anyway. Then, the distribution is skewed in favor of FSP, still without the latter necessarily being the *default* and BP *minor default* plural (further explanation will take place in the following parts). 8% of the loan nominals prefer both FSP and BP together; however, none of the loanwords selects MSP. Similar results were found concerning English loanwords in Mosuli Arabic (Sa'eed 2010) and Palestinian Arabic (Laks 2014) where the FSP is quantitatively the most productive pattern (further argumentation on the relationship between defaultness and openness will be raised in §6).

Further examination of the 29% taking BP patterns, five patterns have been adapted in English loan nominals in JA, as in (2). No alternations among these BPs were reported by any of the participants:

(2)   Singular   Plural   Plural Pattern
        kuub   *kwaab* 'cups'   CCaaC

        ban(i)k   *bnuuk* 'banks'   CCuuC
        kaabtin   *kabaatin* 'captains'   CaCaaCiC
        maatuur   *mawatiir* 'motors'   CaCaCiiC
        taksi   *takaasi* 'taxis'   CaCaaCi

By comparison, referring to the patterns registered for different Arabic dialects (cf. Huneety 2015; Mashaqba 2015), no loanword in the corpus uses many BP patterns that Arabic nominals inflect, as listed in the footnote.[8] The crucial factor seems to be the number of loanwords actively memorized by the participants (evidence will be discussed in §6). Put in simpler words, some BP patterns are more productive than others, and this calls for serious future investigation to consider the idiosyncratic factors explaining this behaviour.[9] However, no answer expects that JA loanwords deploy all the BP patterns available, for the simple reason that not all of them are of equal status when it comes to regularity/productivity/frequency.

The loanwords that do not conform to the consonantal root of Arabic words (typically tri-consonantal) accepted FSP and BP with preference given to FSP over BP, as will be shown below. The behaviour of these examples is not in line with Jarrah et al. (2018), who claim that selecting between these two modes is not allowed, except for a handful. To this end, a preliminary observation would support the assumption that this morphological alternation is due to the degree of nativization[10] that the word has undergone. The more nativized the word is, the more canonical root-based it becomes and the greater is the word's ability to inflect under the more 'ubiquitous' BP.

Figure (1) points to a possible account for the observed data based on the phonological nature of loanword stems.
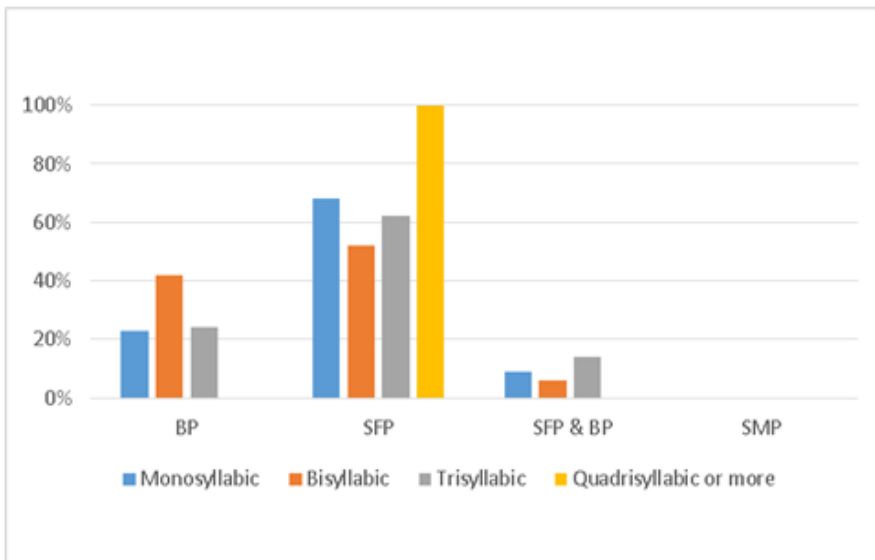
Figure 1. Plural type by number of syllables

Verifying the frequency of plural types according to the number of syllables, we found that SFP is used with nouns of different syllable types, with quadrisyllabic words preferring FSP the most. BP, by comparison, BP is completely avoided by words of four syllables or more.

The plural modes have been calculated according to the number of moras, as in Figure 2.[11]
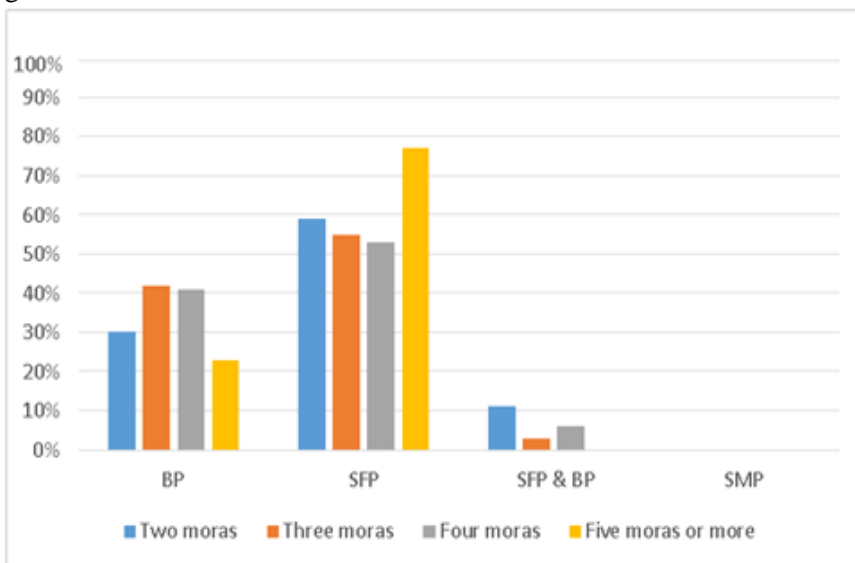

Figure 2. Frequency of plurals by number of moras

Contrary to the conclusions in Jarrah et al. (2018), FSP consistently registered the highest frequency among all mora-types including trimoraic and quadrimoraic words. BP also registered an important indication: although it is preferred most by trimoraic and quadrimoraic words, the data includes examples that take the BP formation other than the three-to-five mora restriction accounted for by Jarrah et al. (2018). 30% of bimoraic words and 23% of words comprising five moras or more select BP over SP.

Finally, applying the phonological similarity test on loanwords that select one of the BP patterns (see section 3 above), it was found that 85% of them obey the singular-plural pattern used by singular nouns (e.g., *galan* 'gallon' > *glaan* 'gallons' vs the JA words *galam* 'pen' > *glaam* 'pens'; *ʕalam* 'flag' > *ʕlaam* 'flags'). The frequency test interestingly found no significant differences between the results of the first experiment and those of the second and third experiments.

6. Discussion of factors contributing to the selection of plural patterns

One of the most important questions we address based on our corpus is: What properties of the singular loanword can determine its plural form, if any? The answer is not an easy task for many reasons. Although the nominal loanwords have singular masculine referents, some are assigned BP (as in *kaabtin* 'captain' > *kabaatin* 'captains'), and some are assigned FSP (as in *dʒiniraal* 'general' > *dʒinaral-aat* 'generals'). More importantly, one cannot exclude the effect of the phonological makeup (e.g., the number and type of syllables and their patterning within the word) on which plural pattern a loanword selects. For instance, one may argue that *ʔantiil* 'antenna' and *kaabtin* 'captain' select BP *ʔanaatiil* and *kabaatin*, respectively, because of the regular, predictable, and productive nature of the plural template *CaCaaCiiC* and *CaCaaCiC* in JA. This pattern is highly predictable when it comes not only to quadri-consonantal stems (see *markaz* 'center' > *maraakiz* and *timsaaħ* 'alligator' > *tamaasiiħ*), but also to the quantity of the vowel of the third syllable in the plural form which echoes its quantity in the singular stem (see previous studies accounting for melodic transfer phenomena in Arabic, e.g., Watson 2002). By contrast, the loanword *mudeel* 'model' [template = CuCeeC] cannot be mapped onto any JA underlying representation that selects the FSP pattern. It is also essential to consider the nature of the underlying representation (UR) that is assigned to a loanword, as the plural form can be taken as an indication of the UR. A good example is *keebil* 'cable', which has two plural forms: *keebl-aat* and *kawaabil*. It would be assumed that if the UR is /keebl/, the plural form is *keebl-aat*. However, if it is analyzed by analogy to most JA words that have a long vowel in the first syllable and a short /i/ in the second one, then this word would be assigned an underlying representation that selects the *CawaaCiC* pattern and be *kawaabil*. Along with these cases, some loanwords may resist a root-and-pattern analysis altogether (e.g., *dʒiniral* > *dʒiniraal-aat* /*dʒanaariil*). In fact, in addition to the idiosyncrasies of the speakers themselves, some idiosyncrasies are associated with specific loanwords. Thus, one of the most interesting results of our study is to prove that the simple dichotomy outlined above cannot be maintained. Rather,

one is dealing with a gradient such that many words form both a BP and a FSP depending on the participant, and the same participant may have both. What follows is a discussion of the major factors contributing to the selection of plural patterns.

Applying the phonological neighbourhood similarity task shows that BP patterns are sensitive to consonants' similarity but SP is not. Thus, the possibility of BP formation increases whenever the phonological similarity increases between English loan nominals and native Arabic BP nominals. One may wonder why the use of the BP would not be guided by a rule especially if rules can be applied through *analogy*, which itself is guided by morpho(phono)logical cues/similarities. This point should become clear once we know how analogy relates to associative memory and rule-based operations. The rule-based model, in turn, has explicit and abstract valid regular operations which are represented separately from any other words (cf. §3). An analogy-based model refers to any direct relations among mental representations of words in an associative network. It posits that such operations are stored in the memory allowing them to produce new forms based on the already stored and organized mental networks of lexical, morphosyntactic, and phonetic associations (Bybee 1988).

Moreover, the JA word system has typically a triconsonantal root; hence, many English words containing four consonants or more will pose a problem to the lexical elicitation task used in this study. The more root-consonants the loanword has, the more difficult it is to adapt it into any of the Arabic templates without consonant or syllable deletion. For instance, the loanword *hi.li.kub.tar* 'helicopter' does not match any of the existing native JA singular bases that have BP patterns. Here, one should distinguish between the number of root consonants (the root morpheme) and the number of actual consonants in the word. JA contains many words with more than three consonants which may include consonants that are not part of the root, such as /m/ in {n-ʃ-r} *minʃaar* 'saw'. This aspect, which seems to be another challenge, is accounted for in Stem Modification Theory (McCarthy and Price 1990) where the transfer effects, such as vowel length/quality and non-root consonants adjacency, are shifted from the singular base to the plural word as in *minʃaar* 'saw' > *manaaʃiir*. In this example, the vowel length and the consonant /m/ are transferred to the BP word (cf. Laks 2014). Such a structure would not cause a problem as it is derived from the triconsonantal root {n-ʃ-r} because, at some point here, one may claim that the existence of a native BP prosodic template allows for implementing the same manifestation for loanwords (e.g., CVCCVC for *markaz* 'center' > *maraakiz* 'centers' vs *banʃar* 'puncture'> *banaaʃir* 'punctures'). However, this proposal failed to cover many similar cases in loanwords, as in (3):

(3)

Singular Loanword	Template	Plural		Native JA Equivalent	Plural
sakʃin 'section'	CVCCVC	*sakʃin-aat*	**sakaaʃin*	*markiz* 'center'	*maraakiz*
biʤaama 'pajamas'	CVCVVCV	*biʤaam-aat*	**baʤayim*	*risaala* 'letter'	*risaayil*
bakam 'pickup'	CVCVC	*bakam-aat*	**(ʔi)bkaam*	*ʕalam* 'flag'	*(ʔi)ʕlaam*
karaaʤ 'garage'	CVCVVC	*karaaʤ-aat*	**ʔakriʤa*	*ʤanaaħ* 'wing'	*ʔaʤniħa*
bakiit 'packet'	CVCVVC	*bakiit-aat*	**bkata*	*fagiir* 'poor'	*fgara*

This work argues against considering BP as the frequent form of pluralization in JA. There is a plausible argument against the *Moraic Condition on Plurality* (Jarrah et al. 2018), in which BP is the normal pattern of plural formation in Arabic, being confined to words weighing 2-5 moras, and against Laks (2014), who claims that BP patterns are restricted almost exclusively to monosyllabic or bisyllabic loanwords. Our data includes many examples (also used in the dialects they investigated) that do not fit such proposals, as in (4).

(4)　　　Singular　　　　　　　　Plural　　　　　　　　　　Gloss
　　　　faaz　　　　　　　　　*faaz-aat*　　　　　　　　'vase'
　　　　tist　　　　　　　　　*tist-aat*　　　　　　　　'test'
　　　　tank　　　　　　　　　*tank-aat ~ tnuuka*　　　'tank'
　　　　drill　　　　　　　　　*drill-aat*　　　　　　　'drill'
　　　　laayk　　　　　　　　*laayk-aat*　　　　　　　'like'
　　　　ṣaaloon　　　　　　　*ṣaaloon-aat*　　　　　　'salon'
　　　　roovar　　　　　　　　*roovar-aat*　　　　　　'Rover'
　　　　rimoot　　　　　　　　*rimoot-aat*　　　　　　'remote control'
　　　　raadaar　　　　　　　*raadaar-aat*　　　　　　'radar'
　　　　fooldar　　　　　　　*fooldar-aat*　　　　　　'folder'

Hence, we claim against any correlation between the choice of BP or SP and the number of moras or syllables in the base. Moreover, our results do not correspond to Levy's (1971) matrix which states that all categories that match the feature [+ foreign] take a SP pattern. Based on our corpus, many bimoraic nominals and nominals with more than four moras tolerate BP templates, as in (5):

(5)　　　Singular　　　　　　　　Plural　　　　　　　　　　Gloss
　　　　gool　　　　　　　　　*gwaal*　　　　　　　　　'goal'
　　　　ʃurt　　　　　　　　　*ʃruuta*　　　　　　　　'shirt'
　　　　sandal　　　　　　　　*ṣanaadil*　　　　　　　'sandal'
　　　　banʃar　　　　　　　　*banaaʃir*　　　　　　　'puncture'
　　　　faṭbool　　　　　　　　*faṭabiil*　　　　　　　'football'

Our data also includes examples that do not conform to Laks (2014), who claims that BP patterns are selected with [+human] singular loanwords, as in (6):

(6)　　　Singular　　　　　　　　Plural　　　　　　　　　　Gloss
　　　　ʃiff　　　　　　　　　*ʃiff-aat*　　　　　　　　'chef'
　　　　budigaard　　　　　　*budigaard-aat*　　　　　'bodyguard'
　　　　hakar　　　　　　　　*hakar-aat*　　　　　　　'hacker'
　　　　gaardinar　　　　　　*gaardinar-aat*　　　　　'gardener'
　　　　neers　　　　　　　　*neers-aat*　　　　　　　'nurse'
　　　　dʒiniraal　　　　　　*dʒiniraal-aat*　　　　　'general'

The frequency analysis provides evidence that a degree of faithfulness and reliance upon rule over memory exists. Based on the corpus of this work, what

distinguishes FSP from the other plural types is its high sensitivity to productivity. That is: FSP has a broad application over different kinds of nouns regardless of the grammatical entity in the singular form. The answer is in line with conclusions concerning the developmental patterns of plural acquisition by typically developing and speech-impaired Arabic-speaking children where FSP is found to be acquired with high accuracy and more frequently earlier than the other types (e.g. Ravid and Farah 1999 for Palestinian Arabic; Aljenaie, Abdalla and Farghal 2011 for Kuwaiti Arabic; Mashaqba, Al-Khawaldeh, AlGweirien and Al-Edwan 2020 for typically developing JA-speaking children; Mashaqba, Abu Sa'aleek, Huneety and Al-Shboul 2020 for JA-speaking children with Down Syndrome). This may explain why FSP is treated as the default pattern of marking the grammatical number in Arabic. This answer is also supported by the response of native speakers of JA who use FSP loanwords although their singular forms are masculine (cf. the data in (6) earlier). Although English loanwords are adapted according to the grammatical system of JA, gender of the nominal stem is not a crucial or comprehensive factor contributing to the plural patterns.

In terms of openness, two productive modes of pluralization are attested: FSP and BP. While FSP is the most productive and the driving default pattern in English loanwords in JA, BP constitutes the minor default. The fact that JA speakers find FSP so easy to produce plural loanwords could also be attributed to the simple structure of FSP, which is formed by adding the suffix *-aat* to nominal bases, in contrast to BPs, which involve root-and-pattern internal change. Hence, FSP forms satisfy the *openness* principle, which predicts the ability of a process to successively accept new forms in the grammar, and thus contributes to the definition of defaultness (Mashaqba, Al-Khawaldeh, AlGweirien and Al-Edwan 2020). In this concern, the productivity/openness dichotomy seems to be clear. Different from MSP and to a lesser degree BP, the productivity of the FSP involves the broad application of the plural suffix *-aat* over different kinds of nouns/adjectives regardless of other grammatical categories of their singular counterparts (e.g., gender, [+/-animate]). Hence, productivity is highly correlated with frequency. Openness, on the other hand, predicts the way the FSP accepts new forms regardless of any phonological constraints. Thus, openness entails structural productivity and a lack of phonological constraints on application.

One final point is that MSP is regular and productive, but it is neither the *default* pattern nor openness-confined (Albirini 2015; Mashaqba, Al-Khawaldeh, AlGweirien and Al-Edwan 2020). This notion poses a challenge to hypotheses that correlate "regularity" with "defaultness" (Clahsen and Neubauer 2010; Al-Shboul, Zuraiq, Huneety and Mashaqba 2022). A good theory of Arabic morphology and loanword morphology should explain why MSP is never selected by loanwords. MSP in JA, similar to the other Arabic varieties, is less frequent, less productive, and less predictable than the FSP because of many factors. The MSP suffix is restricted to human masculine deverbal nominals; the majority of human masculine plurals take the BP patterns. By contrast, the FSP suffix applies to a variety of nominals: semantically feminine animates (*ṭifla* 'baby girl' > *ṭifl-aat*), grammatically non-human nominals marked by the

feminine suffix *-a*/*ah* (e.g., *ʃanta* 'bag' *ʃant-aat*), feminine deverbal derivatives (*muʕallima* 'teacher F.' *muʕallim-aat*), long (penta-lateral masculine nouns) masculine nominals (e.g., *munʕaṭaf* 'turn' *munʕaṭaf-aat*), most words produced by children in the early stage of plural acquisition (Albirini 2015; Mashaqba, Al-Khawaldeh, AlGweirien and Al-Edwan 2020; Al-Shboul, Asassfeh and Pye 2021), and most loanwords (as seen in the corpus of this work).

7. Applicability of dual mechanism on plurals processing in Arabic

Dual mechanism theory accounts for plural formations in Arabic as proceeding via rule (i.e., concatenative affixation) or memory in the case of BP, i.e., an analogy with stored items. The more loanwords with BP's the participants can evoke, the more they can analogize new ones. However, if they remember only a few, because of too infrequent use or lack of knowledge (especially with words that do not match the triconsonantal root system), they will be more prone to resort to the rule "suffix *-aat*", where dubious cases will necessarily arise. The call-up for one plural suffix (FSP suffix *-aat*) also evokes the lack of extra alternatives for concatenational plural suffixes (cf. Kihm 2006). The dual mechanism, therefore, plays a vital role in the construction of plural systems in JA. Memory retrieval takes place productively (29%). It extrapolates BP in the sense that it maps identical vowel melody and consonantal similarity, and word-for-word association. BP forms that are frequent or phonologically similar to other frequent forms are, to some extent, retrieved more easily than those that are not. The crucial factor here seems to be the number of loanwords actively memorized by the participants (measured by phonological similarity experiment). Secondly, the notion that memory is the basis for this process implies that 'old' BPs are stored in the mental lexicon, perhaps acquired item by item alongside the singulars. The number of relative unpredictability of the patterns makes this a reasonable assumption.

As with other complex linguistic aspects, full mastery of the plural system in JA is affected by exposure because words are better memorized when they are encountered more frequently (e.g., Kaushanskaya, Yoo and Marian 2011). The more the word is repeatedly used the better chance it moves from the peripheral to the core system of the language. Remember that our participants were all over 54. Recall also that the mastery of the plural inflection for both native and foreign words may involve different modes of inflection. The best answer to this challenging phenomenon is that the lack of exposure results in having a poor lexicon of loanwords, which affects the ability to establish associations in memory to process BP patterns. This condition would cause heavy reliance on rule over memory.

The results of this study show that the ratio of BP acceptability as influenced by identical vowel melody and consonantal similarity was 85%, but that of frequency was 0%. Based on the oral production task, no obvious frequency effect was registered in the case of BP loanwords since the number of the inflected BP patterns after frequent repetition was not clearly different from the first time they produced the plurals of the target words. This interesting result

suggests that memory association triggered by frequency may effectively work with language learners but not with loanwords for a native speaker. Contrary to previous work (e.g., Marcus et al. 1992; Al-Abed 2017), memory association triggered by phonological similarity between loanwords and the BP patterns does not significantly contribute to avoiding the default *-aat* over-generalization, and frequency would be of no greater influence on BP patterns in the short run. The phonological form of the word, the number of syllables in particular, seems to be of secondary importance, apparently as a limiting factor. Such a claim supports the rule-based approach over the memory-based, but at the same time can be seen in line with the dual mechanism of asymmetrical processing that generates SP of loanwords by *-aat* rule, and BP by memory.

This conclusion leads us to suppose that loanwords first enter the periphery of the language system and then gradually move to the core and thus abide more by the language rules and constraints, and thus more readily memorized (see also Itô and Mester 1995). This involves the words entering the BP system and entails that the longer time the word is borrowed the more frequently it is used, and the more it is traced in memory. Such a conclusion seems hypothetical without empirical examples. In any case, English loanwords are hardly older than 100 years and from the examples given, such a tendency cannot be absolutely confirmed. To prove this hypothesis, one has to compare the English loanwords with older loanwords such as words borrowed from Ottoman Turkish, as in (7); for more examples, refer to Procházka (2009). Such data indicates that high frequency in use and longer time of borrowing play a crucial role in building an active memory that associates the borrowed words with similar tokens in the morphological system of the language. This claim may be a fertile subject to be considered in serious future projects.

(7)   Singular Loanword   Plural   Gloss
        zinzaana   *zanaazin*   'prison cell'
        ffika   *fifak*   'bullet'
        kundara   *kanaadir*   'shoe'
        dabbuus   *dibaabiis*   'mace'
        xaazuug   *xawaziig*   'stake; pile'
        xaaʃuuga   *xawaʃiig*   'spoon'
        gunbula   *ganaabil*   'bomb'
        ʃarʃaf   *ʃaraaʃif*   'bedsheet'
        dʒumruk   *dʒamaarik*   'customs'
        babbuur   *bawabiir*   'steamship; train'
        bakradʒ   *bakaaridʒ*   'kettle'
        ṭaabuur   *ṭawabiir*   'queue'
        ʃankal   *ʃanaakil*   'hook'

Similar conclusions were reported for Arabic loanwords in Turkish, and English loanwords in both Japanese and Dutch. Turkish has borrowed a large number of Arabic words which were initially pluralized using the Arabic plural morpheme, e.g., *inʃāt* 'buildings'. However, a decade ago, the Turkish plural morphemes –ler

and –lar were imposed by the younger generation on all loanwords of Arabic origin, as in *inʃa-lar*. This results in two forms, with the second form being more widespread (K. M. McCarthy 1970). In addition, the length of time in English is a key factor for Japanese loanwords for fitting into the English plural form. Out of a corpus of 311 count nouns, 182 are pluralized via the English plural suffix –s and two via –es (Cannon 1984). In Dutch, out of a corpus of 209 nouns, 8.6% take the en- morpheme, but the majority of them take the -(e)s morpheme with an average of 90.4% (Deron 2002).

8. Conclusion

After careful consideration of previous phonological/morphological work, one concludes that none of them sufficiently accounts for the puzzling behaviour of all (most of) BPs in Arabic. This conclusion supports the assumption that the dichotomy of (non)concatenative morphologies is a relative rather than absolute phenomenon because one type generates multiple variants which may be an indirect reflection of language change (see Laks 2014). As evidenced in the corpus of loanword adaptation in JA, the present work argues for the existence of multiple regularities of plural inflection in JA. It calls for the reconsideration of the treatment of idiosyncratic plural forms in the mental lexicon. Although that many morphologically complex structures (like the Arabic plural system) are in line with dual mechanism theory, future work adopting new morphological approaches is recommended to give more comprehensive explanations. For instance, Relational Morphology (Jackendoff and Audring 2020), a very recent theory, probably would satisfy this inquiry. In this theory, the distinction between productive and non-productive patterns is regarded as gradable, and the boundary between the lexicon and grammar is eliminated. This approach proposes that the predictable parts of idiosyncratic expressions which are stored in the lexicon can be captured by general schemas. This is not in line with Dual mechanism theory where it is one or the other, i.e. rule or memory. To this end, this very important issue will be the main concern of very recent work to develop evidence on the notion that predictable parts of idiosyncratic loanwords/expressions which are stored in the lexicon can be captured by general schemas.

    Future work should address morphological issues (including inflectional and derivational) as implications for the cognitive approaches which are better investigated through independent and specialized psycholinguistic methods through which either mechanism should be decided (see Pinker 2015 and references cited therein to find an appropriate method to gauge the cognitive theories). The different nuances of meanings of the target plural suffixes and whether they would have an effect on the generated plural are recommended for future examination, e.g. *radʒul* 'man' > *ridʒaal* and *ridʒaal-aat*, which do not have the same meaning. Further investigation should be devoted to the behaviour of plural patterns as produced by non-native speakers of Arabic, where results might have pedagogical implications for the field of teaching Arabic as a foreign language. Longitudinal investigations should be conducted to test the

phonological and morphological behaviour of loanwords over a long period of time.

Endnotes

1. Abbreviations throughout the manuscript are: M = masculine, F = feminine, BP = broken plural, SP = sound plural, FSP = feminine sound plural, MSP = masculine sound plural, JA = Jordanian Arabic.

2. JA contains three major varieties which are related to specific groups of people in connection with the geographical area and socioeconomic status: urban dialect (a prestigious dialect spoken mainly in the capital Amman and Zarqa), rural dialect (mainly spoken by villagers in the northwest regions including Irbid, Jerash and Ajloun, and south regions including Tafila, Ma'an, and Karak), and Bedouin dialect (spoken by the tribes who lead nomadic or semi-nomadic lives in the southern and northeast regions of Jordan) (Mashaqba, Huneety, Zuraiq, Al-Omari and Al-Shboul (2020). These dialects in Jordan (as well as the Palestinian dialect) share the morphological system, with some variation (including the nominal system and pluralization); therefore, we sometimes refer to these dialects in our discussion for some comparisons.

3. As an alternative to the prosodic model of BP, Kihm (2006) proposes Root-and-Site morphology where lexical items comprise two components: consonantal *root*, and (external and/or internal) *sites* and identified by feature bundles (e.g., PLURAL, 1SG, 2MP) which host morphological activities between C1 and C2.

4. The exceptions that Jarrah et al. (2018) have accounted for via certain sets of vowel melody match Lavy's 1971 traditional account of plural formation: all categories that match one of the following features [+Derived], [+Foreign], [+Alphabet Letter], [+Adj-aan] take one of the SP patterns.

5. Laks (2014), however, points out that [+/- animate] distinction contributes to the selection of SP/BP in loanwords.

6. The use of the words 'regular' and 'irregular' has been taken with extra caution in this work as the parallel being made with English 'regular' versus 'irregular' plurals (or verbs) is neither perfect nor accurate. Arabic BPs cannot be treated as being irregular in the same way English irregular plurals (or verbs) are. Likewise, Arabic SPs cannot be taken to be regular on a par with English regular plural (or verbs).

7. Parallel forms such as *zool*/*zwaal* 'moving body/bodies' and English-borrowed *gool*/*gwaal* 'goal(s)' are perfect examples of analogical formation. For more details on the significance of analogy in morphology, refer to Blevins and Blevins (2009).

8. The following plural patterns are reported for Wadi Ramm JA: CiCaC, miCaCiiC, CaCaCah, ʔaCCaaC, CCaC, CuCaC, ʔaCCiCah, tiCaaCiiC, CuCaaCiC, CuCaCa, maCaaCiiC, maCaaCiC, CuCCaan, CiCCaan, CaCaaCa, CuCCaaC, CaCaaCiiC, CuCCaC, CCaCC, CaCaC, CuCuC, and CaCiiC (Mashaqba 2015).

9. These five patterns include a long vowel after the second pseudo-root consonant, i.e., something that resembles an interpretable morpheme. There is one exception, but it also includes a long vowel, only after the third pseudo-root consonant. This might indeed be the "idiosyncratic factor" motivating these forms to be more productive than others.

10. A process by which a language acquires a native-speaking community (Roberts 2000).

11. One should be careful when using the term mora vs syllable in determining the behaviour of the target word regarding the plural inflection. Accordingly, it is necessary to see how moras, unlike syllables, come into play as major determinants of the default inflection, if any. Onsets are weightless, a light CV syllable contributes one mora; a heavy CVV syllable contributes two moras. CVC syllables are language-specific, where codas contribute one mora in non-final positions (heavy), but they are weightless (extrametrical) in word-final position through the Weight-by-Position condition. The superheavy syllables CVVC and CVCC are bimoraic, rather than trimoraic, after the final C is deemed extrametrical in CVVC and extrasyllabic in CVCC. For details on how moras are assigned and counted in JA, see Abu Guba (2016, 2021).

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