Salience-weighted agreement feature hierarchy modulates language comprehension

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Abstract

The brain establishes relations between elements of an unfolding sentence in order to incrementally build a representation of who is doing what based on various linguistic cues. Many languages systematically mark the verb and/or its arguments to imply the manner in which they are related. A common mechanism to this end is subject-verb agreement, whereby the marking on the verb covaries with one or more of the features such as person, number and gender of the subject argument in a sentence. The cross-linguistic variability of these features would suggest that they may modulate language comprehension differentially based on their relative weightings in a given language. To test this, we investigated the processing of subject-verb agreement in simple intransitive Arabic sentences in a visual event-related brain potential (ERP) study. Specifically, we examined the differences, if any, that ensue in the processing of person, number and gender features during online comprehension, employing sentences in which the verb either showed full agreement with the subject noun (singular or plural) or did not agree in one of the features. ERP responses were measured at the post-nominal verb. Results showed a biphasic negativity – late-positivity effect when the verb did not agree with its subject noun in one of the features, in line with similar findings from other languages. Crucially however, the biphasic effect for agreement violations was systematically graded based on the feature that was violated, which is a novel finding in view of results from other languages. Furthermore, this graded effect was qualitatively different for singular and plural subjects based on the differing salience of the features for each subject-type. These results suggest that agreement features, varying in their salience due to their language-specific weightings, differentially modulate language comprehension. We postulate a Saliency-weighted Feature Hierarchy based on our findings and argue that this parsimoniously accounts for the diversity of existing cross-linguistic neurophysiological results on verb agreement processing.

1 **Keywords**

- 2 ERPs
- 3 Sentence Processing
- 4 Subject-Verb Agreement
- 5 Arabic
- 6 Agreement Feature Hierarchy

1 Introduction

1.1 Background

An important evolutionary function of human language is to convey ecologically relevant information, such as the state of affairs of the entities in the immediate environment and event descriptions about who is doing what and to whom, so as to elicit an appropriate response in the given context. In order to comprehend the message, the brain thus has to be able to decipher these details incrementally by establishing the relations between the various elements in the unfolding utterance. Furthermore, these relationships must be constructed from the linguistic input even in the presence of intervening material separating the related elements.

Languages differ considerably in the mechanisms they employ in order to establish relations between an event being described in an utterance and the participant(s) of the event. One frequent device attested in many languages is to overtly express such relations on certain elements morphosyntactically (Nichols & Bickel, 2013), such that there is a ‘systematic covariance between a semantic or formal property of one element and a formal property of another (Steele, 1978, p. 610)’, commonly referred to as agreement. Agreement between a verb and its arguments may be based on some or all of the properties or features of the arguments concerned, such as person, number and gender of the nouns, collectively called agreement features (Moravcsik, 1978; Wechsler, 2009) or phi-features. Greenberg (1963) formulated a number of generalisations based on how these features show patterns of dependency and their frequency of occurrence relative to each other across a number of languages of the world. One such generalisation is the Feature Hierarchy shown in (1) below, which has been an important explanatory concept to account for the cross-linguistic diversity in how these features co-occur.

(1) Feature Hierarchy: Person > Number > Gender

1 Further sub-hierarchies of these features have been proposed in accounting for
2 how they influence certain linguistic phenomena in a variety of typologically
3 diverse languages (Silverstein, 1976; Shlonsky, 1989; Corbett, 2000a,b). The
4 question of course is, whether such a hierarchy of agreement features identified
5 on a cross-linguistic basis plays a role in online language comprehension. Indeed,
6 such a systematic organisation of features is said to be a grammaticalised
7 representation of fundamental cognitive categories (Harley & Ritter, 2002),
8 with the relative position of a feature in the hierarchy reflecting the cognitive
9 salience of the feature in relation to the other features, which in turn is said
10 to correlate with dissociations in their online processing (De Vincenzi, 1999;
11 Carminati, 2005; Acuña-Fariña, 2009). For instance, Carminati (2005, p. 263)
12 proposes a Feature Strength Hypothesis mirroring the hierarchy in (1), suggesting
13 that the cognitive significance of a feature should directly correlate with its
14 relative hierarchical importance in language processing, whereby the more
15 significant a feature, the better its disambiguating power is, and in turn the less
16 processing costs it incurs, and vice versa. This would imply that a differential
17 contribution, if any, of the agreement features must be observable in their
18 respective neural processing correlates. Nevertheless, it is worth noting that
19 the hierarchical importance of features posited based on their conceptual or
20 cognitive significance need not necessarily preclude the possibility that the
21 neural correlates of processing the agreement features in online language comprehension
22 may show language-specific differences depending upon their relative salience
23 in a given language, which in turn would be contingent upon the properties
24 specific to the language concerned.

25 1.2 Previous studies

26 A number of studies have examined the processing of agreement features in
27 different languages. In behavioural research, many studies employed a completion
28 task involving sentences with agreement errors in the context of complex phrases,
29 such as ‘*The key to the cabinets are on the table.*’ (see for instance Bock & Miller,

1 1991; Vigliocco, Butterworth, & Semenza, 1995; Hartsuiker, Antón-Méndez, &
2 van Zee, 2001; Eberhard, Cutting, & Bock, 2005; Haskell, Thornton, & MacDonald,
3 2010, among others), whilst some involved a self-paced reading task (Wagers,
4 Lau, & Phillips, 2009; Lago, Shalom, Sigman, Lau, & Phillips, 2015; Tucker,
5 Idrissi, & Almeida, 2015), in some cases with eye-tracking (Pearlmutter, Garnsey,
6 & Bock, 1999; Dillon, Mishler, Sloggett, & Phillips, 2013). An overarching
7 finding from this line of research is that, agreement processes in sentence
8 comprehension and production are complex, and involve factors that are ‘not
9 only syntactic, not only semantic, and not only pragmatic, but all of these
10 at once’ (Eberhard et al., 2005, p. 531). The cross-linguistic importance of
11 agreement as a cue to sentence interpretation was demonstrated in a range
12 of offline experiments conducted within the scope of the Competition Model
13 (e.g., MacWhinney, Bates, & Kliegl, 1984; Bates & MacWhinney, 1989; Bates,
14 1999). These studies further showed that the strength of agreement as a cue
15 to interpretation varies across different languages (for an overview, see Bates,
16 McNew, Devescovi, & Wulfeck, 2001).

17 In order to gain insights into the neurocognitive mechanisms underlying the
18 processing of agreement features, several previous studies have employed the
19 ERP technique, which is particularly well-suited for studying language comprehension
20 in real time thanks to its excellent temporal resolution. ERP studies investigating
21 subject-verb agreement typically employ a violation paradigm, whereby the
22 verb does not agree with its subject in the feature of interest. When ERPs
23 measured at the anomalous verb are compared with those measured at the
24 verb that shows correct agreement, this then is said to shed light on the neural
25 correlates of processing the agreement feature under investigation.

26 Kutas & Hillyard (1983) reported one of the earliest ERP studies on subject-verb
27 agreement in English and found that agreement violations elicited ERP effects
28 that are different in scalp distribution to those elicited by semantic anomalies.
29 Ever since, several ERP studies on the processing of agreement features in a
30 number of languages have been reported (see Molinaro, Barber, & Carreiras,

2011, for a detailed review), the vast majority of which are on Indo-European languages. Results from these studies show that agreement violations of various types of dependencies (i.e., subject-verb, adjective-noun, article-noun etc.) generally elicit a left-anterior negativity (LAN) effect around 300 to 500 ms after the onset of the violation followed by a late-positivity (P600) effect in the 500 to 700 ms window and/or later. As Table 1 illustrates, this is true for the number feature in Dutch, English, Finnish, German, Italian and Spanish; for the gender feature in German, Italian and Spanish; for the person feature in German and Spanish. However, there are a few studies in which an N400 effect ensued instead of a LAN, or no negativity effect ensued at all. These include studies that examined number violations in Basque, English and Hindi; gender violations in Dutch, French, Hebrew, Hindi and Spanish; person violations in Basque and Spanish.

Methodologically, it is of some import here to acknowledge the inherent difficulty in designing fully balanced experiments to investigate the processing of agreement features in any language. Discussing the merits of fully counter-balanced or symmetric designs, Steinhauer & Drury (2012) highlight the fact that it may be possible to employ symmetric designs in most studies examining, say, number violations, whereas it may not be viable to the same degree to employ such designs in studies investigating other kinds of violations. For instance, none of the widely-studied languages allow for fully crossed separate feature violations for the three agreement features. As an example, an agreement violation in English such as ‘*The girl eat the cake’ could be construed at once as a number violation (cf. ‘They eat the cake.’) as well a person violation (cf. ‘I eat the cake.’) depending upon whether it is the ‘They’ or the ‘I’ contrast that one considers. Similar syncretisms exist to varying degrees in the agreement systems of French, German or Dutch; Italian or Spanish do not express gender agreement on the verb; Basque verbs express gender in the second person alone and only in some paradigms; Russian verbs express person and number but not gender in the present tense, number and gender but not person in the past

Table 1: A sample of findings previously reported in the literature for single-feature violations.

Number violations		
Dutch	LAN–P600	Hagoort, Brown, & Groothusen (1993); Kaan (2002)
English	LAN–P600	Osterhout & Mobley (1995); Coulson, King, & Kutas (1998)
Finnish	LAN–P600	Palolahti, Leino, Jokela, Kopra, & Paavilainen (2005)
	LAN–P600	Leinonen, Brattico, Järvenpää, & Krause (2008)
German	LAN–P600	Roehm, Bornkessel, Haider, & Schlesewsky (2005)
Italian	LAN–P600	Angrilli et al. (2002); De Vincenzi et al. (2003)
Spanish	LAN–P600	Barber & Carreiras (2005); Mancini, Molinaro, Rizzi, & Carreiras (2011a)
Basque	P600	Díaz, Sebastián-Gallés, Erdocia, Mueller, & Laka (2011)
	N400–P600	Zawisewski, Santestegán, & Laka (2016)
	N400–P600	Martinez de la Hidalga, Zawisewski, & Laka (2019)
English	P600	Kaan, Harris, Gibson, & Holcomb (2000)
Hindi	P600	Nevins, Dillon, Malhotra, & Phillips (2007)
Gender violations		
German	LAN–P600	Gunter, Friederici, & Schriefers (2000)
Italian	LAN–P600	Molinaro, Vespignani, & Joba (2008)
Spanish	LAN–P600	Barber & Carreiras (2005); Alemán Bañón & Rothman (2016)
Dutch	N400–P600	Hagoort et al. (1993)
French	P600	Frenck-Mestre, Osterhout, McLaughlin, & Foucart (2008)
Hebrew	N400–P600	Deutsch & Bentin (2001, with an animacy interaction)
Hindi	P600	Nevins et al. (2007)
Spanish	N400–P600	Guajardo & Wicha (2014)
Person violations		
German	LAN–P600	Rossi, Gugler, Hahne, & Friederici (2005)
Spanish	LAN–P600	Silva-Pereyra & Carreiras (2007)
Basque	N400–P600	Zawisewski & Friederici (2009); Zawisewski et al. (2016)
	N400–P600	Martinez de la Hidalga et al. (2019)
Spanish	N400–P600	Mancini et al. (2011a)

1 tense; and Chinese or Japanese do not mark the verb for agreement.

2 Perhaps as an alternative means to mitigate such intrinsic limitations, some
3 studies have compared a pair of feature violations with each other or with
4 a combined violation of more than one feature. In the absence of a viable
5 alternative, these studies provide important insights into the processing of
6 agreement, which may not otherwise be available. However, a necessary
7 limitation of these studies may be that their findings may not necessarily generalise
8 always for the processing of all three features in isolation in a given language.

9 A handful of such combined violation studies on subject-verb agreement have
10 reported a modulation of effects (i.e., a quantitative ERP difference) based on
11 the violating feature(s). These include the study on Basque cited above, in
12 which the late-positivity was larger for person and combined person-number
13 violations compared to number violations (Zawiswewski et al., 2016), the study
14 on Hindi mentioned above, in which the late-positivity was found to be larger
15 for combined person-gender violations versus number or gender or combined
16 number-gender violations (Nevins et al., 2007), a study on Spanish that reported
17 a larger late-positivity for combined person-number violations versus person or
18 number violations (Silva-Pereyra & Carreiras, 2007), with the latter concluding
19 that these results do not support the Feature Strength Hypothesis mentioned
20 earlier. By contrast, in another Spanish study, Mancini et al. (2011a) reported a
21 different distribution of the late-positivity in addition to a qualitative difference
22 in the negativities, namely a LAN effect for the number feature and an N400
23 effect for the person feature.

24 To briefly summarise findings from ERP studies on agreement, whilst the LAN-P600
25 biphasic ERP effect is more common for agreement violations of many types,
26 it is by no means universal, especially for subject-verb agreement. An N400
27 is elicited instead of a LAN in many cases, and no negativity at all ensues
28 in some cases. Thus, neurophysiological evidence or counter-evidence for a
29 hierarchy of features based on differences in their salience is inconclusive, with
30 some studies reporting processing differences between the agreement features

1 and others countering this, sometimes within the same language (compare for
2 instance Alemán Bañón & Rothman, 2016; Silva-Pereyra & Carreiras, 2007).
3 Further, a crucial aspect to note in this regard is that, although each feature has
4 been studied in detail in a number of languages, and in some cases combinations
5 of features compared with each other, to our knowledge, none of the studies
6 reported to date compared the processing of person, number and gender agreement
7 systematically within a single experiment. However, such a comparison would
8 be imperative in order to shed light on whether the hierarchy of features
9 postulated based on differences in their cognitive and language-specific salience
10 and distribution across languages has a neural equivalent to it.

11 Does the hierarchy of agreement features indeed have a neural equivalent to
12 it? If so, what is the nature of such a dissociation in neural correlates: is it
13 a quantitative ERP difference (i.e., graded amplitude modulation of effects),
14 or a qualitative one (i.e., different ERP effects)? Do the specific syntactic
15 properties of a language interact with such a dissociation? In other words, do
16 language-specific weightings of the features matter? In the following section,
17 we argue that Arabic provides an ideal testing ground for investigating this.

18 **1.3 Arabic as a test case**

19 In order to investigate whether the hierarchy of agreement features postulated
20 based on differences in their cognitive salience has a neural equivalent to it,
21 certain properties appear to be crucial in determining the language of choice.
22 A first such property is that the language in question should be morphologically
23 rich such that all three agreement features, namely person, number, and gender
24 are overtly expressed on the verb, either suffixally or in a fused form. A
25 second and related property that becomes relevant is that these features should
26 be expressed independently of each other, i.e., they are not underspecified
27 for a certain feature in most cases such that the violation of each feature
28 can be studied without simultaneously violating other features. For instance,
29 commonly studied morphologically rich languages such as German or Spanish

underspecify gender in verb agreement. A third property that is desirable for present purposes is that the feature markings on the target (i.e., the agreeing element (Corbett, 1983); here, the verb) are not always a one-to-one reflection of the agreement features of the element agreed with (i.e., the controller; here, the subject noun) in the language in question. In other words, the realisation of one or more features on the target is not only based on the features of the controller, but sometimes dependent upon certain structural properties of an utterance, such that changes in that property give rise to a concomitant change in the feature marking on the verb despite the subject being identical in both instances.

Arabic is a case in point in this regard. A Semitic language with upwards of 290 million speakers (Simons & Fenning, 2017) in countries spread around a great part of West Asia and North Africa, Arabic exhibits a typical example of diglossia (Ferguson, 1959), whereby a standard written variety for formal purposes and a number of colloquially spoken dialects exist in parallel. Modern Standard Arabic (Ryding, 2005) is the written standard taught in schools and universities (and the variety used for the stimuli here). Nouns are lexically gendered as feminine or masculine even if they are inanimate, and can express three different numbers, namely singular, dual and plural. Arabic is ideally suited to investigate possible processing differences between the agreement features in the context of subject-verb agreement mainly due to the fact that all three agreement features are expressed on the verb (with a few exceptions: gender is not expressed in the first person), as suffixes in the perfective and circumfixes in the imperfective. For example, let us consider a verb such as ‘to write’, which in Arabic would be the triconsonantal root *k-t-b*, with its default citation form being *kataba* ‘he wrote’. Restricting ourselves to the past tense (and therefore only suffixes), and only to singular and plural forms, the verbal paradigm for this root would look as follows: -

	katab-tu	I (m./f.) wrote	katab-naa	We (m./f.) wrote
	katab-ta	You (m.sg.) wrote	katab-tum	You (m.pl.) wrote
1	katab-ti	You (f.sg.) wrote	katab-tunna	You (f.pl.) wrote
	katab-a	He wrote	katab-uu	They (m.) wrote
	katab-at	She wrote	katab-na	They (f.) wrote

2 For an exhaustive introduction to Arabic verbal paradigms, the interested reader
3 is referred to Ryding (2005), but for the present purposes, this example should
4 suffice to illustrate the crucial point discussed earlier, namely that the processing
5 of all three agreement features can each be independently examined in Arabic.
6 A list of minimal pair examples is provided in the supplementary supporting
7 information illustrating the properties of Arabic agreement that are most relevant
8 for our present purposes.

9 **1.4 Relevant properties of Arabic agreement**

10 The Arabic agreement system is morphologically rich, relatively complex, and
11 shows synchronic and diachronic variation between the standard and spoken
12 varieties as well as amongst the dialects (Ferguson, 1997). Of particular relevance
13 here is the word-order dependent asymmetry in subject-verb agreement in
14 case of plural subject nouns (Aoun, Benmamoun, & Choueiri, 2010). The
15 verb generally shows strict or full agreement if the subject precedes the verb
16 (SV order, but see further), whereby it is obligatory for the verb to agree
17 with the subject in person, number and gender, both in Standard Arabic as
18 well as the dialects. By contrast, if the verb precedes the subject (VS order),
19 the verb agrees with the subject in person and gender only, and expresses
20 singular agreement for singular as well as plural nouns that are overtly present.
21 However, if the plural subject were to be covert or dropped, the verb must
22 show plural agreement. That is, number agreement is not only dependent
23 upon whether the subject is singular or plural, but also contingent upon the
24 relative order of the verb and the subject, as well as whether or not the subject
25 is overt. In other words, under certain circumstances, an identical verb form

1 is sometimes correct and sometimes incorrect based on the above mentioned
2 factors that go beyond the number property of the subject noun per se. Thus, a
3 simple feature-matching between the number property of the subject and the
4 verb would not always lead to the correct interpretation.

5 A further aspect of Arabic agreement relevant for the present purposes is the
6 interaction of the number feature with the humanness property of the subject
7 noun (Ryding, 2005). If the subject is singular, the verb agrees with it in
8 person, number and gender, regardless of whether the noun is human or nonhuman.
9 If the subject is plural, by contrast, agreement depends upon the humanness
10 property of the noun. For human plural nouns, the verb shows number (plural)
11 and gender agreement, whereas for nonhuman plural nouns, the verb must
12 show singular feminine agreement in Standard Arabic (Belnap & Shabaneh,
13 1992), a pattern that has been referred to as *deflected agreement* (Ferguson,
14 1997). Nevertheless, there are exceptions to this rule bothways; i.e., nouns
15 such as ‘people’, ‘family’ and a few other collective nouns denoting groups
16 of human referents as abstractions are treated as nonhuman plurals, and as
17 such commonly require deflected agreement (Ryding, 2005). Similarly, even
18 though the subject is actually a nonhuman plural noun, strict agreement may
19 be preferred instead of deflected agreement for idiomatic or stylistic reasons
20 (Ambros, 1977), and sociolinguistic, pragmatic or communicative strategic
21 reasons (Ferguson & Barlow, 1988). To add to this complexity, dialects allow
22 considerable variation in this regard (D’Anna, 2017; Belnap & Shabaneh, 1992;
23 Ambros, 1977) such that ‘alternative patterns of agreement are acceptable
24 without apparent change in meaning’ (Ferguson & Barlow, 1988, p. 16), with
25 the differences in nuance between simple plurality versus individuation, distributive
26 or enumerative plurality playing a role in this regard. This is perhaps not
27 surprising, given that on a more general level, ‘[w]hile person and gender
28 categories seem to have little effect on the meaning of a verb, [...] number is
29 somewhat different. The number of participants in a situation, whether agents
30 or recipients of an action, can affect the situation profoundly.’(Bybee, 1985,

1 p. 23).

2 In sum, it is apparent that the number feature plays a significant role in the
3 Arabic agreement system, interacting in complex ways with properties that are
4 structural (word-order) as well as at the syntax-semantics interface (humanness).
5 That is, plurality of the controller (i.e., subject noun) is key, both for the
6 word-order and overttness based agreement asymmetry as well as humanness
7 based deflected agreement in Arabic. These characteristics of the Arabic agreement
8 system allow investigating potential differences between the agreement features
9 in language processing not possible in quite a comparable manner in many
10 other widely-spoken languages. Furthermore, neurolinguistic investigations of
11 diverse languages are crucial for gaining a broader understanding of the neural
12 underpinnings of language (Bornkessel-Schlesewsky & Schlewsky, 2016), and
13 as such, neurophysiological studies on Arabic are an important contribution
14 from a widely-spoken but extremely understudied language.

15 **1.5 The present study**

16 We report a visual ERP study here, in which we investigated the processing
17 of subject-verb agreement in simple intransitive SV sentences in Arabic. In
18 this experiment, ERP responses were measured at the post-nominal verb as
19 participants read the stimuli in a rapid serial visual presentation. We specifically
20 examined the differences, if any, that ensue in the processing of person, number
21 and gender features during online comprehension, employing sentences in
22 which the verb either showed full agreement with the subject noun (singular or
23 plural) or did not agree in one of the features. The motivations to exclusively
24 employ intransitive sentences for the purposes of the experiment are two-fold.
25 First, there is evidence suggesting that verb valency or transitivity has a strong
26 influence on incremental interpretation, and in processing agreement in particular
27 (Burkhardt, Fanselow, & Schlewsky, 2007). Second, in line with the principle
28 of relational minimality that posits that the parser initially prefers to construct
29 minimal structures (see Bornkessel & Schlewsky, 2006, among others), there

1 is evidence that the initial argument is preferentially interpreted as the subject
2 of an intransitive rather than a transitive structure (the so-called *subject-preference*)
3 from a variety of languages, including German (Schriefers, Friederici, & Kuhn,
4 1995), Turkish (Demiral, Schlesewsky, & Bornkessel-Schlesewsky, 2008) and
5 Mandarin Chinese (Wang, Schlesewsky, Bickel, & Bornkessel-Schlesewsky, 2009)
6 among others.

7 Furthermore, given the significance of the number feature in the Arabic agreement
8 system, we hypothesised that processing differences may ensue between singular
9 and plural agreement. Therefore, the subject number (i.e., singular versus
10 plural) constituted an experimental factor in the design and analysis of our
11 study (see Section 2.2 for further details).

12 **2 Methods**

13 **2.1 Participants**

14 Thirty-four persons, most of them students at the United Arab Emirates University
15 in Al Ain, participated in the experiment after giving informed consent, and
16 received monetary compensation for their participation. All participants were
17 male¹, and were right-handed native Arabic speakers, with normal or corrected-
18 to-normal vision and normal hearing. Three further participants had to be

1. Parts of the UAE University campus are gender-segregated, and the EEG laboratory of the Department of Linguistics was located on the male-only campus at the time the study was conducted, with strict entry restrictions for female undergraduate students. Furthermore, student/research assistants were not available for assistance with data collection, and the first author personally collected the data on his own. It was therefore very difficult to obtain access to the lab for female students to participate in our study. While it is unusual in ERP studies on language processing to recruit exclusively male / female participants, we believe that this need not be a cause for concern in interpreting our results. This is because, except in auditory ERP studies involving implicit voice-based emotional inferences (van den Brink et al., 2010) and the processing of emotional prosody (Schirmer, Kotz, & Friederici, 2002), there is no evidence we could find in the ERP literature on language processing in healthy adults that would suggest systematic gender-based ERP differences. Even the differences reported for implicit processing of emotional prosody disappear when explicit processing of

1 excluded from the final data analyses on the basis of excessive EEG artefacts
 2 and/or too many errors in the behavioural control task. Since Arabic is diglossic
 3 (see Section 1.3), we collected information about the native dialect of participants.
 4 The self-reported dialect of Arabic that participants spoke natively at home
 5 was as follows. Palestinian: 11; Syrian: 8; Jordanian: 5; Egyptian: 3; Iraqi
 6 and Emirati: 2 each; Lebanese, Moroccan and Sudanese: 1 each.

7 **2.2 Experimental Design**

8 We employed an experimental design constituting Arabic sentences in the SV
 9 order with singular and plural subject nouns. All critical sentences were of
 10 the form adverb - subject - verb - prepositional phrase. The adverb was always
 11 ‘yesterday’, subject nouns were always animate and human, and the verbs were
 12 in the simple past tense. The verb in each sentence was either in correct
 13 agreement with its subject noun, or it did not agree in either person, or number,
 14 or gender with the subject (see Section 2.3 for details about the materials).
 15 Note that any violation always involved one feature only. This yielded a
 16 design consisting of eight critical conditions that differed based on two factors,
 17 namely, whether the subject-type (ST) was singular or plural; and whether the
 18 condition-type (CT) was acceptable or a person violation or a number violation
 19 or a gender violation. The motivation at the outset to define and manipulate
 20 subject-type as a primary experimental factor in the present study was crucially
 21 informed by the significant role that the number feature plays in the Arabic
 22 agreement system (see Section 1.4 above). Such a design would allow us to
 23 observe the ERP effects at the position of the verb when information about the
 24 subject noun is already fully available. Any differences in ERP effects at the

prosodic information is required (Schirmer, Kotz, & Friederici, 2005; Schirmer et al., 2006).
 Indeed, in a critical review of several studies that investigated sex differences in language
 processing using a multitude of methods, Wallentin (2009) could find no evidence for a
 consistent difference between healthy adult female and male individuals, neither in their
 verbal abilities nor in their brain structure and function related to language processing, and
 concluded that ‘sex should not be considered a large confounding factor in neuroimaging
 studies of language processing’ (Wallentin, 2009, p. 181).

1 verb would reflect the differences in the processing of the different agreement
2 features. Importantly, any potential subject-type specific differentiation of
3 effects in processing agreement would also become apparent.

4 Table 2 provides an overview of the factors and their levels, with the condition
5 codes relevant to each level, as well as examples pertaining to each condition.
6 Note that Arabic is written and read from right to left, and the example sentences
7 in the table follow this convention. The condition labels that are abbreviated
8 in the table are as follows: SACP: Singular subject, Acceptable agreement;
9 SGEN: Singular subject, Gender agreement violation; SNUM: Singular subject,
10 Number agreement violation; SPER: Singular subject, Person agreement violation;
11 PACP: Plural subject, Acceptable agreement; PGEN: Plural subject, Gender
12 agreement violation; PNUM: Plural subject, Number agreement violation; PPER:
13 Plural subject, Person agreement violation.

Table 2: Critical factors and their individual levels, with condition codes and a complete set of corresponding example stimuli.

Factor	Level	Conditions
ST : Subject-Type	S : Singular noun	SACP, SGEN, SNUM, SPER have a human singular subject, half of them feminine and half masculine
	P : Plural noun	PACP, PGEN, PNUM, PPER have a human plural subject, half of them feminine and half masculine
CT : Condition-Type	ACP : Acceptable	SACP, PACP have a verb that shows full agreement with its subject noun
	GEN : Violation of Gender Agreement	SGEN, PGEN have a verb that violates gender agreement
	NUM : Violation of Number Agreement	SNUM, PNUM have a verb that violates number agreement
	PER : Violation of Person Agreement	SPER, PPER have a verb that violates person agreement

SACP

بالأمس الممرضة حضرت إلى المكان.
 bil-ʔams ʔl-mumarriḍa hadʕar-at ʔl-makaan ʔilaa
 [DEF-nurse]_{3sg.F} [DEF-place] [to] [come]_{Past-3sg.F} [yesterday]

* SGEN

بالأمس الممرضة حضر إلى المكان.
 bil-ʔams ʔl-mumarriḍa hadʕar-a ʔl-makaan ʔilaa
 [DEF-nurse]_{3sg.F} [DEF-place] [to] [come]_{Past-3sg.M} [yesterday]

* SNUM

بالأمس الممرضة حضرت إلى المكان.
 bil-ʔams ʔl-mumarriḍa hadʕar-na ʔl-makaan ʔilaa
 [DEF-nurse]_{3sg.F} [DEF-place] [to] [come]_{Past-3pl.F} [yesterday]

* SPER

بالأمس الممرضة حضرت إلى المكان.
 bil-ʔams ʔl-mumarriḍa hadʕar-tu ʔl-makaan ʔilaa
 [DEF-nurse]_{3sg.F} [DEF-place] [to] [come]_{Past-1sg} [yesterday]

Singular Conditions. Right to left Arabic text with corresponding glosses.
 Intended meaning: ‘Yesterday the female nurse came to the place.’
 A * before condition labels indicates ungrammaticality.

PACP

بالأمس الممرضات حضرتن إلى المكان.
 bil-ʔams ʔl-mumarriḍaat hadʕar-na ʔl-makaan ʔilaa
 [DEF-nurses]_{3pl.F} [DEF-place] [to] [come]_{Past-3pl.F} [yesterday]

* PGEN

بالأمس الممرضات حضروا إلى المكان.
 bil-ʔams ʔl-mumarriḍaat hadʕar-uu ʔl-makaan ʔilaa
 [DEF-nurses]_{3pl.F} [DEF-place] [to] [come]_{Past-3pl.M} [yesterday]

* PNUM

بالأمس الممرضات حضرتن إلى المكان.
 bil-ʔams ʔl-mumarriḍaat hadʕar-at ʔl-makaan ʔilaa
 [DEF-nurses]_{3pl.F} [DEF-place] [to] [come]_{Past-3sg.F} [yesterday]

* PPER

بالأمس الممرضات حضرنا إلى المكان.
 bil-ʔams ʔl-mumarriḍaat hadʕar-naa ʔl-makaan ʔilaa
 [DEF-nurses]_{3pl.F} [DEF-place] [to] [come]_{Past-1pl} [yesterday]

Plural Conditions. Right to left Arabic text with corresponding glosses.
 Intended meaning: ‘Yesterday the female nurses came to the place.’
 A * before condition labels indicates ungrammaticality.

2.3 Materials

As a first step, 120 intransitive verbs were used to construct acceptable sentences with singular nouns, half of which were masculine and the other half feminine. The plural acceptable sentences were then generated from these such that the subject nouns and verbs now showed plurality. Finally, three violation conditions were generated from each of the 240 acceptable sentences such that the agreement marking on the verb either violated person or number or gender in each instance (i.e., never was a combination of these features violated). This resulted in a total of 120 sets of sentences in eight critical conditions, thus 960 critical sentences. As Steinhauer & Drury (2012) have succinctly pointed out, it is crucial in ERP studies involving violations of the sort we have employed here for the experimental design to be fully symmetrical in order to rule out baseline problems as well as confounds resulting from lexical and contextual differences. In recognition of this important fact, our critical conditions were fully counter-balanced, such that there were 60 masculine nouns and 60 feminine nouns used as subjects in our stimuli; each subject noun in our experiment occurred both in its singular and plural forms an equal number of times; similarly, for a given subject noun, the identical verb was used with agreement markings as appropriate for the manipulation. Furthermore, since all the 120 subject nouns occurred in all the 8 critical conditions, there was an equal number of masculine (60) and feminine (60) nouns in acceptable sentences, person violation sentences, number violation sentences and gender violation sentences.

As is apparent from the examples in Table 2, the critical verb (third word from the right in each sentence) expresses the person, number and gender features according to the experimental manipulation involved, such that the affixes on the verb are different between the conditions. A comparable experimental manipulation is not viable in many of the widely-studied languages (see Section 1.2 above). Crucially however, the material preceding the critical position of interest within each subject-type is always identical for a given verb in all four

1 conditions (acceptable, and the three violations). That is to say, for a given
2 verb and subject-type, the context in which the verb is processed is identical,
3 and in view of the counter-balancing of the materials in our experiment, this
4 symmetric design would enable us to ‘avoid virtually all problems that are due
5 to both lexical and contextual differences’ (Steinhauer & Drury, 2012, p. 141).
6 In other words, any effect of lexical frequency and morphological complexity
7 of the verb would apply to all conditions identically equally, and therefore
8 does not confound potential language-related effects of interest such as N400,
9 LAN and P600 observed at the position of the verb. Physical differences, such
10 as the length of the plural verb forms versus their singular counterparts may
11 engender amplitude differences in the P200 time-window, but should not be a
12 cause for concern as far as the later effects of interest are concerned.

13 Fillers were constructed to ensure that the sentence structure is not predictable
14 based on the first word alone and that the overall number of acceptable versus
15 violation sentences is counterbalanced. Thus there were sentences involving
16 subject and object relative clauses, verb-initial orders and a few semantic anomalies.
17 The 960 target sentences were distributed into five unique sets according to a
18 latin square, such that each list contained 36 sentences per critical condition.
19 Of the resulting 288 critical sentences in a given list, 72 were acceptable and
20 the rest were violations. Fillers were interspersed with these lists such that,
21 overall, each stimulus list ended up with an equal number of acceptable and
22 violation sentences, with an equal number of sentences with a masculine or
23 feminine, singular or plural noun. This resulted in a total of 600 sentences
24 per stimulus list (288 critical sentences and 312 fillers). These were each
25 pseudo-randomised to obtain five stimulus lists, one of which was used for
26 every participant. The presentation of the randomised lists was counterbalanced
27 across participants.

1 2.4 Tasks

2 Given the use of a violation paradigm, an acceptability judgement task followed
 3 the presentation of each stimulus sentence, which required ‘yes’ or ‘no’ as
 4 answers. In addition, in order to ensure that participants would process the
 5 sentences attentively, a probe word detection task followed the acceptability
 6 judgement task. The probe task was constructed in such a way that an equal
 7 number of trials required ‘yes’ or ‘no’ as answers. If the probe word was one
 8 of the words that occurred in the preceding stimulus, this required a ‘yes’,
 9 whereas if it was novel, it required a ‘no’. Crucially, the word position from
 10 which the probe word was chosen was equiprobable across the experiment as
 11 well as within each condition, which meant that participants had to be very
 12 attentive throughout stimulus presentation so as to perform the task correctly.

13 2.5 Procedure

14 The methods and procedure employed in the experiment followed the guidelines
 15 of the Helsinki declaration. The experiment was performed in the EEG laboratory
 16 of the Department of Linguistics at the United Arab Emirates University in Al
 17 Ain. In accordance with local regulations, participants gave written informed
 18 consent, and received monetary compensation for their participation. All possible
 19 efforts were undertaken during and after the experiment to guarantee anonymity
 20 to the participants and protection of their personal data. Participants filled an
 21 Edinburgh-Handedness questionnaire in Arabic, and dominant right-handers
 22 alone were accepted for participation. They received printed instructions about
 23 the experiment and the task they had to perform.

24 After setting up the electrode cap, the participant moved to a sound-proof
 25 chamber, where they were seated on a comfortable chair and were requested
 26 to avoid abrupt and drastic movements, especially of the head. Then a resting
 27 state EEG was recorded for possible frequency-based EEG analyses later, where
 28 the participant had to sit still for two minutes with no specific task to perform.
 29 Two more minutes of resting state EEG was recorded, but now the participant

1 had to close their eyes. After a short pause, the experimental session commenced,
2 which consisted of a short practice followed by the actual experiment. Stimuli
3 were presented using the Presentation software (www.neurobs.com) that recorded,
4 among other things, the trial number, reaction time and the button responses.
5 All physical parameters, such as the brightness and contrast settings of the
6 monitor, distance between the chair and the monitor, and the lighting inside
7 the chamber were maintained the same for all the participants.

8 The structure of each trial in the experiment was as follows. The flat-screen
9 LCD monitor was clear before the trial commenced. A fixation asterisk was
10 shown in the centre of the screen for 500 ms, after which the screen became
11 blank for 100 ms. Then the rapid serial visual presentation of the stimulus
12 sentence started. Each stimulus sentence was presented in four separate chunks,
13 namely the adverb, the subject noun, the verb and the prepositional phrase.
14 Since some prepositions form a single orthographic unit together with the
15 noun that follows them, whereas others do not, the sentence-final prepositional
16 phrase comprising of a preposition and a noun was always presented as a single
17 chunk regardless of whether or not the preposition concerned formed a single
18 orthographic unit together with the noun that follows it. Each of the first three
19 chunks (words) appeared in the centre of the screen and remained for 600
20 ms, after which the screen became blank for 100 ms before the appearance
21 of the next word. The prepositional phrases (containing two words) were
22 presented for 750 ms. The word presentation rate we employed is in line
23 with several existing studies on languages that are orthographically and/or
24 or morphologically complex, such as Mandarin Chinese (Wang et al., 2009),
25 Icelandic (Bornkessel-Schlesewsky, Roehm, Mailhammer, & Schlewsky, 2020),
26 Japanese (Wang & Schumacher, 2013) and Turkish (Demiral et al., 2008),
27 among others, in order to provide a comfortable reading rate for participants.
28 After the last chunk of the stimulus sentence was presented, the screen was
29 blank for 500 ms. Following this, a pair of smileys appeared on screen, which
30 prompted the participant to judge the acceptability of the sentence that just

1 preceded. After a maximum of 2000 ms or after a button press, whichever was
2 earlier, the screen became blank again for 500 ms. A time-out was registered
3 when no button was pressed within 2000 ms. Then, a probe word appeared
4 in the middle of the screen for a maximum of 2000 ms, within which the
5 participant had to detect whether the word was present in the preceding stimulus
6 sentence or not. When no button was pressed within 2000 ms, a time-out
7 was registered. At the end of the trial, the screen became blank for 1500 ms
8 (inter-stimulus interval) before the next trial started.

9 Before the actual experiment commenced, there was a short practice consisting
10 of twelve trials, which helped participants to get used to the task and to feel
11 comfortable about the pace of the trials and the blinking regime. For a given
12 participant, none of the experimental stimuli occurred in their practice phase.
13 The task was identical to that of the experiment phase. The EEG of the participants
14 was not recorded in this phase.

15 In the main phase of the experiment, one of the five sets of materials as mentioned
16 above was chosen to be presented in 12 blocks of 50 trials each. All critical
17 trials and most filler trials consisted of 4 chunks (words/phrases), with a handful
18 of filler trials consisting of 3/5/6 chunks. There were equal number of probe
19 words that required 'Yes' or 'No' as answers in each block. Half the number of
20 participants had the 'Yes' button on the right side and the other half had it on
21 the left side so as to counterbalance for any right-dominance effects. The 'Yes'
22 button being on the right or left was also counterbalanced across the stimuli
23 sets. There was a short pause between blocks. Resting state EEG was again
24 recorded at the end of the experimental session. The duration of the overall
25 experimental session including the practice and breaks but excluding the set-up
26 time was about 1 hour and 10 minutes on an average.

27 **2.6 EEG recording and pre-processing and statistical analysis**

28 The EEG was recorded by means of 25 AgAgCl active electrodes fixed at the
29 scalp by means of an elastic cap (Easycap GmbH, Herrsching, Germany). AFZ

served as the ground electrode. Recordings were referenced to the electrode placed on the left mastoid online, but re-referenced offline to the average of the electrodes placed on left and right mastoids. The electrooculogram (EOG) was monitored by means of electrodes placed at the outer canthus of each eye for the horizontal EOG and above and below the participant's right eye for the vertical EOG. Electrode impedances were kept below appropriate levels such as to ensure a good quality signal with minimal noise. All EEG and EOG channels were amplified using a BrainAmp amplifier (Brain Products GmbH, Gilching, Germany) and recorded with a digitisation rate of 250 Hz. The EEG data thus collected was pre-processed for further analysis using a 0.3 – 20 Hz bandpass filter offline in order to remove slow signal drifts that might lead to stimulus-independent differences between conditions. Although baseline corrections are usually employed to exclusively remove differences in the critical epoch due to slow signal drifts, given that stimulus-induced ERP effects are not completely independent of EEG activity in the pre-stimulus interval (see Barry, Rushby, Smith, Clarke, & Croft, 2006; Makeig, 2002, for e.g.), a distortion of effects in the critical ERP epochs may ensue due to transient signal differences between conditions in the baseline interval (see also Alday, 2019). The filter settings we employed effectively circumvents this issue without the need for a baseline correction², and are sufficiently broad to include language-related ERP activity that is typically in the frequency range of about 0.5 to 5 Hz (Roehm, Winkler, Swaab, & Klimesch, 2002). Previous studies employing identical filter settings to ours report no significant differences in results between

2. Nevertheless, in order to verify that this is the case, we reanalysed the data post-hoc using two slightly broader bandpass filters offline, namely 0.1 – 30 Hz and 0.3 – 30 Hz. In the analysis using the 0.1 – 30 Hz bandpass filter, as an expected consequence of the slightly lower high-pass cutoff, slow signal drifts were apparent within the sentence epoch, which however could be rectified using a pre-critical baseline correction. In the analysis using the 0.3 – 30 Hz bandpass filter, due to the identical high-pass cutoff that we have employed in our analysis, no baseline correction was required. The overall pattern of ERPs from these analyses remained comparable to the pattern obtained in our analysis. An overview of this confirmatory analysis is provided in the supplementary supporting information.

1 applying this bandpass filter versus applying baseline corrections (see Burkhardt
2 et al., 2007; Choudhary, Schlesewsky, Roehm, & Bornkessel-Schlesewsky, 2009,
3 for example). Furthermore, these filter settings are in line with several published
4 ERP studies on language processing and has been employed in studies on
5 languages as varied as Basque (Mancini, Massol, Duñabeitia, Carreiras, & Molinaro,
6 2019), German (Frenzel, Schlesewsky, & Bornkessel-Schlesewsky, 2015; Schumacher
7 & Hung, 2012), Hindi (Choudhary et al., 2009), Japanese (Wolff, Schlesewsky,
8 Hirotani, & Bornkessel-Schlesewsky, 2008), Mandarin Chinese (Wang et al.,
9 2009), Spanish (Mancini, Molinaro, Rizzi, & Carreiras, 2011b) and Tamil (Muralikrishnan,
10 Schlesewsky, & Bornkessel-Schlesewsky, 2015). The statistical analyses were
11 performed on this data, but an 8.5 Hz low-pass filter was further applied to
12 the grand-average ERPs for display purposes in order to achieve smoother ERP
13 plots.

14 Artefacts in the continuous EEG data were rejected in two stages. First, epochs
15 in which the signals from the EOG channels exceeded the threshold of 40
16 μ V were automatically rejected. Second, the thus resulting continuous EEG
17 data was further visually inspected to remove eye blink artefacts and other
18 non-stereotypical artefacts such as sudden head movements, chewing etc. that
19 were not already rejected by the automatic rejection procedure. Trials in
20 which the participants did not perform the probe detection task (see Section 2.4
21 for details about the tasks) were considered invalid trials and were excluded
22 from the analysis at the outset; of the remaining valid trials (of about 34 per
23 condition), an average of about 5 trials per condition had to be removed due
24 to artefacts. Therefore the number of trials entering the averaging procedure
25 did not differ significantly across conditions after artefact rejection, and data
26 from about 28 to 29 trials remained in the analysis in each condition (Mean
27 / standard deviation per condition: SACP = 29.44 / 3.08; SGEN = 29.14 /
28 3.27; SNUM = 28.61 / 2.70; SPER = 28.61 / 2.84; PACP = 29.58 / 2.81;
29 PGEN = 28.97 / 3.44; PNUM = 28.85 / 3.11; PPER = 28.50 / 3.13).

30 ERPs were calculated for each participant from 200 ms before the onset of the

1 verb until 1200 ms after onset (so -200 ms to 1200 ms). These were averaged
2 across items per condition per participant before computing the grand-average
3 ERPs across participants per condition. Repeated-measures analyses of variance
4 (ANOVAs) were computed for the statistical analysis of the ERP data, involving
5 the within-participants factors subject-type and condition-type for mean amplitude
6 values per time-window per condition in 4 lateral Regions of Interest (ROIs)
7 and 3 midline ROIs. The lateral ROIs (LATR in the statistical tables) were
8 defined as follows: LA, comprised of the left-anterior electrodes F7, F3, FC5
9 and FC1; LP, comprised of the left-posterior electrodes P7, P3, CP5 and CP1;
10 RA, comprised of the right-anterior electrodes F8, F4, FC6 and FC2; and RP,
11 comprised of the right-posterior electrodes P8, P4, CP6 and CP2. The midline
12 ROIs (MIDR in the statistical tables) were defined as follows: FC, comprised of
13 the fronto-central electrodes FZ and FCZ; CP, comprised of the centro-parietal
14 electrodes CZ and CPZ; and PO, comprised of the parieto-occipital electrodes
15 PZ and POZ.

16 The statistical analysis of the ERP data was carried out in a hierarchical manner
17 in R (R Core Team, 2019). In order to examine the potential differences
18 between the subject-types statistically (and not just by comparing results from
19 separate analyses of the two subject-types), we included all 8 critical conditions
20 (i.e., from both subject-types) in an omnibus ANOVA in each time-window
21 of interest. Specifically, an ANOVA involving the within-participants factors
22 subject-type and condition-type was computed for the lateral and midline regions
23 separately in each time-window of interest, with the lateral analysis involving
24 the lateral ROI factor (LATR) and the midline analysis involving the midline
25 ROI factor (MIDR). In each analysis, as stated in Section 2.2, the primary
26 factor was subject-type. This choice was motivated by the importance of the
27 number property in the Arabic agreement system (see Section 1.4. To avoid
28 excessive type 1 errors due to violations of sphericity, the correction of Huynh
29 & Feldt (1970) was applied when the analysis involved factors with more
30 than one degree of freedom in the numerator. Interactions that are at least

marginally significant were resolved for the individual levels hierarchically. Factors with more than two levels, which resulted in a significant effect, were further resolved by comparing their individual levels pairwise. This procedure meant that the analysis was performed as follows: in each analysis, if there was a main effect of subject-type, this would show a general difference between the subject-types. If there was a main effect of condition-type, given that condition-type differed on 4 levels (ACP, GEN, NUM, PER), this effect would be resolved by pairwise comparisons of the 4 levels (shown as, say, ACP + NUM in the statistical tables to indicate a pairwise comparison of the acceptable condition versus the number violation condition). An effect resulting from such an individual pairwise comparison would be reported as significant only if it was still significant after applying the modified Bonferroni correction (Keppel, 1991). This resulted in a conservative significance scale for the pairwise comparisons, such that p values must be < 0.025 to be considered significant, and $0.025 < p < 0.04$ already considered marginal, and $p > 0.04$ are not significant). If there was an interaction involving subject-type and condition-type, then the interaction will be resolved first by subject-type and then, if the effect of condition-type is significant in a given subject-type, that effect will be resolved by pairwise comparisons as described above. Further, given a resolvable effect was significant both with and without a lateral or midline ROI interaction in a certain analysis, then this suggests a topographically qualified difference, and therefore only the interaction involving the concerned ROI factor (LATR or MIDR) would be resolved further.

The statistical tables reporting ANOVA results follow these conventions: main effects and/or interactions that were at least marginally significant are reported; a factor or interaction following a bullet point means that factor or interaction was at least marginally significant; factorial resolutions are shown with an arrow followed by the factor and level; pairwise comparisons are shown using the format ACP + PER, where ACP and PER are the levels being compared pairwise; DF implies degrees of freedom; three stars beside p -values imply

1 a significance of $p \leq 0.001$; two stars imply $p \leq 0.01$; a single star
2 implies $p \leq 0.05$; a single pale star implies a marginal ($p \leq 0.08$) effect.
3 For pairwise comparisons, the equivalent significance levels as per modified
4 Bonferroni correction are $p \leq 0.0005$, $p \leq 0.005$, $p \leq 0.025$ and p
5 ≤ 0.04 respectively.

6 The tables use the following abbreviations for the factors and levels: ST: subject-type;
7 ST = S: singular subjects; ST = P: plural subjects; CT: condition-type; ACP:
8 acceptable conditions showing correct agreement; GEN: gender agreement violation;
9 NUM: number agreement violation; PER: person agreement violation; LATR:
10 lateral ROIs; LA: left-anterior; LP: left-posterior; RA: right-anterior; RP: right-posterior;
11 MIDR: midline ROIs; FC: fronto-central; CP: centro-parietal; PO: parieto-occipital.

12 **3 Results**

13 **3.1 Behavioural data**

14 The mean acceptability ratings for the stimuli, as well as the probe detection
15 accuracy for the critical conditions, shown in Table 3, were calculated using the
16 behavioural data collected during the experiment. Only those trials in which
17 the acceptability judgement task following each trial was performed (i.e., not
18 timed out) were considered for the analysis. Further, the acceptability data
19 presented here pertain only to those trials in which the participants performed
20 the probe detection task correctly (see Section 2.4 for details about the tasks).
21 Acceptability was highest for the conditions with no violations, whereas it was
22 the lowest for conditions with number violations. Across conditions, acceptability
23 was relatively slightly higher for conditions with a plural subject as compared
24 to the corresponding conditions with a singular subject. The overall accuracy
25 was very high across all conditions. Owing to the fact that the reaction time
26 data are not time-locked to the critical manipulation in the stimulus sentences,
27 they are not reported here (but are available from the corresponding author on
28 request). Figure 1 shows raincloud plots (Allen, Poggiali, Whitaker, Marshall,

1 & Kievit, 2019) of the behavioural acceptability judgements illustrating the
2 differences in ratings between the subject-types. Panel A shows the by-participant
3 variability of acceptability ratings, with the individual data points representing
4 the mean by-participant acceptability of each subject-type and condition-type
5 combination. Panel B shows the by-item variability of acceptability ratings,
6 with the individual data points representing the mean by-item acceptability of
7 each subject-type and condition-type combination.

Table 3: Sentence acceptability ratings and probe detection accuracy

Condition	Sentence Acceptability Rating %	SD	Probe Detection Accuracy %	SD
SACP	90.51	11.86	95.74	4.54
SGEN	23.68	29.67	94.48	4.10
SNUM	25.55	28.76	94.16	5.63
SPER	47.62	22.53	95.58	3.93
PACP	91.68	7.21	95.66	4.44
PGEN	67.00	22.99	94.42	4.89
PNUM	33.91	30.82	94.91	4.45
PPER	51.83	30.02	93.57	5.22

8 The statistical analysis of the behavioural data was performed by means of
9 ANOVAs involving the within-subjects factors subject-type (ST) and condition-type
10 (CT), and the random factors participants (F1) and items (F2). The statistical
11 analysis was carried out in a hierarchical manner as described [Section 2.6](#)
12 above, with the exception that there was no ROI factor involved in the behavioural
13 data analysis. [Table 4](#) shows a summary of effects on the behavioural data
14 collected during the experiment.

15 There were main effects of subject-type and condition-type on the acceptability
16 in the analysis by participants as well as the analysis by items. Resolving the
17 effect of condition-type by comparing the condition-types pairwise showed
18 a significant simple effect of condition-type for all possible comparisons in
19 both analyses, with the largest effect for the ACP + NUM comparison. The

Figure 1: Raincloud plot of the acceptability ratings, showing by-participant variability (A) and by-item variability (B).

Table 4: ANOVA: Acceptability Data

Effects on Acceptability	DF	F1:Participants	DF	F2:Items
♦ ST	1,33	56.39 <.001 ***	1,59	246.80 <.001 ***
♦ CT	3,99	105.60 <.001 ***	3,177	642.50 <.001 ***
↳CT = ACP+PER ♦ CT	1,33	100.70 <.001 ***	1,59	747.10 <.001 ***
↳CT = ACP+NUM ♦ CT	1,33	138.20 <.001 ***	1,59	2503.00 <.001 ***
↳CT = NUM+PER ♦ CT	1,33	54.05 <.001 ***	1,59	115.30 <.001 ***
↳CT = ACP+GEN ♦ CT	1,33	118.10 <.001 ***	1,59	1298.00 <.001 ***
↳CT = GEN+PER ♦ CT	1,33	5.40 0.026 *	1,59	8.99 0.003 **
↳CT = NUM+GEN ♦ CT	1,33	48.57 <.001 ***	1,59	130.90 <.001 ***
♦ ST x CT	3,99	30.96 <.001 ***	3,177	142.60 <.001 ***
↳ST = S ♦ CT	3,99	122.40 <.001 ***	3,177	613.30 <.001 ***
↳CT = ACP+PER ♦ CT	1,33	100.90 <.001 ***	1,59	483.80 <.001 ***
↳CT = ACP+NUM ♦ CT	1,33	141.10 <.001 ***	1,59	1512.00 <.001 ***
↳CT = NUM+PER ♦ CT	1,33	80.24 <.001 ***	1,59	117.50 <.001 ***
↳CT = ACP+GEN ♦ CT	1,33	138.30 <.001 ***	1,59	1967.00 <.001 ***
↳CT = GEN+PER ♦ CT	1,33	108.10 <.001 ***	1,59	151.00 <.001 ***
↳ST = P ♦ CT	3,99	52.95 <.001 ***	3,177	315.50 <.001 ***
↳CT = ACP+PER ♦ CT	1,33	66.45 <.001 ***	1,59	487.80 <.001 ***
↳CT = ACP+NUM ♦ CT	1,33	102.80 <.001 ***	1,59	1077.00 <.001 ***
↳CT = NUM+PER ♦ CT	1,33	11.68 0.001 **	1,59	53.87 <.001 ***
↳CT = ACP+GEN ♦ CT	1,33	44.88 <.001 ***	1,59	188.70 <.001 ***
↳CT = GEN+PER ♦ CT	1,33	14.56 <.001 ***	1,59	71.44 <.001 ***
↳CT = NUM+GEN ♦ CT	1,33	48.92 <.001 ***	1,59	253.80 <.001 ***

- 1 interaction subject-type x condition-type was significant in both the analyses,
- 2 which when resolved for subject-type showed an effect of condition-type for
- 3 both subject-types. This was further resolved by comparing the condition-types
- 4 pairwise, which showed a simple effect of condition-type for all comparisons
- 5 except NUM + GEN in both analyses when the subject was singular. When the
- 6 subject was plural, there was a simple effect of condition-type for all comparisons

1 in both analyses. There were no effects on the probe detection accuracy.

2 **3.2 ERP data**

3 The ERPs at the verb are shown in Figure 2 for the singular subject conditions,
4 and in Figure 3 for the plural subject conditions. Visual inspection of the
5 ERP data showed that the violation conditions mostly engendered a negativity
6 followed by a late-positivity. This qualitative observation was further supported
7 by a running t-test of significance on the ERP plots, as shown in Figure S4,
8 which revealed at least two time-window clusters that should be significant.
9 Along with these observations, considering ERP components that have been
10 known to be relevant for processing agreement in previous studies, we chose
11 two time-windows for analysis, namely 400 – 600ms and 700 – 850 ms. Figure
12 5 shows the topographic map of the ERPs at the position of the verb in the
13 400 – 600ms and 700 – 850 ms time-windows for the two subject-types in the
14 three violation conditions, after the effects for the acceptable condition in each
15 case has been subtracted. (See Section 2.6 for details regarding the statistical
16 analysis).

17 **3.2.1 Time-window 400–600 ms**

18
19 The predominant effect in this time-window is the graded negativity engendered
20 by the violation conditions as opposed to the acceptable conditions, showing
21 clear differences in effects between the two subject-types. Number violations
22 engendered a large broadly distributed negativity effect regardless of subject-type.
23 The modulation of negativities evoked by person and gender violations differed
24 based on whether the subject-type was singular or plural, with gender violations
25 evoking a larger effect than person violations when the subject was singular,
26 and person violations evoking a larger effect than gender violations when the
27 subject was plural. Similarly, the topographic distribution of these negativities
28 also varied, with the effect for person violations showing a central distribution,

1 and that for gender violations showing a centro-parietal distribution. Table 5
2 and Table 6 show a summary of all the effects that reached at least marginal
3 significance at the position of the verb in the 400 – 600 ms time-window for
4 the lateral and midline regions respectively.

5 In the lateral regions, there were a main effects of subject-type and condition-type.
6 Resolving the condition-type by comparing the condition-types pairwise showed
7 a simple effect of condition-type for the comparison ACP + NUM ($p = 0.004$).
8 The interaction subject-type x condition-type as well as the three-way interaction
9 LATR x subject-type x condition-type were significant. Resolving the lateral
10 ROI interaction for the individual regions showed that there was an effect of the
11 interaction subject-type x condition-type in the left-posterior and right-posterior
12 regions. This effect was resolved for subject-type in each concerned region,
13 which showed that in the left-posterior and right-posterior regions, there was
14 an effect of condition-type when the subject was singular. Resolving this further
15 by comparing the condition-type pairwise revealed that there was a simple
16 effect of condition-type for the comparisons ACP + NUM (all $ps \leq 0.022$),
17 ACP + GEN (all $ps = 0.001$) and PER + GEN (all $ps \leq 0.003$) in both
18 left-posterior as well as right-posterior regions. This effect reached significance
19 for the comparison PER + NUM ($p = 0.017$) in the right-posterior region
20 alone. In the left-posterior region, there was an effect of condition-type when
21 the subject was plural, which when resolved by comparing the condition-types
22 pairwise showed a simple effect of condition-type for the comparison NUM +
23 GEN (0.005) and a marginal effect of condition-type for the comparison PER
24 + GEN (0.026).

25 In the midline regions, there were main effects of subject-type and condition-type.
26 The interaction MIDR x subject-type was significant, which when resolved
27 for the individual midline ROIs showed a simple effect of subject-type in the
28 front-central and centro-parietal midline regions. The interaction of MIDR x
29 condition-type was likewise significant, which when resolved for the midline
30 ROIs showed an effect of condition-type in the fronto-central and centro-parietal

1 midline regions, and this effect was marginal in the parieto-occipital midline
2 region. Comparing the condition-types pairwise in each of the three midline
3 regions showed a simple effect of ACP + PER (all p s ≤ 0.022) in the front-central
4 and centro-parietal midline regions. The effect of subject-type was significant
5 for the comparison ACP + NUM (all p s ≤ 0.017) in the fronto-central and
6 centro-parietal midline regions, whereas this effect was marginal ($p = 0.035$)
7 in the parieto-occipital midline region. For the comparison ACP + GEN, there
8 was a significant effect of subject-type in the centro-parietal midline region
9 ($p = 0.013$), whereas this effect was marginal in the parieto-occipital midline
10 region ($p = 0.032$). The three-way interaction MIDR x subject-type x condition-type
11 was significant, which was resolved for the individual midline ROIs. This
12 revealed an effect of the interaction subject-type x condition-type in the centro-parietal
13 and parieto-occipital midline regions. Resolving this effect further, there was
14 an effect of condition-type in both regions when the subject was singular,
15 which when resolved by pairwise comparisons of the condition-types showed
16 a simple effect of condition-type for the comparison ACP + GEN (all p s =
17 0.001) in both regions, for the comparison PER + GEN in the parieto-occipital
18 region ($p = 0.004$), with this effect being marginal in the centro-parietal
19 region ($p = 0.037$), and for the comparison ACP + NUM ($p = 0.018$) in the
20 centro-parietal midline region. In the centro-parietal midline region, there
21 was an effect of condition-type when the subject was plural, which when
22 resolved using pairwise comparisons of condition-types showed a simple effect
23 of condition-type for the comparisons PER + GEN ($p = 0.011$) and NUM +
24 GEN ($p = 0.014$).

Figure 2: ERPs at the verb: Singular subject conditions.

Figure 3: ERPs at the verb: Plural subject conditions.

Figure 4: ERPs at the verb with running t-test to detect potentially significant time-windows: Singular subject conditions.

Figure 5: Topography of effects at the verb.

Table 5: ANOVA: ERPs at the Verb : 400 – 600 ms

Effects in time-window 400–600 ms : Lateral Regions				DF	F	pHF	
◆ ST				1,33	5.55	0.024	★
◆ CT				3,99	3.24	0.025	★
↳ _{CT} = ACP+NUM	◆ CT			1,33	9.25	0.004	★★
◆ ST x CT				3,99	3.03	0.032	★
◆ LATR x ST x CT				9,297	2.37	0.035	★
↳ _{LATR} = LP	◆ ST x CT			3,99	4.54	0.005	★★
	↳ _{ST} = S	◆ CT		3,99	6.31	<.001	★★★
		↳ _{CT} = ACP+NUM	◆ CT	1,33	5.76	0.022	★
		↳ _{CT} = ACP+GEN	◆ CT	1,33	11.95	0.001	★★
		↳ _{CT} = PER+GEN	◆ CT	1,33	9.70	0.003	★★
	↳ _{ST} = P	◆ CT		3,99	2.74	0.050	★
		↳ _{CT} = PER+GEN	◆ CT	1,33	5.38	0.026	☆
		↳ _{CT} = NUM+GEN	◆ CT	1,33	8.87	0.005	★★
↳ _{LATR} = RP	◆ ST x CT			3,99	6.17	<.001	★★★
	↳ _{ST} = S	◆ CT		3,99	7.04	<.001	★★★
		↳ _{CT} = ACP+NUM	◆ CT	1,33	10.25	0.003	★★
		↳ _{CT} = PER+NUM	◆ CT	1,33	6.25	0.017	★
		↳ _{CT} = ACP+GEN	◆ CT	1,33	11.48	0.001	★★
		↳ _{CT} = PER+GEN	◆ CT	1,33	10.56	0.002	★★

Table 6: ANOVA: ERPs at the Verb : 400 – 600 ms

Effects in time-window 400–600 ms : Midline Regions		DF	F	pHF	
◆ ST		1,33	6.47	0.015	★★
◆ MIDR x ST		2,66	5.95	0.014	★★
↳MIDR = FC	◆ ST	1,33	11.40	0.001	★★★
↳MIDR = CP	◆ ST	1,33	4.24	0.046	★
◆ CT		3,99	3.09	0.030	★
◆ MIDR x CT		6,198	2.46	0.043	★
↳MIDR = FC	◆ CT	3,99	2.99	0.034	★
	↳CT = ACP+PER ◆ CT	1,33	6.68	0.014	★
	↳CT = ACP+NUM ◆ CT	1,33	6.24	0.017	★
↳MIDR = CP	◆ CT	3,99	4.29	0.046	★
	↳CT = ACP+PER ◆ CT	1,33	5.73	0.022	★
	↳CT = ACP+NUM ◆ CT	1,33	7.87	0.008	★
	↳CT = ACP+GEN ◆ CT	1,33	6.76	0.013	★
↳MIDR = PO	◆ CT	3,99	2.34	0.077	☆
	↳CT = ACP+NUM ◆ CT	1,33	4.83	0.035	☆
	↳CT = ACP+GEN ◆ CT	1,33	4.99	0.032	☆
◆ ST x CT		3,99	3.68	0.014	★★
◆ MIDR x ST x CT		6,198	2.27	0.056	★
↳MIDR = CP	◆ ST x CT	3,99	4.30	0.006	★★
	↳ST = S ◆ CT	3,99	4.96	0.003	★★
	↳CT = ACP+NUM ◆ CT	1,33	6.14	0.018	★
	↳CT = ACP+GEN ◆ CT	1,33	11.78	0.001	★★
	↳CT = PER+GEN ◆ CT	1,33	4.69	0.037	☆
	↳ST = P ◆ CT	3,99	2.95	0.036	★
	↳CT = PER+GEN ◆ CT	1,33	7.12	0.011	★
	↳CT = NUM+GEN ◆ CT	1,33	6.61	0.014	★
↳MIDR = PO	◆ ST x CT	3,99	5.22	0.002	★★
	↳ST = S ◆ CT	3,99	5.99	<.001	★★
	↳CT = ACP+GEN ◆ CT	1,33	11.74	0.001	★★
	↳CT = PER+GEN ◆ CT	1,33	9.54	0.004	★★

1 Therefore all the negativites that were significant in the 400 – 600 ms time-window
 2 showed a central and centro-parietal maximum. However, a left-lateral trend
 3 was apparent in the scalp topography of the negativities engendered by person
 4 violations when the subject was plural. Since the topography of negativity
 5 effects have important consequences for their functional interpretation (here,
 6 N400 versus LAN), we conducted a post-hoc analysis of the ERPs in an additional
 7 time-window, namely 300 – 500 ms, that was slightly earlier than the 400 – 600
 8 ms time-window, specifically to test whether these effects perhaps show a
 9 left-anterior maximum in this early time-window. The predominant effect
 10 in this time-window was the graded negativity for the violation conditions
 11 as opposed to the acceptable conditions (becoming more prominent in the
 12 400 – 600 ms time-window as reported above), with the gradedness differing
 13 based on whether the subject was singular or plural. Crucially however, there
 14 were no effects that reached significance in the left-anterior regions. Furthermore,
 15 there were no interactions involving the lateral regions of interest. Therefore
 16 we did not find any evidence in our data for a left-anterior maximum for any
 17 of the negativity effects. Nevertheless, the full statistics for the 300 – 500
 18 ms time-window are provided for reference in the supplementary supporting
 19 information.

20 **3.2.2 Time-window 700–850 ms**

21
 22 The predominant effect in this time-window is the late-positivity effect for
 23 violation conditions as opposed to acceptable conditions. Crucially, this effect
 24 is not only graded based on the violating feature, but its modulation is also
 25 different based on the subject-type. The effect thus shows a four-way gradation
 26 when the subject is singular, with number violations evoking the largest positivity
 27 effect as opposed to acceptable sentences, followed by gender violations and
 28 then by person violations. By contrast, only a three-way difference ensues for
 29 plural subjects, with the largest positivity effect for number violations followed

1 by smaller but virtually identical positivities for person violations and gender
2 violations as opposed to acceptable sentences. Table 7 and Table 8 show a
3 summary of all the effects that reached at least marginal significance at the
4 position of the verb in the 700 – 850 ms time-window in the lateral and midline
5 regions respectively.

6 In the lateral regions, there was a main effect of condition-type, which was
7 resolved resolved by comparing the condition-types pairwise. This showed
8 a significant effect of condition-type for the comparisons ACP + PER ($p =$
9 0.016), ACP + NUM ($p = 0$), ACP + GEN ($p < 0.001$) and PER + NUM ($p =$
10 0.014) in all the lateral regions. The interaction subject-type x condition-type
11 and the three-way interaction LATR x subject-type x condition-type were significant.
12 Resolving this interaction for the individual lateral ROIs showed that the interaction
13 subject-type x condition-type was significant in the left-anterior, left-posterior
14 and right-anterior regions. This interaction was resolved for subject-type in
15 all regions concerned, which showed that, when the subject was singular,
16 there was an effect of condition-type in the left-anterior, left-posterior and
17 right-anterior regions, which was resolved by comparing condition-types pairwise
18 in these regions. This showed a simple effect of condition-type for the comparisons
19 ACP + NUM (all $ps \leq 0.011$), ACP + GEN (all $ps \leq 0.001$) and PER
20 + GEN (all $ps \leq 0.024$) in all three regions concerned. There was an
21 effect of condition-type for the comparison PER + NUM ($p = 0.002$) in the
22 left-posterior region, and the effect was marginal in the right-anterior region.
23 When the subject was plural, there was an effect of condition-type only in the
24 left-anterior region, which when resolved further by comparing the condition-types
25 pairwise revealed a simple effect of condition-type for the comparisons ACP +
26 NUM ($p = 0.004$) and NUM + GEN ($p = 0.007$).

27 In the midline regions, there was a main effect of condition-type, which when
28 resolved by comparing the condition-types pairwise showed a significant effect
29 of condition-type for the comparisons ACP + PER ($p = 0.0022$), ACP +
30 NUM ($p = 0$), ACP + GEN ($p = 0$), PER + NUM ($p = 0.002$) and NUM

1 + GEN ($p = 0.043$). The interaction subject-type x condition-type and the
2 three-way interaction MIDR x subject-type x condition-type were significant.
3 Resolving this interaction for the individual midline ROIs showed that the
4 interaction subject-type x condition-type was significant in all three midline
5 regions. This interaction was resolved for subject-type in all regions concerned,
6 which showed that, when the subject was singular, there was an effect of
7 condition-type in all three regions (all $ps = 0$), which was resolved by comparing
8 condition-types pairwise in these regions. There was a simple effect of condition-type
9 for the comparisons ACP + NUM (all $ps < 0.001$), ACP + GEN (all $ps <$
10 0.001), PER + NUM (all $ps \leq 0.005$) and PER + GEN (all $ps \leq 0.009$)
11 in all the midline regions. This effect of condition-type was significant for the
12 comparison NUM + GEN ($p \leq 0.025$) in the parieto-occipital midline region.
13 When the subject was plural, there was an effect of condition-type in all three
14 regions (all $ps \leq 0.045$), which was resolved by comparing condition-types
15 pairwise in these regions. There was a simple effect of condition-type for the
16 comparison ACP + NUM in all the regions (all $ps \leq 0.009$). This effect of
17 condition-type was marginal for the comparison ACP + PER ($p = 0.039$) and
18 significant for the comparison NUM + GEN ($p = 0.016$) in the fronto-central
19 midline region. The effect of condition-type was significant for the comparison
20 ACP + GEN ($p = 0.003$) in the parieto-occipital midline region.

Table 7: ANOVA: ERPs at the Verb : 700 – 850 ms

Effects in time-window 700–850 ms: Lateral Regions				DF	F	pHF	
◆ CT				3,99	10.82	0	***
↳CT = ACP+PER	◆ CT			1,33	6.44	0.016	★
↳CT = ACP+NUM	◆ CT			1,33	30.66	0	***
↳CT = PER+NUM	◆ CT			1,33	6.67	0.014	★
↳CT = ACP+GEN	◆ CT			1,33	15.24	<.001	***
◆ ST x CT				3,99	3.19	0.026	★
◆ LATR x ST x CT				9,297	2.66	0.019	★
↳LATR = LA	◆ ST x CT			3,99	3.51	0.018	★
	↳ST = S	◆ CT		3,99	6.40	<.001	***
		↳CT = ACP+NUM	◆ CT	1,33	12.74	0.011	**
		↳CT = ACP+GEN	◆ CT	1,33	12.72	0.001	**
		↳CT = PER+GEN	◆ CT	1,33	5.53	0.024	★
	↳ST = P	◆ CT		3,99	3.74	0.013	**
		↳CT = ACP+NUM	◆ CT	1,33	9.48	0.004	**
		↳CT = NUM+GEN	◆ CT	1,33	8.27	0.007	★
↳LATR = LP	◆ ST x CT			3,99	2.96	0.035	★
	↳ST = S	◆ CT		3,99	10.89	0	***
		↳CT = ACP+NUM	◆ CT	1,33	18.51	<.001	***
		↳CT = PER+NUM	◆ CT	1,33	11.08	0.002	**
		↳CT = ACP+GEN	◆ CT	1,33	14.93	<.001	***
		↳CT = PER+GEN	◆ CT	1,33	8.18	0.007	★
↳LATR = RA	◆ ST x CT			3,99	3.64	0.017	★
	↳ST = S	◆ CT		3,99	6.55	<.001	***
		↳CT = ACP+NUM	◆ CT	1,33	7.00	0.012	★
		↳CT = PER+NUM	◆ CT	1,33	4.48	0.041	☆
		↳CT = ACP+GEN	◆ CT	1,33	14.01	<.001	**
		↳CT = PER+GEN	◆ CT	1,33	9.21	0.004	**

Table 8: ANOVA: ERPs at the Verb : 700 – 850 ms

Effects in time-window 700–850 ms : Midline Regions				DF	F	pHF	
◆ CT				3,99	13.64	0	***
└ _{CT} = ACP+PER	◆ CT			1,33	5.69	0.022	*
└ _{CT} = ACP+NUM	◆ CT			1,33	30.63	0	***
└ _{CT} = PER+NUM	◆ CT			1,33	11.14	0.002	**
└ _{CT} = ACP+GEN	◆ CT			1,33	22.45	0	***
└ _{CT} = NUM+GEN	◆ CT			1,33	4.41	0.043	*
◆ ST x CT				3,99	4.85	0.003	**
◆ MIDR x ST x CT				6,198	3.87	0.005	**
└ _{MIDR} = FC	◆ ST x CT			3,99	6.07	<.001	***
	└ _{ST} = S	◆ CT		3,99	11.38	0	***
		└ _{CT} = ACP+NUM	◆ CT	1,33	19.09	<.001	***
		└ _{CT} = PER+NUM	◆ CT	1,33	8.95	0.005	**
		└ _{CT} = ACP+GEN	◆ CT	1,33	23.22	0	***
		└ _{CT} = PER+GEN	◆ CT	1,33	12.56	0.001	**
	└ _{ST} = P	◆ CT		3,99	3.46	0.019	*
		└ _{CT} = ACP+PER	◆ CT	1,33	4.61	0.039	*
		└ _{CT} = ACP+NUM	◆ CT	1,33	7.62	0.009	*
		└ _{CT} = NUM+GEN	◆ CT	1,33	6.34	0.016	*
└ _{MIDR} = CP	◆ ST x CT			3,99	5.55	0.001	***
	└ _{ST} = S	◆ CT		3,99	12.58	0	***
		└ _{CT} = ACP+NUM	◆ CT	1,33	19.85	<.001	***
		└ _{CT} = PER+NUM	◆ CT	1,33	13.03	0.001	**
		└ _{CT} = ACP+GEN	◆ CT	1,33	17.98	<.001	***
		└ _{CT} = PER+GEN	◆ CT	1,33	10.55	0.002	**
	└ _{ST} = P	◆ CT		3,99	2.90	0.045	*
		└ _{CT} = ACP+NUM	◆ CT	1,33	10.21	0.003	**
└ _{MIDR} = PO	◆ ST x CT			3,99	3.51	0.018	*
	└ _{ST} = S	◆ CT		3,99	22.68	0	***
		└ _{CT} = ACP+NUM	◆ CT	1,33	17.33	<.001	***
		└ _{CT} = PER+NUM	◆ CT	1,33	16.70	<.001	***
		└ _{CT} = ACP+GEN	◆ CT	1,33	16.87	<.001	***
		└ _{CT} = PER+GEN	◆ CT	1,33	7.56	0.009	*
		└ _{CT} = NUM+GEN	◆ CT	1,33	5.47	0.025	*
	└ _{ST} = P	◆ CT		3,99	3.44	0.024	*
		└ _{CT} = ACP+NUM	◆ CT	1,33	10.10	0.003	**
		└ _{CT} = ACP+GEN	◆ CT	1,33	10.05	0.003	**

1 3.3 Summary of results

2 The ERP results from our study can be summarised as follows.

- 3 • Violation of the agreement features elicited a biphasic negativity – late-positivity
4 effect as opposed to acceptable sentences.
- 5 • However, this biphasic effect was graded based on the feature that was
6 violated as well as the subject-type. Whilst number violations evoked
7 the largest effects overall, the effects for person and gender violations
8 were smaller in comparison, and showed a qualitative difference based
9 on whether the subject-type was singular or plural.
- 10 • In the negativity time-window, a three-way distinction ensued that was
11 different for the two subject-types. Number violations evoked a large
12 broadly distributed negativity effect for both subject-types. Gender violations
13 evoked a larger negativity effect as opposed to person violations when the
14 subject was singular, with a centro-parietal maximum. Person violations
15 evoked a larger negativity effect as opposed to gender violations as well as
16 acceptable conditions when the subject was plural, with a fronto-central
17 distribution. A visually apparent left-anterior trend for this latter effect
18 was however not significant statistically.
- 19 • In the late-positivity time-window, there was a four-way gradation of
20 the positivity effect when the subject was singular, whereas it was a
21 three-way gradation when the subject was plural. Number violations
22 evoked the largest positivity effect in both subject-types. Gender violations
23 evoked a larger positivity effect compared to person violations when the
24 subject was singular, but no such difference ensued when the subject was
25 plural.

26 Based on the latency and topography of effects as well as the experimental
27 conditions, the negativity effects in our study can be plausibly interpreted as

1 instances of an N400 effect³ and the late-positivities as instances of a P600
2 effect. Agreement violations of the sort we employed have been traditionally
3 viewed as formal morphosyntactic rule violations, which are associated with
4 concomitant LAN effects that are interpreted as indicative of the detection of
5 the morphosyntactic violation (Münte, Szentkuti, Wieringa, Matzke, & Johannes,
6 1997; Münte, Matzke, & Johannes, 1997; Friederici, 2002; Bornkessel & Schlesewsky,
7 2006). Further, the likelihood of observing a LAN has been thought to be
8 in direct proportion to the morphological richness of a language (Friederici
9 & Weissenborn, 2007), which nevertheless is said to depend upon whether
10 morphological marking is crucial for assigning syntactic roles in the given
11 language (Friederici, 2011). However, Molinaro, Barber, & Carreiras (2011)
12 draw attention to the fact that the nature of the complexities involved in
13 morphological decomposition for feature identification may dissociate whether
14 a LAN or, alternatively, an N400 ensues. Indeed, Choudhary et al. (2009)
15 provide converging evidence from Hindi that this dissociation results from
16 whether an interpretively relevant cue is violated (in which case an N400
17 ensues), or alternatively the violation involves a cue that is irrelevant for
18 interpretation. In view of this, the absence of a LAN effect and the presence
19 of an N400 in our study is not surprising, given that agreement computation
20 in Arabic is not always predictable based on the features of the agreement
21 controller alone, but is dependent upon specific syntactic properties of the
22 construction involved, such as word-order and whether or not the subject is
23 overt, as well as properties at the syntax-semantic interface such as humanness

3. As mentioned earlier, a confirmatory post-hoc analysis in an earlier time-window did not support an interpretation of some of the negativities in our study as instances of a LAN. Whilst the LAN versus N400 distinction is an important one (but see Bornkessel-Schlesewsky & Schlesewsky (2019) for a model that views all language-related negativities as a family of functionally related rather than distinct negativities), and our data does not rule out the possibility that some agreement violations may indeed lead to a LAN effect whereas others might engender an N400 effect, such a scenario of finding qualitatively different effects for agreement violations based on the feature violated and the language concerned would only strengthen the idea we are proposing here. See Discussion.

(see below for a detailed discussion). The P600 effects in our study can be plausibly interpreted as reflecting repair or reanalysis processes associated with agreement violations (Friederici, 2002, 2011; Bornkessel & Schlesewsky, 2006), thought to be triggered by domain-general conflict monitoring processes (Van de Meerendonk, Chwilla, & Kolk, 2013).

4 Discussion

We investigated the processing of subject-verb agreement in simple intransitive Arabic sentences in this ERP experiment, and present here the findings from one of the first neurocognitive studies examining sentence level processes in Arabic, thus providing first insights into the online processing of the language.

4.1 Hierarchical modulation of effects

As illustrated by the topographic map of effects in Figure 5, our results show that violations of the features not only modulate the biphasic pattern of ERPs, but they also show a qualitative difference in their modulation based on whether the subject was singular or plural. The modulation of effects for the violation conditions as opposed to the acceptable conditions in our study can be represented as a hierarchy as follows:

(2) Modulation of N400

Singular subject conditions : Number / Gender > Person

Plural subject conditions : Number / Person > Gender

(3) Modulation of P600

Singular subject conditions : Number > Gender > Person

Plural subject conditions : Number > Person / Gender

A handful of previous studies investigating processing differences between agreement features (in the subject-verb context or otherwise) have indeed

1 reported a modulation of late-positive P600 effects, albeit for across subject-type
 2 comparisons (Kaan et al., 2000; Deutsch & Bentin, 2001) or for combined
 3 versus single feature violations (Nevins et al., 2007; Zawiswewski et al., 2016;
 4 Alemán Bañón & Rothman, 2016).⁴ However, to our knowledge, a modulation
 5 of negativities (LAN or N400) has not been reported to date in the context of
 6 agreement violations involving all three features⁵, and ours may be one of the
 7 first studies on agreement processing to report such a hierarchical modulation
 8 of the N400 based on the agreement feature involved.

9 The modulation of effects in our study, especially of the negativity, cannot be
 10 satisfactorily explained simply based on differences in the complexity between
 11 the conditions, nor the frequency of a certain type of violation, nor orthographic
 12 salience, nor even the physical characteristics of the morphosyntactic markings
 13 per se. This is because, as we have described in Section 2.3, for a given verb
 14 in each subject-type, the material preceding it was always identical. This
 15 meant that, at the position of the verb, potential effects of differences in lexical
 16 frequency and orthographic or morphological complexity apply to all conditions
 17 identically equally, and therefore do not confound the interpretation of language-related

4. Since the focus in our study is on the differences in effects *within* a subject-type, it is not straightforward to compare our results with these studies. Nevertheless, restricting to subject-verb agreement and single feature violations, the P600 for the two subject-types in our results may be compared to at least two studies. The P600 difference in our results for the number feature between the two subject-types would be in line with a similar finding in Dutch that Kaan et al. (2000) reported. On the other hand, we found P600 effects for gender violations in both subject-types, whereas Deutsch & Bentin (2001) reported a P600 effect only when the subject was plural in Hebrew.

5. In their Basque study, Zawiswewski et al. (2016) found a significant difference in the 300-500 time-window, which they had initially interpreted as an N400 modulation for number violations as opposed to the other conditions; however, the statistics in their study as well as the topography of this effect with a posterior maximum in the P3 electrode region suggests that it is rather a P300 difference that they observe, as has been correctly pointed out by an anonymous reviewer of their manuscript. Their behavioural data also support this interpretation rather than their initial conjecture. Martinez de la Hidalga et al. (2019) report an N400 modulation in Basque, but only involving person and number features.

1 effects of interest at the verb. Physical characteristics of the stimuli such as the
2 visual length of the verb appear to be comparable across conditions, despite
3 minor differences in the P200 amplitudes that were nevertheless not significant
4 (see Figure S4).

5 Rather, we argue that these results suggest that the processing system takes into
6 account the relative salience of the features in the given language. If so, this
7 would be in line with the view put forward by Molinaro, Barber, & Carreiras
8 (2011) in their exhaustive review of cross-linguistic findings on processing
9 agreement, namely that the processing of agreement dependencies is sensitive
10 to the feature involved as well as the constituents expressing the dependency,
11 and that this can result in modulations of negativity effects (such as LAN and/or
12 N400) and late-positivity effects⁶. Specifically, the processing of subject-verb
13 agreement is said to involve semantic factors in addition to morphosyntactic
14 information (Molinaro, Vespignani, Zamparelli, & Job, 2011), and the extent to
15 which lexical-semantic factors play a role in computing subject-verb agreement
16 in a given language is said to have a direct bearing on whether a LAN or an
17 N400 effect is engendered (Molinaro, Barber, Caffarra, & Carreiras, 2015).

18 It may be of some relevance here to briefly turn to an ongoing debate in the ERP
19 literature on morphosyntactic processing, which relates to inter-participant
20 variation of ERP effects. The claim is that most of the LAN effects reported for
21 agreement processing in the literature may simply be artefactual resulting from
22 components that partially overlap temporally and spatially, which happen to
23 be aggregated together due to the grand-averaging of individual ERPs (Tanner,
24 2018, 2015; Tanner & Van Hell, 2014). Whilst we did not find evidence
25 for a LAN effect in our study, it is important to consider whether individual
26 variation amongst our participants might be able to explain some of our results.
27 However, several points speak against such a possibility. Firstly, individual
28 variation, if any, would have been systematic across conditions for a given
29 participant. Secondly, in view of our within-participants design, any such

6. Nevertheless, we do not assume that these effects are strictly following each other in stages.

1 variation would have equally contributed to all the critical conditions since
 2 all of them consisted of the same type of violation, namely a violation of an
 3 agreement feature between the subject and the verb. Thirdly, as Grey, Tanner,
 4 & Van Hell (2017) have reported, variation in ERP effects engendered during
 5 morphosyntactic processing across individuals is said to be minimal in case of
 6 dominant right-handers (as opposed to left-handers). All our participants were
 7 dominantly right-handed individuals (see Section 2.5). Crucially therefore,
 8 given that any potential artefactual outcome resulting from the grand-averaging
 9 procedure would be equally applicable to all our critical conditions, individual
 10 variation may not fully account for, nor nullify, the subject-type specific differences
 11 in the modulation of effects we found in our study.

12 **4.2 Salience-weighted Feature Hierarchy**

13 In view of the agreement feature hierarchy in (1) originally proposed based
 14 on cross-linguistic distribution of these features (Greenberg, 1963), the graded
 15 effects in the present study are not surprising. Rather, our results provide
 16 neurophysiological evidence for the idea that the relative position of a feature
 17 in the hierarchy directly reflects its relative cognitive salience (Harley & Ritter,
 18 2002, but see below) and thereby its relative importance in language processing
 19 (Carminati, 2005) in comparison to other features. Nevertheless, the modulation
 20 of effects found in our study suggests that the feature hierarchy based on
 21 distributional properties and conceptual or cognitive aspects of the features
 22 may differ from a hierarchy based on the relative language-specific salience
 23 of the features, which need not be identical across languages. That is, the
 24 hierarchy of feature salience appears to differ based on language-specific properties,
 25 and may exhibit slight variations even within a given language depending
 26 upon the specifics of the construction involved and general language-use in the
 27 speech community as well as the way each feature is morphologically encoded
 28 in the language. We argue below that this variation is neither an aberration
 29 nor arbitrary. Rather, it is systematic based on the relative weightings of the

1 salience of a given feature in a language.

2 We postulate a salience hierarchy of agreement features that is language-specific
3 rather than universal. The properties of a given language as well as the relative
4 salience of the agreement features determine the hierarchy and thereby differentially
5 modulate language comprehension. If the hierarchy is flat such that there is
6 minimal difference in salience between the features, then no modulation of ERP
7 effects should be expected for single feature violations in the given language.
8 If there is a hierarchical difference in salience between the features, then there
9 would be a concomitant modulation of ERP effects, such that violating a highly
10 salient agreement feature evokes a larger effect compared to violating a less
11 salient feature.

12 The idea that some properties in a language may be relatively more salient
13 than others for language comprehension is not new. This was first put forward
14 in the context of the Competition Model (e.g., [MacWhinney et al., 1984](#); [Bates](#)
15 [& MacWhinney, 1989](#); [Bates, 1999](#)), in which such linguistic properties or cues
16 with language-specific weightings interact during language comprehension.
17 Agreement is one such cue, the strength of which has been shown to vary
18 across languages (for an overview, see [Bates et al., 2001](#)). Within the domain
19 of online language processing, [Bornkessel-Schlesewsky & Schlewsky \(2009\)](#)
20 have proposed that information types such as case-marking, word-order, animacy
21 etc., called prominence information, all interact during online language comprehension,
22 and that their relative prominence depends upon their language-specific weightings.
23 For instance, word-order has higher weighting in English than, say, animacy,
24 and determines the argument roles, whereas in a language like Turkish, case is
25 more prominent, and so on. Furthermore, in a recent article, [Bornkessel-Schlesewsky](#)
26 [& Schlewsky \(2019\)](#) have argued for a neurobiologically plausible model,
27 whereby they posit that all the language-related negativities form a family
28 of functionally related rather than distinct negativities, and that amplitude
29 modulations of negativities are said to reflect ‘precision-weighted predictive
30 coding errors, with precision (the inverse of variance) reflecting the relevance

1 of a particular stimulus feature in a given language (Bornkessel-Schlesewsky &
2 Schlewsky, 2019, p. 11)'.
3

4 We extend the idea of weightings to the domain of agreement features, such
5 that they are organised on a salience-weighted hierarchy that modulates language
6 comprehension, with differences in their salience due to specific properties
7 of a given language determining their position on the hierarchy. Further,
8 this hierarchy interacts with other prominence scales and discourse context
9 such that the modulation of effects may vary within the language based on
10 the specific type of construction (Mancini et al., 2011a). This proposal would
11 parsimoniously account for the fact that ERP effects for subject-verb agreement
12 violations show a graded hierarchy in certain languages / constructions, whereas
13 such a pattern does not ensue in others.

13 **4.3 Language-specific feature weightings**

14 In support of our proposal that the hierarchy of agreement features may vary
15 well be language-specific based on the relative salience of the features in the
16 given language, we motivate here a language-internal explanation of how these
17 different weightings come about in Arabic.

18 As mentioned in Section 1.4 when motivating Arabic as a suitable language
19 for the purpose of investigating our research question, verb agreement is not
20 merely dependent upon the features of the subject noun in Arabic. Specifically,
21 number and gender agreement in particular involve complex interactions with
22 syntactic and semantic properties of a sentence and its event participants, such
23 that verb agreement in these features is not always determined by the number
24 and gender properties of the subject noun concerned.

25 To reiterate the salient points about the Arabic agreement system, number
26 agreement is not only dependent upon the number property of the subject
27 noun, but also upon the relative order of the verb and the subject as well as
28 whether or not the subject is going to be overt . In other words, under certain

1 circumstances, an identical verb form is sometimes correct and sometimes
2 incorrect based on factors that go beyond the number property of the subject
3 noun per se. Thus, a simple feature-matching between the number property of
4 the subject and the verb would not always lead to the correct interpretation.

5 Similarly, gender agreement depends upon an interplay between the number
6 feature and the humanness property of the subject noun, whereby plural masculine
7 and feminine nouns require the verb to show full agreement if the noun is
8 human, whereas for non-human (animate and inanimate) plural nouns, regardless
9 of whether they are masculine or feminine, the verb must show singular-feminine
10 agreement. Gender contrast is preserved in human subjects but neutralised in
11 non-human subjects. In effect, determining the correct gender agreement for a
12 given utterance is dependent upon the gender, number as well as the position
13 of the subject noun on the animacy hierarchy (specifically humanness).

14 By contrast, the person feature does not exhibit any variation of this sort
15 in Arabic as far as agreement is concerned. In other words, an agreement
16 violation involving the person feature is always reliably a violation, and therefore,
17 the processing system need not consider global properties of the language when
18 evaluating person agreement in Arabic.

19 Therefore, evaluating number and gender agreement involves factors beyond
20 the number and gender properties of the noun, which co-determine the processing
21 of these features. In other words, number and gender, in that order, are more
22 salient in Arabic for processing subject-verb agreement than person . This
23 would explain the hierarchy of effects we observed in our study for singular
24 subjects. However, results for plural subject nouns would suggest that the
25 hierarchy is qualitatively different from that for singular subjects, in that the
26 gender feature may be less salient than the person feature for plural subjects.
27 There may be at least three language-internal reasons for this difference. First,
28 when speaking about or addressing a group of individuals involving both women
29 and men, speakers of Arabic overwhelmingly tend to use masculine agreement.

1 Second, and related to the previous point, many spoken varieties of Arabic
2 show no gender distinction between the masculine and feminine in the plural,
3 with the masculine plural affix used as morphological marker for both. That
4 is, based on language-use, a verb that shows masculine agreement for a group
5 of individuals also involving women is not a violation in Arabic. Third, the
6 humanness interaction described above, namely that non-human masculine
7 plural nouns require the verb (and adjectives etc.) to show singular feminine
8 agreement across the board, means that roughly half of the utterances involving
9 masculine plural nouns require feminine agreement. That is, a verb that shows
10 feminine agreement in the context of masculine plural subjects (albeit non-human)
11 is not always a violation either. Simply put, both mismatching paradigms,
12 namely, masculine subjects requiring feminine verb agreement and subjects
13 involving feminine referents requiring and/or allowing masculine verb agreement,
14 exist in the language. As a consequence, gender agreement mismatches involving
15 plural nouns (masculine or feminine) are not always violations, which explains
16 the fact that the effects for gender violations in our study were smallest for
17 plural subjects.

18 **4.4 Implications and Outlook**

19 Previous results from morphologically rich languages such as Hindi and Basque
20 are of particular relevance here. In Hindi, in which subject-verb agreement is
21 purely based on the features of the nominative subject noun, Nevins et al.
22 (2007) have found that no modulation of effects ensued based on whether
23 number or gender is violated. Although their study did not include a pure
24 person violation, there was a combined person + number violation condition,
25 which elicited a larger P600 effect. Furthermore, the P600 effect for the
26 combined violation of person + number was larger than that for both the combined
27 number + gender violation and individual number and gender violations. A
28 potential caveat for the larger P600 in their study for person + number violations
29 may have been the relative infrequency of this condition in comparison to

1 the other violation conditions in their stimuli. Remaining ambivalent about
2 whether or not the infrequency of this condition played a role, the authors
3 attributed the larger P600 effect to the increased orthographic salience of
4 person violations in Hindi rather than an additive effect, but added that it
5 may be due to a cross-linguistically privileged status of the person feature.
6 In Basque, Zawiswewski et al. (2016) have reported a larger P600 effect for
7 person violations as opposed to number violations. By contrast, the effect for
8 a combined violation of person + number did not differ from that for a person
9 violation, with these two conditions showing an equally larger P600 effect
10 compared to number violation. This would imply that the person feature is
11 more salient in Basque, and that a combined violation of a more salient and
12 less salient feature would not lead to additive effects. In the first instance,
13 these results may appear to suggest that the person feature is somehow more
14 significant and especially salient than the other features. However, two studies
15 that specifically investigated person agreement are a case in point here. Seemingly
16 anomalous, but alternatively interpretable person agreement (the so-called
17 ‘unagreement’) in Spanish (Mancini et al., 2011b) and Basque (Mancini et
18 al., 2019) evoke negativities (albeit with topographic and latency differences)
19 but no P600 in comparison to outright and irresolvable person violations.
20 Taken together, these results and the results from our study do not speak for a
21 universal special status for the person feature, but rather provide converging
22 evidence to our claim that modulation of effects correlate with language-specific
23 differences in the salience of a given feature.

24 Consequently, we argue that a parsimonious account of apparently contradictory
25 results from Hindi and Basque mentioned above on the one hand and our
26 results from Arabic on the other would be along the lines of what we propose
27 here, namely that the agreement features person, number and gender may
28 show different hierarchies (or no hierarchies at all) depending upon the specific
29 properties of a language, based on their relative salience in the given language,
30 with differences in language-specific weightings resulting from a number of

1 language-internal reasons.

2 Our proposal here is not entirely incompatible with the idea of orthographic
3 salience contributing to the larger P600 effect for the combined person + number
4 violation in Hindi. However, a more general explanation for the increased
5 salience of the person feature in Hindi may be that, whereas number and
6 gender are expressed on the main verb even in the perfective aspect when
7 the agent is in ergative case, person marking is underspecified by contrast, and
8 only available from the auxiliary in the perfective aspect. In the imperfective
9 aspect, when the person feature is exclusively available on the main verb as in
10 the stimuli employed by [Nevins et al. \(2007\)](#), it is more prominent and salient,
11 and a violation of this highly salient feature would have led to a concomitantly
12 larger P600 effect in their study. Similarly, in the Basque study by [Zawiswewski](#)
13 [et al. \(2016\)](#), the word-final subject morpheme in the auxiliary verb for the
14 number violation was orthographically minimally different from that for the
15 grammatical condition (*-*zue* versus -*zu*), whereas the morpheme indicating
16 person and person + number violations were quite distinct (*-*t* and *-*gu* versus
17 -*zu*), and therefore much more salient visually and phonetically. This may have
18 contributed to the equally larger P600 for these latter violations as opposed to
19 number violations in that study. The behavioural data that the authors have
20 reported strongly supports this claim, such that the violations involving the
21 distinct morphemes were almost always accurately detected as such, and much
22 quicker, in comparison to number violations, which were detected with a lower
23 accuracy, and at a slower pace.

24 In sum, existing results from Hindi and Basque can be accounted for based on
25 the increased salience of the person feature (in the Hindi study, due to the
26 orthography and exclusive availability of person in their stimuli; in the Basque
27 study, perhaps due to the orthographic distinctness of the morpheme indicating
28 person violation, but see below), without having to resort to a universally
29 privileged or significant status for the person feature. To reiterate what we
30 have stated earlier in [Section 4.2](#), a potential special status for a feature posited

1 based on its conceptual and cognitive aspects may differ from its linguistic
2 status in a given language based on its salience in the agreement system of the
3 language concerned. In other words, the person feature is more salient in Hindi
4 and Basque, albeit due to very different reasons, leading to a similar pattern
5 of results in these languages. By contrast, the person feature seems to be the
6 least salient feature in Arabic in comparison to number or gender, as explained
7 earlier. Our proposal here of a language-specific salience-weighted feature
8 hierarchy parsimoniously accounts for these results as well as qualitative ERP
9 differences that have been sometimes reported for the different feature violations
10 within a given language, such as the results from Spanish (Mancini et al.,
11 2011a). Further, it satisfactorily provides a general and overarching account
12 for cross-linguistic differences in the pattern of results reported for subject-verb
13 agreement violations, such as in Dutch (Kaan et al., 2000) and Hebrew (Deutsch
14 & Bentin, 2001), among others.

15 Compelling evidence in support of our proposal for a salience-weighted feature
16 hierarchy that would preclude a universal special status for a given agreement
17 feature comes from a recent study on Basque, in which Martinez de la Hidalga
18 et al. (2019) investigated the processing differences between person and number
19 agreement in unaccusative verbs (e.g., ‘to fall’) versus unergative verbs (e.g.,
20 ‘to run’), and have reported N400 modulations based on the feature violated,
21 and P600 modulations that differed based on the feature violated and the verb
22 type. Person violations elicited a larger N400 effect than number violations
23 in both verb-types. Interestingly, number violations elicited a larger P600
24 effect as opposed to person violations when the verb was unaccusative, whereas
25 person violations elicited a larger P600 effect as opposed to number violations
26 when the verb was unergative, thus showing the opposite pattern. The authors
27 interpreted these results as a result of salience differences between the two
28 verb-types: unergative verbs involve agent arguments that are commonly highest
29 on the animacy hierarchy (i.e., human) and therefore the person feature is more
30 salient for unergative verbs, thus resulting in a larger P600 for person violations

1 compared to number violations. By contrast, unaccusative verbs involve theme
2 arguments that are often lowest on the animacy hierarchy and thus the person
3 feature is less salient, resulting in the opposite pattern for unaccusative verbs.
4 Thus the results of this study strongly support our argument here, namely that
5 a conceptual or cognitive special status for a feature (in this case, person)
6 may not always translate to a similarly higher level of salience at a linguistic
7 level universally across languages. Further, in line with our own findings, they
8 neatly illustrate that differences in salience weightings may lead to different
9 hierarchies for the same feature across different constructions within a given
10 language depending upon a number of factors that are specific to the language
11 concerned.

12 Furthermore, the concept of salience-based weightings enables generating specific
13 hypotheses about agreement processing in understudied languages. For instance,
14 whilst we do not yet have any independent evidence from Arabic for whether
15 or not multiple feature violations would lead to additive effects when the
16 features are on a hierarchy based on their salience differences, results from
17 Hindi and Basque point to the fact that an additive effect need not necessarily
18 ensue. Nevertheless, further research is necessary to investigate the question
19 in detail. Furthermore, if agreement is always regular in a language and
20 there are no apparent salience differences between the features based on the
21 properties of the language concerned, then no modulation of effects should be
22 expected, whereas in languages in which the features have different salience
23 weightings either due to orthographic reasons (as in Hindi), or syntactic or
24 semantic reasons (as in Arabic or Basque), then modulations of effects should
25 be expected.

26 Our proposal for a Salience-weighted Feature Hierarchy is conceptually in
27 line with the agreement feature hierarchy (Greenberg, 1963) and the Feature
28 Strength Hypothesis (Carminati, 2005), and provides neurophysiological evidence
29 for the idea that agreement processes involve syntactic, semantic and pragmatic
30 factors all at once (Eberhard et al., 2005; Vigliocco et al., 1995). However,

1 our findings do not support a universal special status for specific features
 2 (say, person) in language processing purely based on their distributional and
 3 cognitive or conceptual properties across languages. Rather, the crucial difference
 4 between what we postulate here and previous proposals is that, the hierarchy
 5 of features may differ based on language-specific characteristics and salience,
 6 whereby the relative position of a feature depends upon the language-specific
 7 weighting of the feature. Our proposal parsimoniously accounts for the fact
 8 that ERP effects for agreement violations may show a graded hierarchy in
 9 certain languages / constructions, whereas such a pattern may not ensue in
 10 others.

11 **4.5 Conclusion**

12 In the study presented here, we investigated the processing differences between
 13 person, number and gender agreement in Arabic, a widely-spoken but understudied
 14 language. One of the first neurophysiological studies examining sentence level
 15 processes in Arabic to date, the findings from our study are an important
 16 addition to existing cross-linguistic results on online language comprehension.
 17 Thanks to the within-language within-participants systematic comparison of
 18 all three agreement features in the context of subject-verb agreement in our
 19 study, we were able to show for the first time that the agreement features
 20 differentially modulate language comprehension based on their relative salience.
 21 The salience weightings of features may and do differ across languages depending
 22 upon the specific properties of the language concerned, thus giving rise to a
 23 hierarchy of agreement features that is language-specific rather than universal.
 24 Such a Salience-weighted Feature Hierarchy, we argue, would parsimoniously
 25 account for the diversity of existing cross-linguistic neurophysiological results
 26 on verb agreement processing, without having to resort to a universal special
 27 status for a certain feature, nor having to assume a universally static hierarchy
 28 of features that does not take into account the typological properties of individual
 29 languages. Furthermore, our proposal enables generating specific testable hypotheses

- 1 about agreement processing in languages that are as yet unstudied or understudied.
- 2 In this respect, our study is an important contribution towards understanding
- 3 how the human brain processes and comprehends vastly diverse languages
- 4 with equal ease and poise.

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Compliance statement

We report how we determined our sample size, all data exclusions, all inclusion / exclusion criteria, whether inclusion / exclusion criteria were established prior to data analysis, all manipulations, and all measures in the study. No part of the study procedures / analyses was pre-registered prior to the research being conducted. Data and analysis code will be made available upon request by contacting the corresponding author.

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Salience-weighted agreement feature hierarchy modulates language comprehension.

Supplementary Materials

Manuscript Pre-Print

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S1 Supplementary Materials

S1.1 Arabic agreement examples

The minimal pair examples provided in the following pages illustrate the important aspects of the Arabic agreement system. Examples A1 to A4 contain human subjects, B1 to B4 contain non-human animate subjects, C1 to C4 contain non-human inanimate subjects. In each set, x1 and x2 contain masculine nouns (in of the respective animacy classes A, B or C as mentioned above), and x3 and x4 contain feminine nouns. Similarly, in each set, x1 and x3 contain singular nouns, x2 and x4 contain their plural counterparts. Each sentence is provided in the SV and VS orders. At the end, the dropped-subject variants of examples A2 and A4 are provided in A2-DS and A4-DS respectively.

The following are the salient points to be noted:

- In all sets, regardless of the number property of the subject noun, the verb in the VS order is always singular. This illustrates the agreement asymmetry based on word-order (Aoun et al., 2010).
- In sets B and C, except when the subject noun is singular masculine, the verbs and adjectives show singular feminine agreement across the board, regardless of the gender of the non-human (animate or inanimate) noun. This illustrates deflected agreement (Ferguson, 1997).
- When a plural subject is not going to be overt (i.e., dropped) in a sentence, the verb must show full number agreement. The dropped-subject variants of examples A2 and A4 illustrate this.

We thank Moustafa Mansour (p.c.) for these minimal pair examples.

الولد	الصغير	نام.	A1 - SV
ʔl-walad	ʔl-ṣaḡiir	naam-a	
[DEF-boy] _{3sg.M}	[DEF-little] _{3sg.M}	[sleep] _{Past-3sg.M}	
‘The little boy slept.’			
نام	الولد	الصغير.	A1 - VS
naam-a	ʔl-walad	ʔl-ṣaḡiir	
[sleep] _{Past-3sg.M}	[DEF-boy] _{3sg.M}	[DEF-little] _{3sg.M}	
‘The little boy slept.’			
الأولاد	الصغار	ناموا.	A2 - SV
ʔl-awlaad	ʔl-ṣiḡaar	naam-uu	
[DEF-boys] _{3pl.M}	[DEF-little] _{3pl.M}	[sleep] _{Past-3pl.M}	
‘The little boys slept.’			
نام	الأولاد	الصغار.	A2 - VS
naam-a	ʔl-awlaad	ʔl-ṣiḡaar	
[sleep] _{Past-3sg.M}	[DEF-boys] _{3pl.M}	[DEF-little] _{3pl.M}	
‘The little boys slept.’			
البنت	الصغيرة	نامَتْ.	A3 - SV
ʔl-bint	ʔl-ṣaḡiira	naam-at	
[DEF-girl] _{3sg.F}	[DEF-little] _{3sg.F}	[sleep] _{Past-3sg.F}	
‘The little girl slept.’			
نامَتْ	البنت	الصغيرة.	A3 - VS
naam-at	ʔl-bint	ʔl-ṣaḡiira	
[sleep] _{Past-3sg.F}	[DEF-girl] _{3sg.F}	[DEF-little] _{3sg.F}	
‘The little girl slept.’			
البنات	الصغيرات	نمن.	A4 - SV
ʔl-banaat	ʔl-ṣaḡiiraat	nam-na	
[DEF-girls] _{3pl.F}	[DEF-little] _{3pl.F}	[sleep] _{Past-3pl.F}	
‘The little girls slept.’			
نامَتْ	البنات	الصغيرات.	A4 - VS
naam-at	ʔl-banaat	ʔl-ṣaḡiiraat	
[sleep] _{Past-3sg.F}	[DEF-girls] _{3pl.F}	[DEF-little] _{3pl.F}	
‘The little girls slept.’			

الكلب الصغير نام.	B1 - SV
ʔl-kalb ʔl-ṣaḡiir naam-a	
[DEF-dog] _{3sg.M} [DEF-little] _{3sg.M} [sleep] _{Past-3sg.M}	
‘The little dog slept.’	
نام الكلب الصغير.	B1 - VS
naam-a ʔl-kalb ʔl-ṣaḡiir	
[sleep] _{Past-3sg.M} [DEF-dog] _{3sg.M} [DEF-little] _{3sg.M}	
‘The little dog slept.’	
الكلاب الصغيرة نامت.	B2 - SV
ʔl-kilaab ʔl-ṣaḡiira naam-at	
[DEF-dogs] _{3pl.M} [DEF-little] _{3sg.F} [sleep] _{Past-3sg.F}	
‘The little dogs slept.’	
نامت الكلاب الصغيرة.	B2 - VS
naam-at ʔl-kilaab ʔl-ṣaḡiira	
[sleep] _{Past-3sg.F} [DEF-dogs] _{3pl.M} [DEF-little] _{3sg.F}	
‘The little dogs slept.’	
البقرة الصغيرة نامت.	B3 - SV
ʔl-baqra ʔl-ṣaḡiira naam-at	
[DEF-COW] _{3sg.F} [DEF-little] _{3sg.F} [sleep] _{Past-3sg.F}	
‘The little cow slept.’	
نامت البقرة الصغيرة.	B3 - VS
naam-at ʔl-baqra ʔl-ṣaḡiira	
[sleep] _{Past-3sg.F} [DEF-COW] _{3sg.F} [DEF-little] _{3sg.F}	
‘The little cow slept.’	
الأبقار الصغيرة نامت.	B4 - SV
ʔl-abqaar ʔl-ṣaḡiira naam-at	
[DEF-COWS] _{3pl.F} [DEF-little] _{3sg.F} [sleep] _{Past-3sg.F}	
‘The little cows slept.’	
نامت الأبقار الصغيرة.	B4 - VS
naam-at ʔl-abqaar ʔl-ṣaḡiira	
[sleep] _{Past-3sg.F} [DEF-COWS] _{3pl.F} [DEF-little] _{3sg.F}	
‘The little cows slept.’	

C1 - SV	الهاتف	الكبير	كسر.
	ʔl-haatif	ʔl-kabiir	kasar-a
	[DEF-phone] _{3sg.M}	[DEF-big] _{3sg.M}	[break] _{Past-3sg.M}
	‘The big phone broke down.’		
C1 - VS	كسر	الهاتف	الكبير.
	kasar-a	ʔl-haatif	ʔl-kabiir
	[broke] _{Past-3sg.M}	[DEF-phone] _{3sg.M}	[DEF-big] _{3sg.M}
	‘The big phone broke down.’		
C2 - SV	الهواتف	الكبيرة	كسرت.
	ʔl-hawaatif	ʔl-kabiira	kasar-at
	[DEF-phones] _{3pl.M}	[DEF-big] _{3sg.F}	[broke] _{Past-3sg.F}
	‘The big phones broke down.’		
C2 - VS	كسرت	الهواتف	الكبيرة.
	kasar-at	ʔl-hawaatif	ʔl-kabiira
	[broke] _{Past-3sg.F}	[DEF-phones] _{3pl.M}	[DEF-big] _{3sg.F}
	‘The big phones broke down.’		
C3 - SV	الطاولة	الكبيرة	كسرت.
	ʔl-ṭaawila	ʔl-kabiira	kasar-at
	[DEF-table] _{3sg.F}	[DEF-big] _{3sg.F}	[break] _{Past-3sg.F}
	‘The big table broke down.’		
C3 - VS	كسرت	الطاولة	الكبيرة.
	kasar-at	ʔl-ṭaawila	ʔl-kabiira
	[break] _{Past-3sg.F}	[DEF-big] _{3sg.F}	[DEF-table] _{3sg.F}
	‘The big table broke down.’		
C4 - SV	الطاولات	الكبيرة	كسرت.
	ʔl-ṭaawulaat	ʔl-kabiira	kasar-at
	[DEF-tables] _{3pl.F}	[DEF-big] _{3sg.F}	[break] _{Past-3sg.F}
	‘The big tables broke down.’		
C4 - VS	كسرت	الطاولات	الكبيرة.
	kasar-at	ʔl-ṭaawulaat	ʔl-kabiira
	[break] _{Past-3sg.F}	[DEF-tables] _{3pl.F}	[DEF-big] _{3sg.F}
	‘The big tables broke down.’		

الأولاد الصغار. نام A2 - VS
 ?l-awlaad ?l-ṣiḡaar naam-a
 [DEF-boys]_{3pl.M} [DEF-little]_{3pl.M} [sleep]_{Past-3sg.M}

‘The little boys slept.’

البنات الصغيرات. نامت A4 - VS
 ?l-banaat ?l-ṣaḡiiraat naam-at
 [DEF-girls]_{3pl.F} [DEF-little]_{3pl.F} [sleep]_{Past-3sg.F}

‘The little girls slept.’

ناموا. A2 - DS
 naam-uu
 [sleep]_{Past-3pl.M}

‘They(m.) slept.’

نمن. A4 - DS
 nam-na
 [sleep]_{Past-3pl.F}

‘They(f.) slept.’

1 S1.2 Confirmatory post-hoc analyses

2 S1.2.1 Time-window 300–500 ms

3

4 As mentioned in the main article, we analysed the data in the 300 – 500 ms
 5 time-window post-hoc specifically to test whether we can find evidence for
 6 a LAN effect in our data. As the data presented here show, we could not
 7 find any evidence for the same. This time-window does not convey any new
 8 information other than confirming the pattern of effects found in the 400 – 600
 9 ms time-window reported in the main article. In view of this, and the fact that
 10 it partially overlaps in time with the one mentioned above, we do not discuss
 11 data from this time-window. Nevertheless it is provided here for reference.

12 The predominant effect in this time-window is the graded negativity for the
 13 violation conditions as opposed to the acceptable conditions, with the gradedness

1 differing based on whether the subject was singular or plural. Table S1 shows
2 a summary of all the effects that reached at least marginal significance at the
3 position of the verb in the 300 – 500 ms time-window.

4 There were no main effects. The interaction ROI x subject-type was significant
5 in the midline regions, which when resolved for the individual ROIs showed a
6 simple effect of subject-type in the fronto-central midline region. The interaction
7 subject-type x condition-type was significant in the lateral and midline regions.
8 This effect was resolved in the lateral regions alone (due to a ROI interaction
9 in the midline regions), which showed an effect of condition-type when the
10 subject was singular. This was resolved further by comparing the condition-types
11 pairwise, which showed a simple effect of condition-type for the comparison
12 PER + NUM alone.

13 The three-way interaction ROI x subject-type x condition-type was significant
14 in the midline regions alone, which was resolved for the individual ROIs. This
15 showed a marginal effect of subject-type x condition-type in the fronto-central
16 midline region, and the effect was significant in the central, centro-parietal,
17 parietal and parieto-occipital midline regions, which was resolved for subject-type
18 in each region. When the subject-type was singular, there was an effect of
19 condition-type in the central, centro-parietal, parietal and parieto-occipital
20 midline regions. Resolving this effect by comparing the condition-types pairwise
21 revealed the following. There was a simple effect of condition-type in the
22 central, centro-parietal and parieto-occipital midline regions for the comparison
23 ACP + NUM, and this effect was marginal in the parietal midline region.
24 Comparing PER + NUM, there was a simple effect of condition-type in the
25 centro-parietal and parieto-occipital midline regions, with this effect being
26 marginal in the central midline region. Comparing ACP + GEN, there was
27 simple effect of condition-type in the central, parietal and parieto-occipital
28 midline regions, with this effect being marginal in the centro-parietal region.
29 Comparing PER + GEN, there was a simple effect of condition-type in the
30 parieto-occipital midline region, with this effect being marginal in central,

1 centro-parietal and parietal midline regions. When the subject-type was plural,
 2 there was an effect of condition-type in the fronto-central, central and centro-parietal
 3 midline regions. Resolving this effect by comparing the condition-types pairwise
 4 revealed the following. There was a simple effect of condition-type in the
 5 fronto-central, central and centro-parietal midline regions for the comparison
 6 PER + GEN. For the comparison NUM + GEN, there was a marginal effect of
 7 condition-type in the central and centro-parietal midline regions.

Table S1: ANOVA: ERPs at the Verb : 300 – 500 ms

Effects in time-window 300–500 ms				DF	Lateral Regions		DF	Midline Regions	
◆ MIDR x ST							5,165	4.56	★
↳ MIDR = FCZ							1,33	4.47	★
◆ ST x CT				3,99	2.99	★	3,99	3.70	★★
↳ ST = S	◆ CT			3,99	3.02	★			
	↳ CT = PER+NUM	◆ CT		1,33	6.77	★			
◆ MIDR x ST x CT							15,495	3.03	★★
↳ MIDR = FCZ	◆ ST x CT						3,99	2.62	☆
	↳ ST = P	◆ CT					3,99	2.59	☆
		↳ CT = PER+GEN	◆ CT				1,33	5.96	★
↳ MIDR = CZ	◆ ST x CT						3,99	4.79	★★
	↳ ST = S	◆ CT					3,99	3.89	★★
		↳ CT = ACP+NUM	◆ CT				1,33	7.47	★
		↳ CT = PER+NUM	◆ CT				1,33	4.88	☆
		↳ CT = ACP+GEN	◆ CT				1,33	5.86	★
		↳ CT = PER+GEN	◆ CT				1,33	5.11	☆
	↳ ST = P	◆ CT					3,99	3.11	★
		↳ CT = PER+GEN	◆ CT				1,33	8.46	★
		↳ CT = NUM+GEN	◆ CT				1,33	4.97	☆
↳ MIDR = CPZ	◆ ST x CT						3,99	4.27	★★
	↳ ST = S	◆ CT					3,99	4.38	★★
		↳ CT = ACP+NUM	◆ CT				1,33	6.59	★
		↳ CT = PER+NUM	◆ CT				1,33	7.38	★
		↳ CT = ACP+GEN	◆ CT				1,33	4.78	☆
		↳ CT = PER+GEN	◆ CT				1,33	5.35	☆
	↳ ST = P	◆ CT					3,99	2.43	☆
		↳ CT = PER+GEN	◆ CT				1,33	5.85	★
		↳ CT = NUM+GEN	◆ CT				1,33	5.41	☆
↳ MIDR = PZ	◆ ST x CT						3,99	4.39	★★
	↳ ST = S	◆ CT					3,99	3.92	★★
		↳ CT = ACP+NUM	◆ CT				1,33	5.11	☆
		↳ CT = ACP+GEN	◆ CT				1,33	7.04	★
		↳ CT = PER+GEN	◆ CT				1,33	5.23	☆

Continued on next page ...

...Table S1 continued

Effects in time-window 300–500 ms				DF	Lateral Regions	DF	Midline Regions	
↳MIDR =	POZ	♦ ST x CT				3,99	3.72	★★
		↳ST = S	♦ CT			3,99	5.89	★★★
			↳CT = ACP+NUM	♦ CT		1,33	8.94	★★
			↳CT = PER+NUM	♦ CT		1,33	6.09	★
			↳CT = ACP+GEN	♦ CT		1,33	10.51	★★
			↳CT = PER+GEN	♦ CT		1,33	7.52	★

S1.2.2 Alternative filter settings

The EEG data collected during the experiment was pre-processed for analysis using a 0.3 – 20 Hz bandpass filter offline in order to remove slow signal drifts that might lead to stimulus-independent differences between conditions. As discussed in the EEG preprocessing section of the main article, the filter settings we employed effectively circumvents distortion issues without the need for a baseline correction, and are sufficiently broad to include language-related ERP activity that is typically in the frequency range of about 0.5 to 5 Hz (Roehm et al., 2002). Previous studies employing identical filter settings to ours report no significant differences in results between applying this bandpass filter versus applying baseline corrections (see Burkhardt et al., 2007; Choudhary et al., 2009). Nevertheless, in order to verify that this is the case with our data as well, we reanalysed the data post-hoc using two slightly different bandpass filter settings: by increasing the low-pass cut-off frequency alone (0.3 – 30 Hz) or by decreasing the high-pass cut-off frequency in addition to increasing the low-pass cut-off (0.1 – 30 Hz).

Figure S1 shows the ERPs of the entire sentence epoch for the singular subject conditions and for the filter settings we employed for the analysis of our data, namely a 0.3 – 20 Hz bandpass filter. This figure illustrates that the effects of interest at the critical position in our study, namely the verb (the third N1-P2 complex in the figure starting after about 1.5 seconds into the trial), do not appear to dependent upon the ERPs before the pre-critical positions. Further, no significant ERP differences are apparent in the pre-critical positions, perhaps as an expected consequence of our fully counter-balanced design and identical materials preceding the verb in a given subject-type.

Figure S2 shows the ERPs of the entire sentence epoch for the singular subject conditions from the analysis using the 0.3 – 30 Hz bandpass filter. ERPs using this filter setting remain very much comparable to those we report. Figure S3 shows the ERPs of the entire sentence epoch for the singular subject conditions

1 from the analysis using the 0.1 – 30 Hz bandpass filter. As an expected consequence
2 of the lower high-pass cutoff in this setting, slow signal drifts were apparent
3 within the sentence epoch, which however could be mostly rectified to some
4 extent using a pre-critical baseline correction (-200 to 0 ms), with some of
5 the differences originating starting from the sentence onset still remaining.
6 Nevertheless, the overall pattern of ERPs at the critical position remained
7 similar to the other two analyses. Differences in magnitude and presence or
8 absence of some effects (which are to be expected in a comparison of this sort)
9 notwithstanding, [Table S2](#) provides an overview of this confirmatory analysis,
10 and highlights the crucial parts of this analysis, which show a consistent pattern
11 that obtains in all of the filter settings. These observations are further supported
12 by a running t-test of significance on the ERP plots comparing the two different
13 filter settings, as shown in [Figure S4](#) and [Figure S5](#) respectively.

Figure S1: ERPs of the entire sentence epoch: Singular subject conditions.
0.3 – 20 Hz BPF.

Figure S2: ERPs of the entire sentence epoch: Singular subject conditions.
0.3 – 30 Hz BPF.

Figure S3: ERPs of the entire sentence epoch: Singular subject conditions.
0.1 – 30 Hz BPF.

Figure S4: ERPs at the verb with running t-test to detect potentially significant time-windows: Singular subject conditions. 0.3 – 20 Hz BPF.

Figure S5: ERPs at the verb with running t-test to detect potentially significant time-windows: Singular subject conditions. 0.3 – 30 Hz BPF.

Table S2: ANOVA: ERPs at the Verb. Comparable effects for three different filter settings. The main article presents results based on data analysis using a 0.3 – 20 Hz bandpass filter, which circumvents the need for a pre-stimulus baseline correction.

Omnibus effects for following bandpass filter settings BLC => -200 to 0 ms baseline correction		0.3–20 Hz No BLC		0.3–30 Hz No BLC		0.1–30 Hz BLC	
Time-window 400–600 ms : Lateral regions	DF	F	pHF	F	pHF	F	pHF
◆ ST	1,33	5.55	0.024	9.05	0.005	3.89	0.056
◆ LATR x ST	3,99			2.65	0.077		
◆ CT	3,99	3.24	0.025				
◆ LATR x CT	9,297					2.88	0.021
◆ ST x CT	3,99	3.03	0.032				
◆ LATR X ST x CT	9,297	2.37	0.035	2.91	0.009		
Time-window 400–600 ms : Midline regions	DF	F	pHF	F	pHF	F	pHF
◆ ST	1,33	6.47	0.015	10.03	0.003	4.48	0.04
◆ MIDR x ST	2,66	5.95	0.014	7.51	0.006		
◆ CT	3,99	3.09	0.030				
◆ MIDR x CT	6,198	2.46	0.043			8.94	0
◆ ST x CT	3,99	3.68	0.014				
◆ MIDR X ST x CT	6,198	2.27	0.056	2.51	0.038	2.55	0.036
Time-window 700–850 ms : Lateral regions	DF	F	pHF	F	pHF	F	pHF
◆ CT	3,99	10.82	0	11.06	0	4.74	0.004
◆ LATR x CT	9,297					2.47	0.049
◆ ST x CT	3,99	3.91	0.026	5.28	0.002	2.59	0.057
◆ LATR X ST x CT	9,297	2.66	0.019	2.93	0.010		
Time-window 700–850 ms : Midline regions	DF	F	pHF	F	pHF	F	pHF
◆ CT	3,99	13.64	0	14.25	0	7.41	<.001
◆ MIDR x CT	6,198					5.54	<.001
◆ ST x CT	3,99	4.85	0.003	6.91	<.001	3.44	0.019
◆ MIDR X ST x CT	6,198	3.87	0.005	4.21	0.003		

1 **S1.3 Critical Items**

2 **S1.3.1 Items Distribution Scheme**

3 The distribution of critical items into five sets was carried out as follows: out
 4 of the 120 critical items in each of the 8 critical conditions, half contained
 5 masculine and the other half contained feminine nouns as subjects. Thus 60
 6 critical nouns in each condition were masculine and 60 were feminine. To
 7 distribute these items in a fully counterbalanced manner, the masculine and
 8 feminine items are distributed separately. In each condition, 18 sentences
 9 containing masculine nouns and 18 sentences containing feminine nouns were
 10 selected for each of the five sets of stimuli. Therefore, in each of the 8 conditions,
 11 36 sentences were selected in total per stimulus set. This ensured that, within
 12 each given set, all conditions are equiprobable, all items occurred equal number
 13 of times (albeit in different conditions), all participants saw all items (albeit in
 14 different conditions), and there were equal number of sentences in each of the
 15 8 critical conditions, half of them masculine and half feminine.

16 Thus each participant saw a total of 36 sentences in each of the 8 critical
 17 conditions, 18 of which contained a masculine noun, and 18 contained a feminine
 18 nouns. The 18 sentences for a given subject (noun) gender from each condition
 19 containing 60 sentences in that gender were selected in two stages (first 12,
 20 and then 6), again to ensure equiprobability of items in all respects. This was
 21 also in order to ensure that, across the five sets, each stimulus sentence is
 22 equifrequent across the sets. This is illustrated in [Figure S6](#) schematically.
 23 One of the five lists was used for each participant. The presentation of the lists
 24 was counterbalanced across participants.

25 The pointed and unpointed frequency information for the critical nouns and
 26 verbs used in the stimuli were extracted from Aralex lexical database ([Boudelaa](#)
 27 [& Marslen-Wilson, 2010](#)) whenever available (because this information was
 28 not available for a small number of cases). This information is provided in
 29 the following pages. Then, the critical sentences used in the study are listed

Figure S6: Items Distribution Scheme

- 1 with their item numbers and condition codes. In the interest of space, only
- 2 translations are provided and not the full phonological and morphological
- 3 gloss, and only a list of the 240 acceptable sentences (60 x 2 (singular, plural)
- 4 x 2 (masculine, feminine)) and not their violation counterparts.

Orthographic Form Queried	Orthographic Frequency	Nouns		Pointed Stem	Pointed Frequency
		Unpointed stem	Unpointed Frequency		
الأستاذ	42.84	أستاذ	222.41	أُسْتَاذ	222.41
الأب	26.71	أب	167.24	أَب	59.51
البائع	3.1	بائع	19.76	بَائِع	19.76
لبحار	1.22	بحار	24.85	بَحَار	10.59
التاجر	5.62	تاجر	26.63	تَاَجِر	26.37
الإمام	15.37	إمام	67.69	إِمَام	67.69
الجندي	22.39	جندي	108.59	جُنْدِيّ	108.59
المجدد	0.7	مجدد	8.55	مُجَدِّد	8.55
الساحر	4.76	ساحر	18.61	سَاِحِر	18.61
الراكب	3.33	راكب	28.4	رَاكِب	28.4
الرائد	14.38	رائد	55.96	رَائِد	55.96
الرجل	122.16	رجل	385.64	رَجُل	378.27
المصارع	1.3	مصارع	17.75	مُصَارِع	8.65
الشيخ	278.86	شيخ	436.76	شَيْخ	435.35
الرفيق	2.89	رفيق	89.13	رَفِيق	89.13
الرئيس	1349.82	رئيس	4117.04	رَئِيس	4117.04
الزبون	6.01	زبون	13.74	زَبُون	9.27
المتظاهر	0.18	متظاهر	39.06	مُتَظَاهِر	39.06
الساكن	1.3	ساكن	15.65	سَاكِن	15.48
المدخن	1.07	مدخن	7.27	مُدَخِّن	5.75
السائق	11.68	سائق	50	سَائِق	50
السجين	2.52	سجين	21.63	سَجِين	21.63
الشاعر	85.93	شاعر	190.98	شَاعِر	190.98
الشرطي	6.71	شرطي	30.71	شُرْطِيّ	27.48
المهندس	96.02	مهندس	206.3	مُهَنْدِس	206.3
الصبي	4.63	صبي	16.31	صَبِيّ	13.81
المطرب	5.07	مطرب	28.7	مُطَرِّب	28.7

الصيد	3.25	صيد	25.35	صَيَاد	25.35
الصحافي	37.69	صحافي	288.82	صَحَافِيّ	288.82
الطفل	49.21	طفل	159.55	طِفْل	151.2
الطيار	13.42	طيار	45.57	طَيَّار	45.57
العاذف	1.2	عاذف	16.08	عَازِف	16.08
العامل	37.69	عامل	462.8	عَامِل	460.76
السائق	11.68	سائق	50	سَائِق	50
الراعي	12.74	راعي	62.07	رَاعِي	61.68
الفلاح	6.76	فلاح	42.64	فَلَّاح	38.79
المقرئ	0.05	مقرئ	0.53	مُقَرِّئ	0.53
القاضي	73.03	قاضي	142.02	قَاضِي	141.99
القائد	45.7	قائد	249.27	قَائِد	249.27
الولد	4.97	ولد	167.08	وَلَد	54.51
المريض	19.35	مريض	58.65	مَرِيض	58.65
الغواص	0.13	غواص	15.12	غَوَّاص	15.12
المحقق	19.27	محقق	73.28	مُحَقِّق	38
المسؤول	82.66	مسؤول	749.64	مَسْئُول	749.64
المتسابق	0.29	متسابق	5.39	مُتَسَابِق	5.39
الحاج	29.81	حاج	396.22	حَاجّ	48.69
المدير	129.03	مدير	499.22	مُدِير	499.22
الفقيه	7.93	فقيه	20.12	فَقِيه	20.12
النائب	142.58	نائب	553.47	نَائِب	553.47
السباح	0.75	سباح	21.01	سَبَّاح	7.27
الملاك	2.42	ملاك	14.5	مَلَاكِم	7.43
المستشار	80.44	مستشار	208.34	مُسْتَشَار	208.34
الخطاط	1.69	خطاط	6.35	خَطَّاط	6.35
المحارب	1.46	محارب	46.42	مُحَارِب	11.51
المصور	5.75	مصور	31.66	مُصَوِّر	23.8
المستثمر	19.32	مستثمر	202.22	مُسْتَثْمِر	199.16
النجار	7.57	نجار	15.39	نَجَّار	13.15
المبدع	8.89	مبدع	48.13	مُبْدِع	48.13

المخبر	1.59	مخبر	8.35	مَخْبَر	4.9
المزارع	7.44	مزارع	60.43	مَزَارِع	30.11
البنت	4.32	بنت	9.4	بِنْت	9.4
العروس	4.55	عروس	19.92	عَرُوس	19.92
المذبة	2.94	مذبة	19.69	مُذْبِع	19.69
الزوجة	16.75	زوج	324.45	زَوْج	313.84
المغامرة	9.73	مغامر	51.55	مُغَامِر	44.51
المثقة	4.4	مثقف	146.66	مُثَقَّف	146.66
المشعوذات	0.05	مشعوذ	1.97	مُشْعَوِذ	1.97
المعلمة	0.81	معلم	96.72	مُعَلِّم	95.51
العجوز	10.01	عجوز	24.43	عَجُوز	24.43
المحامية	2.21	محامي	116.55	مُحَامِي	116.28
الوزيرة	10.3	وزير	1881.99	وَزِير	1881.99
الطباخة	0.03	طباخ	2.1	طَبَّاخ	2.04
المحاسبة	11.08	محاسب	52.57	مُحَاسِب	40.4
العميلة	2.57	عميل	27.48	عَمِيل	3.35
الرسامة	0.73	رسام	27.88	رَسَّام	27.65
المشرفة	8.89	مشرف	68.61	مُشْرِف	41.88
المرشحة	8.17	مرشح	291.51	مُرَشَّح	287.99
الممثلة	13.55	ممثل	382.51	مُمَثِّل	51.62
الفنانة	14.75	فنان	248.08	فَنَّان	248.08
المدرسة	52.2	مدرس	219.19	مَدْرَس	168.79
المرمضة	1.51	ممرض	8.22	مُمَرِّض	8.22
الصائمة	0.08	صائم	4.77	صَائِم	4.77
الطالبة	2.7	طالب	570.76	طَالِب	296.15
الباحثة	7.28	باحث	142.29	بَاحِث	141.79
المتهمة	3.56	متهم	199.1	مُتَّهَم	171.61
الأميرة	7.46	أمير	299.93	أَمِير	299.93
اللاجئة	0.23	لاجئ	184.93	لَاجِئ	184.93
المواطنة	7.59	مواطن	541.47	مُوَاطِن	13.38

الموظفة	1.9	موظف	174.21	مُوظَّف	174.21
الخادمة	2.42	خادم	51.81	خَادِم	51.81
الفتاة	18.75	فتا	58.39	فَتَا	58.39
الطفلة	5.05	طفل	159.55	طِفْل	151.2
المشاركة	197.12	مشارك	711.57	مُشَارِك	611.59
المغنية	2.05	مغني	16.27	مُغَنِّي	15.22
اللاعبة	3.46	لاعب	491.53	لَاعِب	491.14
المرافقة	2.83	مرافق	114.01	مُرَافِق	73.74
المؤمنة	1.85	مؤمن	55.89	مُؤَمِّن	2.79
المصلي	0.34	مصلي	1.64	مَصْلِي	1.41
الناشطة	10.12	ناشط	40.21	نَاشِط	40.21
الناخبة	1.22	ناخب	88.83	نَاخِب	88.83
المدربة	3.75	مدرب	120.56	مُدْرِب	109.9
المضيضة	6.84	مضيف	35.77	مُضِيف	34.26
المسافرة	0.91	مسافر	50.99	مُسَافِر	50.99
العارضة	5.2	عارض	121.12	عَارِض	101.29
الملكة	15.24	ملك	676.75	مَلِك	392.61
الأسيرة	0.21	أسير	25.97	أَسِير	25.97
الطبيبة	1.07	طبيب	73.81	طَبِيب	73.81
المراسلة	0.65	مراسل	62.96	مُرَاسِل	5.75
التلميذة	0.52	تلميذ	21.96	تَلْمِيز	21.96
السائحة	0.21	سائح	47.64	سَائِح	47.64
المفتشة	0.08	مفتش	15.42	مُفْتَش	15.42
المتنافسة	3.72	متنافس	12.59	مُتَنَافِس	12.56
الحارسة	0.26	حارس	54.77	حَارِس	54.77
الخريج	1.2	خريج	56.15	خَرِيج	56.15
المرشدة	0.08	مرشد	22.85	مُرْشِد	22.85
السيدة	99.09	سيده	184.73	سَيِّدَة	184.73
الخطيبة	0.21	خطيب	40.67	خَطِيب	40.67
العالمية	1.04	عالم	1545.6	عَالِم	22.65

المراقبة	22.34	مراقب	285.27	مُرَاقِب	117.43
الأم	35.81	أم	717.55	أُم	389.78
الأساتذة	6.87	أساتذ	62.73	أَسَاتِذ	62.73
الاباء	1.22	إباء	2.27	إِبَاء	2.27
البائعون	0.13	بائع	19.76	بَائِع	19.76
البحارة	1.22	بحار	24.85	بَحَار	10.59
التجار	25.51	تجار	570.17	تُجَار	67.56
الأئمة	1.72	أئم	8.35	أُئِمَّ	8.35
الجنود	58.68	جنود	152.28	جُنُود	152.28
المجندون	0.23	مجند	8.55	مُجَنَّد	8.55
السحرة	1.79				
الركاب	25.98	ركاب	64.44	رُكَّاب	57.66
الرواد	7.96	رواد	34.59	رَوَّاد	34.59
الرجال	49.57	رجال	491	رِجَال	490.71
المصارعون	0.16	مصارع	17.75	مُصَارِع	8.65
الشيوخ	42.5	شيوخ	74.99	شُيُوخ	74.99
الرفاق	2.65	رفاق	28.93	رِفَاق	28.93
الرؤساء	25.44	رؤساء	140.22	رُؤُسَاء	140.22
الزبائن	12.17	زبائن	35.93	زَبَائِن	35.93
المتظاهرون	7.75	متظاهر	39.06	مُتَظَاهِر	39.06
الساكنون	0.1	ساكن	15.65	سَاكِن	15.48
المدخنون	0.1	مدخن	7.27	مُدَّخِن	1.22
السائقون	0.62	سائق	50	سَائِق	50
السجناء	14.2	سجناء	26.07	سُجَنَاء	26.07
الشعراء	29.44	شعراء	68.45	شُعَرَاء	61.54
المحققون	4.86	محقق	73.28	مُحَقِّق	35.28
المهندسون	1.38	مهندس	206.3	مُهَنْدِس	206.3
الصبية	2.44	صبي	16.31	صَبِي	13.81
المطربون	0.52	مطرب	28.7	مُطَرِّب	28.7
الصيادون	1.09	صياد	25.35	صَيَّاد	25.35
الصحافيون	5.93	صحافي	288.82	صَحَافِي	288.82
الأطفال	52.93	أطفال	222.44	أَطْفَال	222.44

الطيّارون	0.7	طيار	45.57	طَيّار	45.57
العاظفون	0.18	عاظف	16.08	عَاظِف	16.08
العمال	130.38	عمال	323.76	عَمّال	234.18
السائقون	0.62	سائق	50	سائِق	50
رعاة	1.61	رعا	22.95	رُعا	3.39
الفلاحون	1.95	فلاح	42.64	فَلّاح	38.79
المقرئ	0.05	مقرئ	0.53	مُقَرِّئ	0.53
القضاة	16.49	قضا	46.49	قُضا	41.03
القادة	48.84	قاد	316.43	قاد	316.43
الأولاد	5.41	أولاد	70.19	أَوّالاد	70.19
المرضى	5.2	مرضى	12.59	مَرَضَى	12.59
الغواصون	0.18	غواص	15.12	غَوّاص	15.12
المحققون	4.86	محقق	73.28	مُحَقِّق	35.28
المسؤولون	37.24	مسؤول	749.64	مَسْؤُول	749.64
المتسابقون	0.34	متسابق	5.39	مُتَسَابِق	5.39
الحجاج	13.99	حجاج	30.11	حُجاج	30.11
المدراء	0.57	مدراء	4.04	مُدَرّاء	4.04
الفقهاء	5.64	فقهاء	12.16	فُقَهَاء	12.16
النواب	142.16	نواب	275.53	نُواب	275.53
السباحون	0.1	سباح	21.01	سَبّاح	7.27
الملاكمون	0.18	ملاكم	14.5	مُلاكِم	7.43
المستشارون	0.81	مستشار	208.34	مُسْتَشَار	208.34
الخطاطون	0.13	خطاط	6.35	خَطّاط	6.35
المحاربون	0.49	محارب	46.42	مُحَارِب	11.51
المصورون	0.47	مصور	31.66	مُصَوِّر	23.8
المستثمرون	9.73	مستثمر	202.22	مُسْتَثْمِر	199.16
النجارون	0.08	نجار	15.39	نَجّار	13.15
المبدعون	1.12	مبدع	48.13	مُبْدِع	48.13
المخبرون	0.03	مخبر	8.35	مُخْبِر	3.45

المزارعون	2.18	مزارع	60.43	مُزَارِع	30.21
البنات	8.35	بن	712.92	بَن	49.15
العرائس	1.14	عرائس	2.99	عَرَائِس	2.99
المذيعات	0.49	مذيع	19.69	مُذِيع	19.69
الزوجات	2.63	زوج	324.45	زَوْج	313.84
المغامرات	2.7	مغامر	51.55	مُغَامِر	44.51
المثقفات	0.16	مثقف	146.66	مُثَقَّف	146.66
المشعوذات	0.05	مشعوذ	1.97	مُشْعَوِذ	1.97
المعلمات	0.49	معلم	96.72	مُعَلِّم	95.51
العجائز	0.62	عجائز	1.94	عَجَائِز	1.94
المحاميات	0.1	محامي	116.55	مُحَامِي	0.26
الوزيرات	0.1	وزير	1881.99	وَزِير	1881.99
الطباخات	0.03	طباخ	2.1	طَبَّاخ	2.04
المحاسبات	0.47	محاسب	52.57	مُحَاسِب	40.4
العميلات	0.03	عميل	27.48	عَمِيل	3.35
لرسامة	0.73	رسام	27.88	رَسَّام	27.65
المشرفة	8.89	مشرف	68.61	مُشْرِف	41.88
المرشحات	1.4	مرشح	291.51	مُرَشَّح	287.99
الممثلات	1.35	ممثل	382.51	مُمَثِّل	330.9
الفنانات	0.81	فنان	248.08	فَنَان	248.08
المدرسات	0.31	مدرس	219.19	مُدَرِّس	50.4
الممرضات	0.7	ممرض	8.22	مُمَرِّض	8.22
الصائمه	0.08	صائم	4.77	صَائِم	4.77
الطالبات	3.46	طالب	570.76	طَالِب	296.15
الباحثات	0.29	باحث	142.29	بَاحِث	141.79
المتهمات	0.1	متهم	199.1	مُتَّهِم	27.48
الأميرات	0.49	أمير	299.93	أَمِير	299.93
اللاجئات	0.16	لاجئ	184.93	لَاجِئ	184.93
المواطنات	0.1	مواطن	541.47	مُؤَاطِن	527.3
الموظفات	0.49	موظف	174.21	مُوظَّف	174.21
الخادما	0.42	خادم	51.81	خَادِم	51.81
الفتيات	9.1	فتي	34.45	فَتَي	22.82

المشاركات	3.3	مشارك	711.57	مُشَارَك	611.59
المغنيات	0.21	مغني	16.27	مُعَنِّي	15.22
اللاعبات	4.01	لاعب	491.53	لَاعِب	491.14
المرافقات	0.05	مرافق	114.01	مُرَافِق	6.9
المؤمنات	0.1	مؤمن	55.89	مُؤْمِن	0.99
المصليات	0.08	مصلي	1.64	مُصَلِّي	0.2
الناشطات	0.31	ناشط	40.21	نَاشِط	40.21
الناخبات	0.21	ناخب	88.83	نَاخِب	88.83
المدربات	0.03	مدرب	120.56	مُدْرِب	109.9
المضيفات	0.18	مضيف	35.77	مُضِيف	34.26
المسافرة	0.91	مسافر	50.99	مُسَافِر	50.99
العارضات	0.94	عارض	121.12	عَارِض	101.29
الملكات	0.99	ملك	676.75	مَلَك	8.22
الأسيرات	0.08	أسير	25.97	أَسِير	25.97
الطبيبات	0.23	طبيب	73.81	طَبِيب	73.81
المراسلات	1.09	مراسل	62.96	مُرَاسِل	5.75
التلميذات	0.31	تلميذ	21.96	تَلْمِيز	21.96
السائحات	0.13	سائح	47.64	سَائِح	47.64
المفتشة	0.08	مفتش	15.42	مُفْتَش	15.42
المتنافسات	0.05	متنافس	12.59	مُتَنَافِس	12.56
الحارسات	0.03	حارس	54.77	حَارِس	54.77
الخريجات	0.21	خريج	56.15	خَرِيج	56.15
المرشدات	0.03	مرشد	22.85	مُرْشِد	22.85
السيدات	15.01	سيد	960.31	سَيِّد	960.31
الخطيبات	0.03	خطيب	40.67	خَطِيب	40.67
العالمات	0.08	عالم	1545.6	عَالِم	22.65
المراقبات	0.08	مراقب	285.27	مُرَاقِب	117.43
الأمهات	3.36	أمه	21.27	أُمّه	21.27

Orthographic Form Queried	Orthographic Frequency	Verbs		Pointed Stem	Pointed Frequency
		Unpointed stem	Unpointed Frequency		
حاضر	7.44	حاضر	160.3	حَاضِر	158.1
سافر	11.83	سافر	59.01	سَافِر	26.99
تجول	2.52	تجول	22.52	تَجَوَّل	13.25
نزل	10.2	نزل	68.94	نَزَلَ	24.95
وقع	100.24	وقع	372.59	وَقَعَ	255.38
خطب	4.45	خطب	37.58	خُطِبَ	17.72
استولى	4.94	أستولى	6.31	أَسْتَوْلَى	6.31
قدم	104.4	قدم	920.5	قَدَّمَ	423.77
خرج	35.97	خرج	285.66	خَرَجَ	109.61
غادر	28.84	غادر	121.51	غَادَرَ	65.79
أقلع	0.42	قلع	41.33	قُلِعَ	4.87
قلل	3.41	قلل	39.98	قَلَّلَ	11.01
صمم	3.51	صمم	19.5	صَمَّمَ	10.52
وقف	131.92	وقف	384.58	وَقَّفَ	324.06
رحل	8.37	رحل	256.96	رَحَلَ	14.66
استمع	9.75	أستمع	21.04	أَسْتَمَعَ	21.04
رجع	2.76	رجع	110.04	رَجَعَ	5.95
صرخ	1.77	صرخ	35.77	صَرَخَ	11.67
انصرف	3.51	نصرف	16.18	نُصِرِفَ	16.18
دخن	0.13	دخ	3.45	دُخَ	3.45
تسبب	24.21	تسبب	81.89	تَسَبَّبَ	76.34
انتحر	2.89	نتحر	7.27	نُتْحِرَ	7.27
أبدع	2.05	بدع	20.81	بُدِعَ	9.04
بحث	80.86	بحث	889.76	بَحَثَ	156.95
توجه	58.18	توجه	347.9	تَوَجَّهَ	178.06
سبح	0.34	سبح	9.86	سَبَّحَ	0.92
غنى	9.44	غنى	23.18	غَنَّى	13.51
ارتمى	0.16	أرتمى	0.23	أُرْتَمَى	0.23
كتب	192.23	كتب	693.29	كَتَبَ	431.89
ركض	0.57	ركض	8.91	رَكَضَ	3.39
استعرض	9.62	أستعرض	18.25	أَسْتَعْرَضَ	18.25

افتخر	0.34	فتخر	4.8	فُتِّخِرَ	4.8
أضرب	1.27	ضرب	273.96	ضُرِبَ	20.51
ركب	4.94	ركب	39.45	رَكِبَ	7.82
ابتعد	3.38	أبتعد	9.47	أُبْتَعِدَ	9.47
فرح	9.52	فرح	71.67	فَرِحَ	36.56
انتقل	26.45	أنتقل	64.57	أُنْتَقِلَ	64.57
نظر	94.93	نظر	987.3	نَظَرَ	736.16
وافق	54.33	وافق	210.11	وَافَقَ	157.21
لعب	44.63	لعب	465.85	لَعِبَ	116.15
رقد	0.21	رقد	6.67	رُقِدَ	0.26
غطس	0.31	غطس	3.55	عَطَسَ	2.7
انشغل	1.82	نشغل	9.44	نُشِغِلَ	9.44
ظهر	116.08	ظهر	494.88	ظَهَرَ	200.51
ركز	14.38	ركز	169.34	رَكَّزَ	57.89
تخشع	0.03	خشع	0.16	خَشَّعَ	0.1
تقدم	210.33	تقدم	648.35	تَقَدَّمَ	430.45
تناقش	10.56	ناقش	142.16	نَاقِشَ	90.9
شارك	60.42	شارك	483.08	شَارَكَ	200.68
تدرب	2.16	درب	34.75	دَرَّبَ	10.91
تألق	4.94	تألق	18.38	تَأَلَّقَ	12.2
أفصح	1.2	أفصح	2.7	أَفْصَحَ	2.7
رسم	37.53	رسم	159.71	رَسَمَ	97.12
انتصر	4.03	أنتصر	10.29	أُنْتَصَرَ	10.29
ذهب	37.61	ذهب	291.09	ذَهَبَ	180.85
تمكن	46.37	تمكن	265.8	تَمَكَّنَ	260.77
أقبل	4.27	أقبل	12.53	أَقْبَلَ	12.53
أفلح	1.25	فلح	16.21	فُلِحَ	16.08
وصل	129.26	وصل	398.69	وَصَلَ	358.35
اشتغل	1.87	أشتغل	3.88	أُشْتَغِلَ	3.88
استيقظت	2.03	أستيقظ	5.88	أُسْتَيْقِظَ	5.88
احتفلت	4.5	أحتفل	14.56	أُحْتَفِلَ	14.56
أجاب	1.2	أجاب	172.67	أَجَابَ	172.67

صَعَدَ	10.65	صَعَدَ	64.24	صعد	7.02	صعدت
نَجَّ	2.37	نَجَّ	11.05	نج	1.33	نجت
عَبَّرَ	78.64	عَبَّرَ	694.31	عبر	17.01	عبرت
مَكَّثَ	2.93	مَكَّثَ	7.4	مكث	0.7	مكثت
سَارَعَ	25.12	سَارَعَ	40.83	سارع	5.25	سارعت
عَاشَ	70.78	عَاشَ	70.78	عاش	8.97	عاشت
سَخَّرَ	4.96	سَخَّرَ	18.05	سخر	2.11	سخر
صَادَقَ	4.04	صَادَقَ	109.94	صادق	2.13	صادقت
أَكْثَرَ	1382.97	أَكْثَرَ	1382.97	أكثر	0.08	أكثرت
جَلَسَ	77.42	جَلَسَ	338.66	جلس	3.95	جلست
كَشَفَ	190.39	كَشَفَ	373.01	كشف	35.06	كشفت
نَحَتَ	4.34	نَحَتَ	17.23	نحت	0.52	نحتت
شَدَّدَ	132.79	شَدَّدَ	158.59	شدد	7.07	شددت
قَامَ	599.59	قَامَ	599.59	قام	120.65	قامت
أَشْتَهَرَ	13.78	أَشْتَهَرَ	13.78	أشتهر	4.37	اشتهرت
تَكَلَّمَ	71.41	تَكَلَّمَ	74.14	تكلم	2.68	تكلمت
حَضَرَ	169.84	حَضَرَ	269.06	حضر	9.39	حضرت
أَمْسَكَ	3.68	أَمْسَكَ	3.68	أمسك	0.86	أمسكت
رَسَبَ	1.25	رَسَبَ	2.24	رسب	0.29	رسبت
أَسْتَغْرَبَ	6.51	أَسْتَغْرَبَ	6.51	أستغرب	1.22	استغربت
أَمْتَلَّ	0.36	أَمْتَلَّ	0.36	أمتل	0.16	امتثلت
تَبَرَّعَ	11.77	تَبَرَّعَ	49.41	تبرع	0.42	تبرعا
أَلْتَحَقَ	10.13	أَلْتَحَقَ	10.13	ألتحق	1.74	التحقت
دَافَعَ	21.76	دَافَعَ	101.52	دافع	1.92	دافعت
أَنْخَرَطَ	1.64	أَنْخَرَطَ	1.64	أنخرط	0.6	انخرطت
تَعَبَ	7.46	تَعَبَ	20.97	تعب	1.35	تعبت
وَقَفَ	29.59	وَقَفَ	384.58	وقف	12.07	وقفت
رَغِبَ	11.64	رَغِبَ	363.74	رغب	2.63	رغبت
أَنْتَهَ	90.77	أَنْتَهَ	90.77	أنته	69.78	انتهت
سَقَطَ	76.5	سَقَطَ	134.3	سقط	20.34	سقطت
حَرَصَ	83.7	حَرَصَ	219.97	حرص	8.17	حرصت
عَنِمَ	1.05	عَنِمَ	4.8	غنم	0.26	غنمت

شَرَعَ	68.84	شَرَعَ	99.65	شرع	5.33	شرعت
سَاهَمَ	74.76	سَاهَمَ	163.43	ساهم	20.29	ساهمت
أَمْتَنَعَ	14.7	أَمْتَنَعَ	14.7	أمتنع	4.29	امتنعت
وَاطَبَ	0.39	وَاطَبَ	1.38	واطب	0.1	واظبت
أَعْلَنَ	788.24	أَعْلَنَ	788.24	أعلن	99.27	أعلنت
أَنْزَعَ عَجَ	0.46	أَنْزَعَ عَجَ	0.46	أنزعج	0.21	انزعجت
شَعَرَ	89.55	شَعَرَ	475.22	شعر	15.58	شعرت
أَعْتَذَرَ	12.43	أَعْتَذَرَ	12.43	اعتذر	3.04	اعتذرت
هَرَبَ	5.36	هَرَبَ	61.45	هرب	2.68	هربت
أَكَّدَ	1172.36	أَكَّدَ	1177	أكد	69.23	أكدت
عَادَ	293.88	عَادَ	293.88	عاد	33.89	عادت
دَخَلَ	201.17	دَخَلَ	462.07	دخل	44.4	دخلت
أَقْتَرَبَ	21.76	أَقْتَرَبَ	21.76	أقترب	6.14	اقتربت
أَحْتَفَظَ	13.41	أَحْتَفَظَ	13.41	أحتفظ	3.36	احتفظت
وَقَعَ	255.38	وَقَعَ	372.59	وقع	76.44	وقعت
أَبْلَغَ	115.46	أَبْلَغَ	115.46	أبلغ	9.02	أبلغت
أَبْتَهَجَ	0.49	أَبْتَهَجَ	0.49	أبتهج	0.21	ابتهجت
رَكَزَ	57.89	رَكَزَ	169.34	ركز	12.95	ركزت
سَمَ	3.12	سَمَ	3.12	سم	0.65	سئمت
تَأَخَّرَ	46.52	تَأَخَّرَ	58.32	تأخر	6.06	تأخرت
حَصَلَ	322.97	حَصَلَ	557.02	حصل	67.8	حصلت
ضَحِكَ	9.01	ضَحِكَ	44.58	ضحك	1.69	ضحكت
عَجَزَ	163.49	عَجَزَ	212.05	عجز	36.96	عجزت
حَاضِرَ	158.1	حَاضِرَ	160.3	حاضر	7.31	حاضرا
سَافَرَ	26.99	سَافَرَ	59.01	سافر	2.16	سافروا
جَوَّلَ	3.62	جَوَّلَ	245.39	جول	0.03	تجولوا
نَزَلَ	6.02	نَزَلَ	68.94	نزل	1.74	نزلوا
وَقَعَ	61.91	وَقَعَ	372.59	وقع	5.75	وقعوا
خُطِبَ	17.72	خُطِبَ	37.58	خطب	0.47	خطبا
أَسْتَوَّلَ	15.12	أَسْتَوَّلَ	15.12	أستول	3.33	استولوا
قَدَّمَ	423.77	قَدَّمَ	920.5	قدم	13.37	قدموا
خَرَجَ	109.61	خَرَجَ	285.66	خرج	6.55	خرجوا

غادروا	5.12	غادر	121.51	غَادَر	65.79
أقلعوا	0.03	أقلع	3.48	أَقْلَعَ	3.48
قللوا	0.23	قلل	39.98	قَلَّلَ	11.01
صمموا	0.13	صمم	19.5	صَمَّمَ	10.52
وقفوا	3.23	وقف	384.58	وَقَّفَ	29.59
رحلوا	1.38	رحل	256.96	رَحَلَ	3.65
استمعوا	0.94	أستمع	21.04	أَسْتَمَعَ	21.04
رجعوا	0.39	رجع	110.04	رَجَعَ	2.89
صرخوا	0.16	صرخ	35.77	صَرَخَ	11.67
انصرفوا	0.68	أنصرف	2.7	أَنْصَرَفَ	2.7
دخنوا	0.1	دخن	2.56	دَخَنَ	0.26
تسببوا	1.3	سبب	800.96	سَبَّبَ	27.06
انتحروا	0.18	أنتحر	1.38	أَنْتَحَرَ	1.38
أبدعوا	0.26	أبدع	3.29	أَبْدَعَ	3.29
بحثوا	2.24	بحث	889.76	بَحَثَ	156.95
توجهوا	3.07	توجه	347.9	تَوَجَّهَ	178.06
سبحوا	0.05	سبح	9.86	سَبَّحَ	0.92
غنوا	0.21	غن	9.37	عَنَّ	7.56
ارتمى	0.16	أرتمى	0.23	أَرْتَمَى	0.23
كتبوا	4.4	كتب	693.29	كُتِبَ	7.5
ركضوا	0.05	ركض	8.91	رَكَضَ	3.39
استعرضوا	0.26	أستعرض	18.25	أَسْتَعْرَضَ	18.25
افتخروا	0.03	أفتخر	0.03	أَفْتَحَرَ	0.03
أضربوا	0.21	أضرب	1.61	أَضْرَبَ	1.61
ركبوا	0.31	ركب	39.45	رَكَبَ	7.82
ابتعدوا	0.68	أبتعد	9.47	أَبْتَعَدَ	9.47
فرحوا	0.18	فرح	71.67	فَرَحَ	0.99
انتقلوا	2.47	أنقل	64.57	أَنْتَقَلَ	64.57
نظروا	1.04	نظر	987.3	نَظَرَ	736.16
وافقوا	5.07	وافق	210.11	وَافَقَ	157.21
لعبوا	2.57	لعب	465.85	لَعِبَ	116.15
رقدوا	0.05	رقد	6.67	رَقَدَ	0.3

غَطَسَ	2.7	غَطَسَ	3.55	غَطَسَ	0.31
أَنْشَغَلَ	3.25	أَنْشَغَلَ	3.25	أَنْشَغَلَ	0.62
ظَهَرَ	19.07	ظَهَرَ	494.88	ظَهَرُوا	1.74
أَنْتَبَهَ	1.97	أَنْتَبَهَ	1.97	أَنْتَبَهُوا	0.75
تَقَدَّمَ	430.45	تَقَدَّمَ	648.35	تَقَدَّمُوا	4.6
نَاقَشَ	90.9	نَاقَشَ	142.16	تَنَاقَشُوا	0.05
شَارَكَ	200.68	شَارَكَ	483.08	شَارَكُوا	18.6
تَدَرَّبَ	11.54	تَدَرَّبَ	12.39	تَدَرَّبُوا	1.35
أَلَقَ	5.98	أَلَقَ	46.91	تَأَلَّقُوا	0.13
أَفْصَحَ	2.7	أَفْصَحَ	2.7	أَفْصَحُوا	0.05
رَسَّمَ	3.88	رَسَّمَ	159.71	رَسَمُوا	0.52
أَنْتَصَرَ	10.29	أَنْتَصَرَ	10.29	أَنْتَصَرُوا	0.68
ذَهَبَ	180.85	ذَهَبَ	291.09	ذَهَبُوا	4.4
تَمَكَّنَ	260.77	تَمَكَّنَ	265.8	تَمَكَّنُوا	7.05
أَقْبَلَ	12.53	أَقْبَلَ	12.53	أَقْبَلُوا	0.31
أَفْلَحَ	2.66	أَفْلَحَ	2.66	أَفْلَحُوا	0.13
وَصَلَ	358.35	وَصَلَ	398.69	وَصَلُوا	13.16
أَشْتَغَلَ	3.88	أَشْتَغَلَ	3.88	أَشْتَغَلُوا	0.39
أَسْتَيْقِظَ	5.88	أَسْتَيْقِظَ	5.88	أَسْتَيْقِظُوا	2.11
أَحْتَفَلَ	14.56	أَحْتَفَلَ	14.56	أَحْتَفَلُوا	0.03
جَبَّنَ	0.36	جَبَّنَ	6.87	أَجَبْنُوا	0.16
صَعَّدَ	10.65	صَعَّدَ	64.24	صَعَّدُوا	0.03
نَجَّوْ	2.17	نَجَّوْ	12.13	نَجَّوْ	0.03
عَبَّرَ	78.64	عَبَّرَ	694.31	عَبَّرُوا	0.03
مَكَّثَ	2.93	مَكَّثَ	7.4	مَكَّثُوا	0.73
سَارَعَ	25.12	سَارَعَ	40.83	سَارَعُوا	7.15
عَشَ	17.52	عَشَ	26.79	عَشُوا	0.1
سَخَّرَ	4.96	سَخَّرَ	18.05	سَخَّرُوا	2.11
صَادَقَ	105.89	صَادَقَ	109.94	صَادَقُوا	25.9
أَكْثَرَ	1382.97	أَكْثَرَ	1382.97	أَكْثَرُوا	503.61
جَلَسَ	77.42	جَلَسَ	338.66	جَلَسُوا	0.21
كَشَفَ	190.39	كَشَفَ	373.01	كَشَفُوا	60.73

نَحَت	4.34	نَحَت	17.23	نَحَت	2.47
شَدَد	132.79	شَدَد	158.59	شَدَد	20.08
تَفَوَّق	16.93	تَفَوَّق	61.64	تَفَوَّق	0.05
قُم	53.13	قُم	455.33	قُم	0.31
أَشْتَهَر	13.78	أَشْتَهَر	13.78	أَشْتَهَر	5.98
تَكَلَّمَ	71.41	تَكَلَّمَ	74.14	تَكَلَّمَ	7.31
حَضَرَ	169.84	حَضَرَ	269.06	حَضَرَ	0.16
مَس	16.44	مَس	67.56	مَس	1.98
رَسَب	1.25	رَسَب	2.24	رَسَب	0.47
أَسْتَغْرَب	6.51	أَسْتَغْرَب	6.51	أَسْتَغْرَب	3.54
مَثَل	3.68	مَثَل	3.68	مَثَل	0.42
تَبَرَّع	11.77	تَبَرَّع	49.41	تَبَرَّع	4.08
أَلْتَحَق	10.13	أَلْتَحَق	10.13	أَلْتَحَق	0.03
دَافِع	21.76	دَافِع	101.52	دَافِع	0.03
نُخِرِط	7	نُخِرِط	7	نُخِرِط	1.33
تَعَب	7.46	تَعَب	20.97	تَعَب	2.86
نَجَّح	4.14	نَجَّح	236.51	نَجَّح	0.23
تَوَقَّف	243.78	تَوَقَّف	283.69	تَوَقَّف	53.76
رَغِب	11.64	رَغِب	363.74	رَغِب	0.03
أَنْتَهَي	5.26	أَنْتَهَي	5.26	أَنْتَهَي	0.03
سَقَط	76.5	سَقَط	134.3	سَقَط	0.03
حَرَص	83.7	حَرَص	219.97	حَرَص	0.1

غَنِمَ	3.32	غَنِمَ	4.8	غَنِمَ	0.68
شَرَعَ	3.19	شَرَعَ	99.65	شَرَعَ	0.03
سَاهَمَ	74.76	سَاهَمَ	163.43	سَاهَمَ	0.05
أَمْتَنَعَ	14.7	أَمْتَنَعَ	14.7	أَمْتَنَعَ	5.75
وَاطَبَ	0.39	وَاطَبَ	1.38	وَاطَبَ	0.03
أَعْلَنَ	788.24	أَعْلَنَ	788.24	أَعْلَنَ	203.52
نَزَعَ	2.6	نَزَعَ	2.6	نَزَعَ	0.49
شَعَرَ	89.55	شَعَرَ	475.22	شَعَرَ	0.08
أَعْتَذَرَ	12.43	أَعْتَذَرَ	12.43	أَعْتَذَرَ	6.09
هَرَبَ	37.38	هَرَبَ	61.45	هَرَبَ	6.92
أَكَّدَ	1172.36	أَكَّدَ	1177	أَكَّدَ	0.16
عَدَنَ	42.02	عَدَنَ	42.02	عَدَنَ	32.8
دَخَلَ	201.17	دَخَلَ	462.07	دَخَلَ	0.1
أَقْتَرَبَ	21.76	أَقْتَرَبَ	21.76	أَقْتَرَبَ	8.22
أَحْتَفَظَ	13.41	أَحْتَفَظَ	13.41	أَحْتَفَظَ	0.03
وَقَعَ	61.91	وَقَعَ	372.59	وَقَعَ	0.18
أَبْلَغَ	115.46	أَبْلَغَ	115.46	أَبْلَغَ	0.03
بَتَّهَجَ	1.35	بَتَّهَجَ	1.35	بَتَّهَجَ	0.16
رَكَزَ	57.89	رَكَزَ	169.34	رَكَزَ	14.38
سَنِمَ	3.12	سَنِمَ	3.12	سَنِمَ	0.65
تَأَخَّرَ	46.52	تَأَخَّرَ	58.32	تَأَخَّرَ	0.03
حَصَلَ	322.97	حَصَلَ	557.02	حَصَلَ	0.39
ضَحِكَ	9.01	ضَحِكَ	44.58	ضَحِكَ	4.24
عَجَزَ	163.49	عَجَزَ	212.05	عَجَزَ	36.96

بالأمس الأستاذ حاضَرَ في الكلية	01SACP_M	Yesterday the professor lectured at the college
بالأمس الأب سافَرَ إلى المدينة	02SACP_M	Yesterday the father traveled to the city
بالأمس البائع تجوَّلَ في السوق	03SACP_M	Yesterday the salesman wandered into the market
بالأمس البحَّار نَزَلَ من السفينة	04SACP_M	Yesterday the sailor got off the ship
بالأمس التاجر وقَّع على العقد	05SACP_M	Yesterday the trader signed the contract
بالأمس الإمام خطَبَ في المسجد	06SACP_M	Yesterday the imam preached at the mosque
بالأمس الجندي استولَى على الحدود	07SACP_M	Yesterday the soldier took over the border
بالأمس المجنَّد قدِمَ إلى المخفر	08SACP_M	Yesterday the recruit came to the station
بالأمس الساحر خرَجَ من المسرح	09SACP_M	Yesterday the magician came out of the theater
بالأمس الراكب غادرَ من المحطة	10SACP_M	Yesterday the passenger left the station
بالأمس رائد أقْلَعَ إلى الفضاء	11SACP_M	Yesterday the astronaut took off to space
بالأمس الرجل قلَّلَ من التدخين	12SACP_M	Yesterday the man reduced smoking
بالأمس المصارع صمَّمَ على الفوز	13SACP_M	Yesterday the wrestler was determined to win
بالأمس الشيخ وقَّفَ على الحصن	14SACP_M	Yesterday the Sheikh stood on the fortress
بالأمس الرفيق رحَلَ إلى المهجر	15SACP_M	Yesterday the comrade left for exile
بالأمس الرئيس استمَعَ إلى الحكومة	16SACP_M	Yesterday the president listened to the government
بالأمس الزبون رجَعَ إلى الدكان	17SACP_M	Yesterday the customer returned to the store
بالأمس المتظاهر صرَّخَ في الميدان	18SACP_M	Yesterday the demonstrator screamed in the square
بالأمس الساكن انصَرَفَ إلى البيت	19SACP_M	Yesterday the dweller went to the house
بالأمس المدخن دخَّنَ في الشرفة	20SACP_M	Yesterday the smoker smoked on the balcony
بالأمس السائق تسبَّبَ في الحادث	21SACP_M	Yesterday the driver caused the accident
بالأمس السجين انتحَرَ في الزنزانة	22SACP_M	Yesterday the prisoner committed suicide in the cell
بالأمس الشاعر أبدَعَ في القصيدة	23SACP_M	Yesterday the poet excelled in the poem
بالأمس الشرطي بحثَ عن الجثة	24SACP_M	Yesterday the policeman looked for the body
بالأمس المهندس توجَّهَ إلى البرج	25SACP_M	Yesterday the engineer went to the tower
بالأمس الصبي سبَحَ في البحيرة	26SACP_M	Yesterday the boy swam in the lake
بالأمس المطرب غنَّى في النادي	27SACP_M	Yesterday the singer sang in the club
بالأمس الصياد ارتمى على الطريدة	28SACP_M	Yesterday the hunter jumped onto the prey
بالأمس الصحافي كَتَبَ في الجريدة	29SACP_M	Yesterday the journalist wrote in the newspaper
بالأمس الطفل ركضَ في الغرفة	30SACP_M	Yesterday the child ran into the room

بالأمس الطيّار استعرضَ في الجو	31SACP_M	Yesterday the pilot showed his skills in the sky
بالأمس العازف افتخَرَ بالمقطوعة	32SACP_M	Yesterday the musician was proud of the piece
بالأمس العامل أضربَ عن العمل	33SACP_M	Yesterday the worker went on strike
بالأمس السائق ركبَ في الشاحنة	34SACP_M	Yesterday the driver rode on the truck
بالأمس الراعي ابتعدَ عن القطيع	35SACP_M	Yesterday the shepherd moved away from the herd
بالأمس الفلاح فرحَ بالمحصول	36SACP_M	Yesterday the farmer rejoiced at the crop
بالأمس المقرئ انتقلَ إلى الجامع	37SACP_M	Yesterday the (Quran) reciter moved to the mosque
بالأمس القاضي نظرَ في القضية	38SACP_M	Yesterday the judge looked into the case
بالأمس القائد وافقَ على الخطة	39SACP_M	Yesterday the leader approved the plan
بالأمس الولد لعبَ في الحديقة	40SACP_M	Yesterday the boy played in the garden
بالأمس المريض رقدَ في العيادة	41SACP_M	Yesterday the patient lay in the clinic
بالأمس الغواص غطسَ في البحر	42SACP_M	Yesterday the diver dived into the sea
بالأمس المحقق انشغلَ بالجريمة	43SACP_M	Yesterday the investigator was busy with the crime
بالأمس المسؤول ظهرَ في التلفاز	44SACP_M	Yesterday the person in charge appeared on TV
بالأمس المتسابق ركّزَ على الهدف	45SACP_M	Yesterday the contestant focused on the goal
بالأمس الحاج تخشعَ حول الكعبة	46SACP_M	Yesterday the pilgrim felt humble around the Kaaba
بالأمس المدير تقدّمَ إلى المنصة	47SACP_M	Yesterday the manager came to the podium
بالأمس الفقيه تناقشَ في المسألة	48SACP_M	Yesterday the jurist discussed the issue (with others)
بالأمس النائب شاركَ في المؤتمر	49SACP_M	Yesterday the deputy participated in the conference
بالأمس السباح تدربَ في النهر	50SACP_M	Yesterday the swimmer trained in the river
بالأمس الملاكم تألّقَ في المباراة	51SACP_M	Yesterday the boxer excelled during the fight
بالأمس المستشار أفصحَ عن المشروع	52SACP_M	Yesterday the counselor disclosed the project
بالأمس الخطاط رسمَ على اللوحة	53SACP_M	Yesterday the calligrapher drew on the board
بالأمس المحارب انتصرَ في المعركة	54SACP_M	Yesterday the warrior won the battle
بالأمس المصور ذهبَ إلى الإحتفال	55SACP_M	Yesterday the photographer went to the celebration
بالأمس المستثمر تمكّنَ من الربح	56SACP_M	Yesterday the investor managed to get profit
بالأمس النجار أقبلَ إلى الورشة	57SACP_M	Yesterday the carpenter came to the workshop
بالأمس المبدع أفلحَ في العمل	58SACP_M	Yesterday the creator succeeded in his work
بالأمس المخبر وصلَ إلى الحقيقة	59SACP_M	Yesterday the informant reached the truth
بالأمس المزارع اشتغلَ في الحقل	60SACP_M	Yesterday the farmer worked in the field

بالأمس البنت استيقظت من النوم	01SACP_F	Yesterday the girl woke up from sleep
بالأمس العروس احتفلت بالزفاف	02SACP_F	Yesterday the bride celebrated the wedding
بالأمس المذيعة أجابت على السؤال	03SACP_F	Yesterday the female broadcaster answered the question
بالأمس الزوجة صعدت إلى السطح	04SACP_F	Yesterday the wife went on the roof
بالأمس المغامرة نجت من الموت	05SACP_F	Yesterday the female adventurer escaped death
بالأمس المثقفة عبّرت عن الرأي	06SACP_F	Yesterday the educated woman expressed her opinion
بالأمس المشعوذة مكثت في القرية	07SACP_F	Yesterday the female sorcerer stayed in the village
بالأمس المعلمة سارعت إلى القاعة	08SACP_F	Yesterday the female teacher rushed to the classroom
بالأمس العجوز عاشت في القصر	09SACP_F	Yesterday the old woman lived in the palace
بالأمس المحامية سخرت من الدفاع	10SACP_F	Yesterday the female lawyer mocked the defense
بالأمس الوزيرة صادقت على الاتفاق	11SACP_F	Yesterday the female minister ratified the agreement
بالأمس الطباخة أكثرت من الأكل	12SACP_F	Yesterday the female cook prepared too much food
بالأمس المحاسبة جلست في المكتب	13SACP_F	Yesterday the female accountant sat in the office
بالأمس العميلة كشفت عن السر	14SACP_F	Yesterday the female agent revealed the secret
بالأمس الرسامة نحّت على الحائط	15SACP_F	Yesterday the female painter carved on the wall
بالأمس المشرفة شددت على الانضباط	16SACP_F	Yesterday the female supervisor emphasized discipline
بالأمس المرشحة تفوقت في الإمتحان	17SACP_F	Yesterday the female candidate excelled in the exam
بالأمس الممثلة قامت بالدور	18SACP_F	Yesterday the actress performed the role
بالأمس الفنانة اشتهرت بالغناء	19SACP_F	Yesterday the female artist became famous for singing
بالأمس المدرّسة تكلمت عن الواجب	20SACP_F	Yesterday the female teacher talked about the assignment
بالأمس الممرضة حضرت إلى المكان	21SACP_F	Yesterday the female nurse came to the place
بالأمس الصائمة أمسكت عن الطعام	22SACP_F	Yesterday the fasting woman stopped eating
بالأمس الطالبة رسبت في الإختبار	23SACP_F	Yesterday the female student failed on the test
بالأمس الباحثة استغربت من النتيجة	24SACP_F	Yesterday the female researcher was surprised by the result
بالأمس المتهمّة امتثلت للأوامر	25SACP_F	Yesterday the accused woman complied with the orders
بالأمس الأميرة تبرّعت بالدم	26SACP_F	Yesterday the princess donated blood
بالأمس اللاجئة التحقت بالمخيم	27SACP_F	Yesterday the female refugee joined the camp
بالأمس المواطنة دافعت عن القانون	28SACP_F	Yesterday the female citizen defended the law
بالأمس الموظفة انخرطت في الجمعية	29SACP_F	Yesterday the female employee joined the association
بالأمس الخادمة تعبّت من الشغل	30SACP_F	Yesterday the maid became tired of work

بالأمس الفتاة نجحت في الحفل	31SACP_F	Yesterday the girl succeeded in the party
بالأمس الطفلة توقفت عن البكاء	32SACP_F	Yesterday the little girl stopped crying
بالأمس المشاركة رغبت في الكلام	33SACP_F	Yesterday the female participant wanted to talk
بالأمس المغنية انتهت من الجولة	34SACP_F	Yesterday the female singer finished the tour
بالأمس اللاعبة سقطت في الحلبة	35SACP_F	Yesterday the female player fell into the ring
بالأمس المرافقة حرصت على السلامة	36SACP_F	Yesterday the female companion stressed safety
بالأمس المؤمنة غنمت بالمغفرة	37SACP_F	Yesterday the female believer gained forgiveness/mercy
بالأمس المصلية شرعت في الدعاء	38SACP_F	Yesterday the praying woman started the prayer
بالأمس الناشطة ساهمت في الحوار	39SACP_F	Yesterday the female activist contributed to the dialogue
بالأمس الناحبة امتنعت عن التصويت	40SACP_F	Yesterday the female voter abstained from voting
بالأمس المدربة واطبقت على التمارين	41SACP_F	Yesterday the female trainer continued to do exercises
بالأمس المضيفة أعلنت عن الوصول	42SACP_F	Yesterday the airhostess announced the arrival
بالأمس المسافرة انزعجت من التأخير	43SACP_F	Yesterday the female traveler was annoyed by the delay
بالأمس العارضة شعرت بالخجل	44SACP_F	Yesterday the female model felt shy
بالأمس الملكة اعتذرت عن الحضور	45SACP_F	Yesterday the queen apologized for not attending
بالأمس الأسيرة هربت من القصر	46SACP_F	Yesterday the female captive escaped from the palace
بالأمس الطبيبة أكدت على الدواء	47SACP_F	Yesterday the female doctor confirmed the medication
بالأمس المراسلة عادت من الرحلة	48SACP_F	Yesterday the female reporter returned from the trip
بالأمس التلميذة دخلت إلى الفصل	49SACP_F	Yesterday the female pupil went into the classroom
بالأمس السائحة اقتربت من الجمل	50SACP_F	Yesterday the female tourist approached the camel
بالأمس المفتشة احتفظت بالدليل	51SACP_F	Yesterday the female inspector kept the evidence
بالأمس المتنافسة وقعت على الأرض	52SACP_F	Yesterday the female contestant fell on the floor
بالأمس الحارسة أبلغت عن الحادثة	53SACP_F	Yesterday the female guard reported the accident
بالأمس الخريجة ابتهجت بالشهادة	54SACP_F	Yesterday the female graduate student was happy with the certificate
بالأمس المرشدة ركزت على الالتزام	55SACP_F	Yesterday the female guide stressed commitment
بالأمس السيدة سئمت من الانتظار	56SACP_F	Yesterday the lady was fed up with waiting
بالأمس الخطيبة تأخرت عن الموعد	57SACP_F	Yesterday the fiancée was late for the appointment
بالأمس عالمة حصلت على المكافأة	58SACP_F	Yesterday the female scientist received the prize
بالأمس المراقبة ضحكت من المشهد	59SACP_F	Yesterday the forewoman laughed from the scene
بالأمس الأم عجزت عن الوقوف	60SACP_F	Yesterday the mother could not stand up

بالأمس الأساتذة حاضروا في الكلية	01PACP_M	Yesterday the professors lectured at the college
بالأمس الآباء سافروا إلى المدينة	02PACP_M	Yesterday the fathers traveled to the city
بالأمس البائعون تجولوا في السوق	03PACP_M	Yesterday the salesmen wandered into the market
بالأمس البحارة نزلوا من السفينة	04PACP_M	Yesterday the sailors got off the ship
بالأمس التجار وقّعوا على العقد	05PACP_M	Yesterday the traders signed the contract
بالأمس الأئمة خطبوا في المسجد	06PACP_M	Yesterday the imams preached at the mosque
بالأمس الجنود استولوا على الحدود	07PACP_M	Yesterday the soldiers took over the border
بالأمس المجندون قدموا إلى المخفر	08PACP_M	Yesterday the recruits came to the station
بالأمس السحرة خرجوا من المسرح	09PACP_M	Yesterday the magicians came out of the theater
بالأمس الركاب غادروا من المحطة	10PACP_M	Yesterday the passengers left the station
بالأمس الرواد اقلعوا إلى الفضاء	11PACP_M	Yesterday the astronauts took off to space
بالأمس الرجال قللوا من التدخين	12PACP_M	Yesterday the men reduced smoking
بالأمس المصارعون صمموا على الفوز	13PACP_M	Yesterday the wrestlers were determined to win
بالأمس الشيوخ وقفوا على الحصن	14PACP_M	Yesterday the Sheikhs stood on the fortress
بالأمس الرفاق رحلوا إلى المهجر	15PACP_M	Yesterday the comrades left for exile
بالأمس الرؤساء استمعوا إلى الحكومة	16PACP_M	Yesterday the presidents listened to the government
بالأمس الزبائن رجعوا إلى الدكان	17PACP_M	Yesterday the customers returned to the store
بالأمس المتظاهرون صرخوا في الميدان	18PACP_M	Yesterday the demonstrators screamed in the square
بالأمس الساكنون انصرفوا إلى البيوت	19PACP_M	Yesterday the dwellers went to the house
بالأمس المدخنون دخّنوا في الشرفة	20PACP_M	Yesterday the smokers smoked on the balcony
بالأمس السائقون تسبّبوا في الحادث	21PACP_M	Yesterday the drivers caused the accident
بالأمس السجناء انتحروا في الزنزانة	22PACP_M	Yesterday the prisoners committed suicide in the cell
بالأمس الشعراء أبدعوا في القصيدة	23PACP_M	Yesterday the poets excelled in the poem
بالأمس المحققون بحثوا عن الجثة	24PACP_M	Yesterday the policemen looked for the body
بالأمس المهندسون توجهوا إلى البرج	25PACP_M	Yesterday the engineers went to the tower
بالأمس الصبية سبحوا في البحيرة	26PACP_M	Yesterday the boys swam in the lake
بالأمس المطربون غنّوا في النادي	27PACP_M	Yesterday the singers sang in the club
بالأمس الصيادون ارتموا على الطرائد	28PACP_M	Yesterday the hunters jumped onto the prey
بالأمس الصحفيون كتبوا في الجريدة	29PACP_M	Yesterday the journalists wrote in the newspaper
بالأمس الأطفال ركضوا في الغرفة	30PACP_M	Yesterday the children ran into the room

بالأمس الطيارون استعرَضُوا في الجو	31PACP_M	Yesterday the pilots showed their skills in the sky
بالأمس العازفون افتخَرُوا بالمقطوعة	32PACP_M	Yesterday the musicians were proud of the piece
بالأمس العمَّال أضربُوا عن العمل	33PACP_M	Yesterday the workers went on strike
بالأمس السائقون ركَبُوا في الشاحنات	34PACP_M	Yesterday the drivers rode on the truck
بالأمس الرعاة ابتعدُوا عن القطيع	35PACP_M	Yesterday the shepherds moved away from the herd
بالأمس الفلاحون فرِحُوا بمحصولهم	36PACP_M	Yesterday the farmers rejoiced at the crop
بالأمس المقرئون انتقلُوا إلى الجامع	37PACP_M	Yesterday the (Quran) reciters moved to the mosque
بالأمس القضاة نظَرُوا في القضية	38PACP_M	Yesterday the judges looked into the case
بالأمس القادة وافقُوا على الخطة	39PACP_M	Yesterday the leaders approved the plan
بالأمس الأولاد لعبُوا في الحديقة	40PACP_M	Yesterday the boys played in the garden
بالأمس المرضى رَقَدُوا في العيادة	41PACP_M	Yesterday the patients lay in the clinic
بالأمس الغواصون غطَسُوا في البحر	42PACP_M	Yesterday the divers dived into the sea
بالأمس المحققون انشغَلُوا بالجريمة	43PACP_M	Yesterday the investigators were busy with the crime
بالأمس المسؤولون ظهرُوا في التلفاز	44PACP_M	Yesterday the people in charge appeared on TV
بالأمس المتسابقون انتبَهُوا إلى التعليمات	45PACP_M	Yesterday the contestants focused on the goal
بالأمس الحجاج تخشَعُوا حول الكعبة	46PACP_M	Yesterday the pilgrims felt humble around the Kaaba
بالأمس المدراء تقدَّمُوا إلى المنصة	47PACP_M	Yesterday the managers came to the podium
بالأمس الفقهاء تناقَشُوا في المسألة	48PACP_M	Yesterday the jurists discussed the issue (with others)
بالأمس النواب شارَكُوا في المؤتمر	49PACP_M	Yesterday the deputies participated in the conference
بالأمس السباحون تدَرَّبُوا في النهر	50PACP_M	Yesterday the swimmers trained in the river
بالأمس الملاكمون تألَّقُوا في المباراة	51PACP_M	Yesterday the boxers excelled during the fight
بالأمس المستشارون أفصحُوا عن المشروع	52PACP_M	Yesterday the counselors disclosed the project
بالأمس الخطاطون رَسَمُوا على اللوحة	53PACP_M	Yesterday the calligraphers drew on the board
بالأمس المحاربون انتصَرُوا في المعركة	54PACP_M	Yesterday the warriors won the battle
بالأمس المصورون ذهبُوا إلى الإحتفال	55PACP_M	Yesterday the photographers went to the celebration
بالأمس المستثمرون تمكَّنُوا من الربح	56PACP_M	Yesterday the investors managed to get profit
بالأمس النجارون أقبلُوا إلى الورشة	57PACP_M	Yesterday the carpenters came to the workshop
بالأمس المبدعون أفلَحُوا في العمل	58PACP_M	Yesterday the creators succeeded in their work
بالأمس المخبرون وصلُوا إلى الحقيقة	59PACP_M	Yesterday the informants reached the truth
بالأمس المزارعون اشتغَلُوا في الحقل	60PACP_M	Yesterday the farmers worked in the field

بالأمس البنات استيقظن من النوم	01PACP_F	Yesterday the girls woke up from sleep
بالأمس العرائس احتفلن بالزفاف	02PACP_F	Yesterday the brides celebrated the wedding
بالأمس المذيعات أجبن على السؤال	03PACP_F	Yesterday the female broadcasters answered the question
بالأمس الزوجات صعدن إلى السطح	04PACP_F	Yesterday the wives went on the roof
بالأمس المغامرات نجون من الموت	05PACP_F	Yesterday the female adventurers escaped death
بالأمس المثقفات عبرن عن الرأي	06PACP_F	Yesterday the educated women expressed their opinion
بالأمس المشعوذات مكثن في القرية	07PACP_F	Yesterday the female sorcerers stayed in the village
بالأمس المعلمات سارغن إلى القاعة	08PACP_F	Yesterday the female teachers rushed to the classroom
بالأمس العجائز عشن في القصر	09PACP_F	Yesterday the old women lived in the palace
بالأمس المحاميات سخرن من الدفاع	10PACP_F	Yesterday the female lawyers mocked the defense
بالأمس الوزيرات صادقن على الاتفاق	11PACP_F	Yesterday the female ministers ratified the agreement
بالأمس الطباخات أكثرن من الأكل	12PACP_F	Yesterday the female cooks prepared too much food
بالأمس المحاسبات جلسن في المكتب	13PACP_F	Yesterday the female accountants sat in the office
بالأمس العمليات كشفن عن السر	14PACP_F	Yesterday the female agents revealed the secret
بالأمس الرسامات نحثن على الحائط	15PACP_F	Yesterday the female painters carved on the wall
بالأمس المشرفات شددن على الانضباط	16PACP_F	Yesterday the female supervisors emphasized discipline
بالأمس المرشحات تفوقن في الإمتحان	17PACP_F	Yesterday the female candidates excelled in the exam
بالأمس الممثلات قمن بالدور	18PACP_F	Yesterday the actresses performed the role
بالأمس الفنانات اشتهرن بالغناء	19PACP_F	Yesterday the female artists became famous for singing
بالأمس المدرسات تكلمن عن الواجب	20PACP_F	Yesterday the female teachers talked about the assignment
بالأمس الممرضات حضرن إلى المكان	21PACP_F	Yesterday the female nurses came to the place
بالأمس الصائمات أمسكن عن الطعام	22PACP_F	Yesterday the fasting women stopped eating
بالأمس الطالبات رسبن في الإختبار	23PACP_F	Yesterday the female students failed on the test
بالأمس الباحثات استغربن من النتيجة	24PACP_F	Yesterday the female researchers were surprised by the result
بالأمس المتهمات امتثلن للأوامر	25PACP_F	Yesterday the accused women complied with the orders
بالأمس الأميرات تبرعن بالدم	26PACP_F	Yesterday the princesses donated blood
بالأمس اللاجئات التحقن بالمخيم	27PACP_F	Yesterday the female refugees joined the camp
بالأمس المواطنات دافعن عن القانون	28PACP_F	Yesterday the female citizens defended the law
بالأمس الموظفات انخرطن في الجمعية	29PACP_F	Yesterday the female employees joined the association
بالأمس الخادما تعبن من الشغل	30PACP_F	Yesterday the maids became tired of work

بالأمس الفتيات نجحن في الحفل	31PACP_F	Yesterday the girls succeeded in the party
بالأمس الطفلات توقفن عن البكاء	32PACP_F	Yesterday the little girls stopped crying
بالأمس المشاركات رغبن في الكلام	33PACP_F	Yesterday the female participants wanted to talk
بالأمس المغنيات انتهين من الجولة	34PACP_F	Yesterday the female singers finished the tour
بالأمس اللاعبات سقطن في الحلبة	35PACP_F	Yesterday the female players fell into the ring
بالأمس المرافقات حرصن على السلامة	36PACP_F	Yesterday the female companions stressed safety
بالأمس المؤمنات غنمن بالمغفرة	37PACP_F	Yesterday the female believers gained forgiveness/mercy
بالأمس المصليات شرعن في الدعاء	38PACP_F	Yesterday the praying women started the prayer
بالأمس الناشطات ساهمن في الحوار	39PACP_F	Yesterday the female activists contributed to the dialogue
بالأمس الناخبات امتنعن عن التصويت	40PACP_F	Yesterday the female voters abstained from voting
بالأمس المدربات واطبن على التمارين	41PACP_F	Yesterday the female trainers continued to do exercises
بالأمس المضيفات أعلن عن الوصول	42PACP_F	Yesterday the airhostesses announced the arrival
بالأمس المسافرين انزعجن من التأخير	43PACP_F	Yesterday the female travelers were annoyed by the delay
بالأمس العارضات شعرن بالخجل	44PACP_F	Yesterday the female models felt shy
بالأمس الملكات اعتذرن عن الحضور	45PACP_F	Yesterday the queens apologized for not attending
بالأمس الأسيرات هربن من القصر	46PACP_F	Yesterday the female captives escaped from the palace
بالأمس الطبيبات أكدن على الدواء	47PACP_F	Yesterday the female doctors confirmed the medication
بالأمس المراسلات عدن من الرحلة	48PACP_F	Yesterday the female reporters returned from the trip
بالأمس التلميذات دخلن إلى الفصل	49PACP_F	Yesterday the female students went into the classroom
بالأمس السائحات اقتربن من الجمل	50PACP_F	Yesterday the female tourists approached the camel
بالأمس المفتشات احتفظن بالدليل	51PACP_F	Yesterday the female inspectors kept the evidence
بالأمس المتنافسات وقعن على الأرض	52PACP_F	Yesterday the female contestants fell on the floor
بالأمس الحارسات أبلغن عن الحادثة	53PACP_F	Yesterday the female guards reported the accident
بالأمس الخريجات ابتهجن بالشهادة	54PACP_F	Yesterday the female graduate students were happy with the certificate
بالأمس المرشدات ركزن على الالتزام	55PACP_F	Yesterday the female guides stressed commitment
بالأمس السيدات سئمن من الإنتظار	56PACP_F	Yesterday the ladies were fed up with waiting
بالأمس الخطيبات تأخرن عن الموعد	57PACP_F	Yesterday the fiancées were late for the appointment
بالأمس العالمات حصلن على المكافأة	58PACP_F	Yesterday the female scientists received the prize
بالأمس المراقبات ضحكن من المشهد	59PACP_F	Yesterday the forewomen laughed from the scene
بالأمس الأمهات عجزن عن الوقوف	60PACP_F	Yesterday the mothers could not stand up