**Title**

Vowel Harmony in Turkish

**Description**

Vowel harmony is a phonological phenomenon common in many languages (e.g., Finnish, Turkish, and others) in which some vowels cannot be together with others in (monomorphemic) words. The reason for vowel harmony in these languages is that, because of how vowels are pronounced in a word, it may be easier to combine some vowels with others (e.g., front vowels with front vowels and back vowels with back vowels). For instance, in Turkish, which is the language used in the present experiment, there are four front vowels (i, ö, ü, e; [/i/, /ø/, /y/, /e/]) and four back vowels (ı, o, u, a [/ɯ/,/o/,/u/,/a/]). Typically, monomorphemic Turkish words are composed of only front vowels (e.g., güven [trust] and ödül [award]) or only back vowels (e.g., karar [decision] and yakın [near])

As also happens in languages like Finnish, compound words can contain one word with back vowels and one with front vowels (e.g. günbatımı [sunset]). More important, while relatively infrequent, there are, a number of monomorphemic words in Turkish in which vowel harmony does not occur—this is often the case of loan words (parti, [party]), but it may also happen in Turkish words (haber [news]).

There is some evidence of the effects of vowel harmony on spoken word recognition in languages with vowel harmony. For instance, Vroomen et al. (1998) showed that vowel harmony can be used as cues to determine word boundaries in Finnish in an interdependent manner (see also Bertram et al., 2004, for evidence of the role of vowel harmony in compound words in Finnish during sentence reading).

The question here is whether the effects of vowel harmony also apply to printed word recognition. Indeed, the evidence of vowel harmony effect during visual word recognition is extremely scarce. In a recent lexical decision experiment conducted in Finnish, disharmonious pseudowords produced faster responses (i.e., it was easier to say “nonword”) than harmonious pseudowords (Perea et al., 2022). While these findings revealed that it is possible to find an effect of vowel harmony during printed word recognition, the focus was only on pseudowords. One might argue that disharmonious pseudowords may induce less word-likeness (because of the disharmony), producing faster “no” responses. Keep in mind that all words in the Perea et al. (2022) were harmonious, so that any disharmonious letter strings were necessarily pseudoword—note that it is extremely difficult to find disharmonious words in Finnish (beyond a small set of loan words). Notably, as indicated above, it is possible to find a reasonably large set of disharmonious words in Turkish, thus avoiding this interpretive issue. Furthermore, using Turkish allows us to manipulate vowel harmony for both word and nonword stimuli.

In the present lexical decision experiment, we selected two types of Turkish words: words that comply with vowel harmony (i.e., all front vowels, or all back vowels; resim [picture], takım [team]), and words that did not comply vowel harmony (i.e., containing both front and back vowels; beyaz, [white]). In addition, we created two types of pseudowords in Turkish: harmonious (düvem) and disharmonious (minya). In both types of sets, we controlled for the size of the orthographic neighborhood (e.g., OLD20, Yap et al., 2009).

**Hypotheses**

The predictions are as follow. If vowel harmony plays a role during visual word recognition in Turkish, we expect to find: (1) faster responses to harmonious words than disharmonious words, and (2) faster responses to disharmonious pseudowords than harmonious pseudowords. This is actually the pattern reported by Kiliç (2017) in a lexical decision experiment that was part of an unpublished master’s thesis; however, this experiment did not contain the specific details of the manipulation.

**Design plan**

**Study type**

Experiment - A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.

**Blinding**

For studies that involve human subjects, they will not know the treatment group to which they have been assigned.

**Study design**

The participants will be presented with all the four target conditions (i.e. a within-participants design).

**Randomization**

Items will appear to the participant in a random order.

**Sampling Plan**

**Data collection procedures**

The experiment will be created with PsychoPy, integrated online via Pavlovia.org, and delivered to the participant via the Prolific website. The participants will get paid according to Prolific standards. To be included, the participants need to be adult native speakers of Turkish. Participants with reading disability or abnormal vision will be excluded.

**Sample size**

A total of 30 participants will be recruited.

**Sample size rationale**

Each word condition contains 90 trials (target words). Thus, with 30 participants, each condition will have 2700 observations, which is considered sufficient for within-participants comparisons as it is substantially higher than 1600 (Brysbaert & Stevens, 2018).

**Variables**

**Manipulated variables**

There are two types of Turkish target words. Target words (nouns with a length of 4-6 letters) were either harmonious (all vowels were from the same type, front or back, for instance, SANAT [art]) or disharmonious (words contained both front and back vowels, for instance, ZAFER [victory]). The manipulation for the target nonwords was the same (harmonic pseudowords vs disharmonic pseudowords). These pseudowords were generated with the target words and the bigram algorithm with the help of the pseudoword generator (UniPseudo, New, 2023).

**Measured variables**

Accuracy and reaction time will be measured in the lexical decision task.

**Analysis Plan**

**Statistical models**

Bayesian linear mixed model will be used to analyze the data. word and non-word will be analyzed separately. For word targets, the only fixed factor was type of word (harmonious vs disharmonious). We will use the maximal random structured model (by-subject and by-item intercept and slope for type of word). The exgaussion family will be used to model for reaction time and the Bernoulli family will be used for accuracy data. The analyses for the pseudoword targets will be the same for the word targets.

**Inference criteria**

We will consider that there is evidence for an effect of vowel harmony when 95% credible interval of its posterior distribution does not intersect zero.

**Data exclusion**

Reaction times shorter than 250 ms. 2000 ms is the deadline to make a response, and thereby response times above 2000 ms will be automatically categorized as errors by the program (PsychPy). Participants who have less accuracy than %75 will be excluded.