

## **Productivity, Universality, and Cumulativity in Sound Symbolism: A Pokémonastics Study of Georgian and English**

In recent years, the Pokémonastics research program has used Pokémon names to study sound symbolism in various languages (Kawahara 2023). In particular, experimental studies have investigated the productivity of sound symbolism patterns, their universality across languages, and their cumulativity within a language (Kawahara & Kumagai 2019, Godoy et al. 2020, Kawahara & Breiss 2021, Kumagai & Kawahara 2022, a.o.). We conducted two Pokémonastics experiments examining Georgian sound symbolism patterns in Georgian and English speakers. Unlike previous studies, our experiments used auditory stimuli instead of orthographic stimuli. We found that some patterns of sound symbolism present in the Georgian lexicon were reproduced by Georgian and English speakers while others were not. Our results yield evidence for universal and language-specific sound symbolism patterns, unproductive sound symbolism patterns, and sub-linear cumulativity in sound symbolism.

The basis of our study was Holisky & Kakhadze's (1988) description of sound symbolism patterns in Georgian verbs that express ways of speaking or making noise (e.g. [k'ivis] 'emit very loud, high pitch sound'). Georgian has three stop series: voiced, voiceless, and ejective. In terms of their sound symbolic properties in these verbs, the stop series form a scale from lowest pitch (voiced) to highest pitch (ejective). Among vowels, /i/ is associated with higher pitch and louder volume and /u/ with lower pitch and softer volume; /a/ has no particular pitch association but conveys louder volume than both /i/ and /u/.

To test whether Georgian and English speakers would reproduce these sound symbolism patterns, we presented participants with novel Pokémon names and asked them whether each one would be more suitable for a pre-evolution (smaller, weaker) or post-evolution (bigger, stronger) Pokémon. The names varied along two dimensions: Stop Type (voiced, voiceless, or ejective) and Vowel (/a/, /i/, or /u/). Each name was of the form C<sub>1</sub>V<sub>1</sub>C<sub>2</sub>V<sub>2</sub>C<sub>3</sub>e, where C<sub>1</sub> and C<sub>2</sub> were different stops of the same type, V<sub>1</sub> and V<sub>2</sub> were identical vowels, and C<sub>3</sub> was a sonorant from /m n r l/. The stimuli were recorded as nonce Georgian words by a native speaker of Georgian.

In testing the productivity of the Georgian sound symbolism patterns in a Pokémonastics paradigm, we assumed that associations with pitch and volume would correspond to associations with Pokémon size and strength. We predicted that Georgian speakers would associate voiced stops most strongly with post-evolution Pokémon, voiceless stops less so, and ejectives least of all. Based on the volume associations of vowels, we predicted that /a/ would elicit more post-evolution responses than /i/ or /u/. For /i/ and /u/, we predicted two possible patterns: based on volume associations, /i/ (louder) should elicit more post-evolution responses than /u/ (softer), but based on pitch associations, /u/ (lower) should elicit more post-evolution responses than /i/ (higher). We also set out to test whether English speakers would reproduce these same sound symbolism patterns despite their origins in a different language. In particular, we wished to test whether English speakers would associate ejectives with pre-evolution Pokémon despite lacking native-language experience with ejectives. We hypothesized that they might; however, we also considered alternative hypotheses. Due to ejectives' phonetic salience, English speakers might associate them with post-evolution Pokémon. Or, since English does not have ejective phonemes, English speakers might simply treat them as plain voiceless stops, since both stop types are

voiceless. Finally, it should be noted that Pokémonastics studies have previously found that English speakers associate voiced stops more strongly with post-evolution Pokémon than voiceless stops (Kawahara & Breiss 2021) and both /a/ and /u/ more strongly with post-evolution Pokémon than /i/ (Kawahara & Breiss 2021, Kawahara & Moore 2021).

We only analyzed the responses of participants who were not able to articulate what the experiment was about after completing it. Figure 1 shows the rates of post-evolution response by Stop Type and Vowel, averaged across subjects, in the Georgian experiment. Figure 2 shows the results of the English experiment. For each experiment, we fit a mixed-effects logistic regression to the results with response (post- or pre-evolution) as the dependent variable and Stop Type, Vowel, and their interaction as fixed effects. We then carried out post-hoc pairwise comparisons among the three stop types and the three vowels. For Georgian speakers, voiced stops were significantly more likely to elicit post-evolution responses than either voiceless stops or ejectives, but the latter two stop types did not differ significantly. This suggests that some sound symbolism patterns found in the Georgian lexicon are unproductive. Moreover, voiced stops' association with post-evolution Pokémon may simply reflect a universal sound symbolism pattern that has also been found in Japanese (Kawahara & Kumagai 2019), Brazilian Portuguese (Godoy et al. 2020), English (Kawahara & Breiss 2021), and Russian (Kumagai & Kawahara 2022). For English speakers, voiced stops and ejectives were significantly more likely to elicit post-evolution responses than voiceless stops, though there was no significant difference between voiced stops and ejectives. This replicates the finding that English speakers associate voiced stops with largeness. We believe that English speakers also associated ejectives with larger, stronger Pokémon due to their phonetic salience. For English speakers, both /a/ and /u/ elicited more post-evolution responses than /i/, replicating earlier findings in English and (for /a/ > /i/) other languages (Godoy et al. 2020, Kumagai & Kawahara 2022). For Georgian speakers, however, /a/ elicited more post-evolution responses than /u/ and (marginally) /i/ while /u/ and /i/ did not differ. The contrasting sound symbolic associations for /u/ may constitute language-specific patterns. Finally, in both experiments, there were significant interactions of Stop Type and Vowel such that the extent to which voiced stops (Georgian speakers) or ejectives (English speakers) elicited more post-evolution responses than voiceless stops was lesser among names with /a/. This amounts to sub-linear cumulativity of distinct sound symbolism effects and contrasts with Kawahara & Breiss's (2021) finding of linear cumulativity.

