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# Does the Name Say It All? Investigating Phoneme-Personality Sound Symbolism in First Names

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Sound symbolism has typically been demonstrated as an association between certain phonemes and perceptual dimensions (e.g., size or shape). For instance, the *maluma-takete effect* is the sound symbolic association between sonorant and voiceless stop phonemes and round and sharp visual shapes, respectively. Here we explored a novel association between phonemes and a more abstract dimension: personality. Further, although sound symbolism has often been examined using nonwords, here we studied it in the context of existing first names. In Experiments 1 and 2, we presented first names containing sonorant versus voiceless stop consonants and found that participants associated these with different personality factors from the HEXACO model of personality. In general, names with sonorant phonemes (e.g., *Mona*, *Owen*) were associated with high Emotionality, Agreeableness, and Conscientiousness, whereas names with voiceless stop phonemes (e.g., *Katie*, *Curtis*) were associated with high Extraversion. In Experiment 3, we examined whether the associations of a person's name predict their personality. A sample of 1,071 individuals provided their names and completed a HEXACO personality inventory. We found no real-world evidence of the associations we observed in the lab. In Experiment 4, we used invented names and tested participants in the lab once again, finding evidence of the same associations as in Experiment 1 and 2. This suggests that phonemes, and not just existing knowledge of individuals with particular names, are key to the associations observed. Finally, in Experiment 5, we found that these effects are not mediated by likability. We discuss potential mechanisms for the observed associations.

*Keywords:* sound symbolism, bouba/kiki, personality, HEXACO, connotations



## Sound Symbolism

*Sound symbolism* is the phenomenon by which certain phonemes seem inherently associated with certain kinds of things (for recent reviews, see Lockwood & Dingemanse, 2015; Sidhu & Pexman, 2018). As an example, consider the nonwords *maluma* and *takete*, and the round and sharp shapes shown in Figure 1. When asked which of the nonwords go with which of the shapes, approximately 90% of people (see Styles & Gawne, 2017) pair *maluma* with the round shape and *takete* with the jagged shape. Something in the sound and/or articulation of these nonwords leads to the sense that they go along better with certain kinds of shapes; this is a sound symbolic association. In addition to such overt effects, sound symbolism also emerges implicitly in that individuals have a faster reaction time (RT) when responding to sound symbolically congruent versus incongruent pairings of stimuli (e.g., *maluma* with a round vs. a jagged shape; e.g., Hung, Styles, & Hsieh, 2017; Ohtake & Haryu, 2013). There are also differences in event related potentials when processing congruent versus incongruent sound-shape pairings, suggesting that these congruencies have effects beyond observable behavior (e.g., Asano et al., 2015; Ković, Plunkett, & Westermann, 2010; Sučević, Savić, Popović, Styles, & Ković, 2015).

The example given in Figure 1 is one of the most well studied sound symbolic effects and has come to be known as the *maluma/takete effect* (Köhler, 1929). The effect goes beyond this pair of nonwords and applies to groups of phonemes with similar acoustic and articulatory properties. In general, certain sonorant consonants (/m/, /n/ and /l/; see Table 1 for definitions of linguistic terms), voiced stop consonants (/b/, /d/ and /g/, though to a lesser extent; cf. Bottini, Barilari, & Collignon, 2019), and back rounded vowels (e.g., /u/ as in *who'd*, and /oʊ/ as in *hoed*) show an association with round shapes; while voiceless stop consonants (e.g., /p/, /t/ and /k/), and high-front unrounded vowels (e.g., /i/ as in *heed*) show an association with sharp shapes (e.g., D'Onofrio, 2014; McCormick, Kim, List, & Nygaard, 2015; Nielsen & Rendall, 2011). The maluma/takete effect is not the only example of sound symbolism. Another is the *mil/mal effect*: an association between high-front

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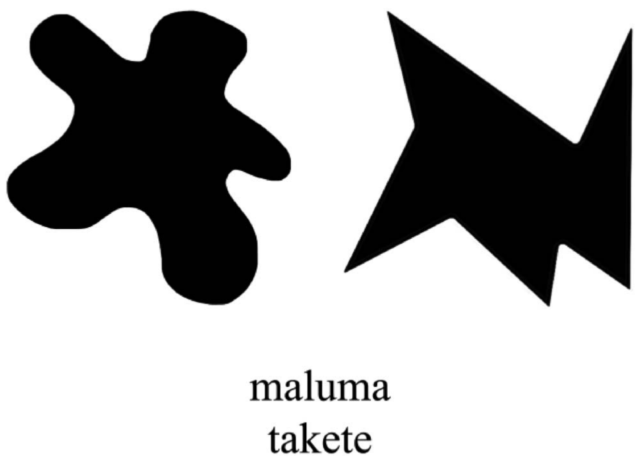


*Figure 1.* An illustration of the maluma/takete effect, in which most individuals judge the nonword *maluma* as a better match for the round shape on the left, and the nonword *takete* as a better match for the sharp shape on the right.

vowels (e.g., /i/) and small shapes and between low-back vowels (e.g., /ɑ/, as in *hawed*) and large shapes (Newman, 1933; Sapir, 1929). Associations have also been demonstrated between certain phonemes and other perceptual dimensions, such as brightness (e.g., Newman, 1933), speed (Cuskley, 2013), hue (Moos, Smith, Miller, & Simmons, 2014), and taste (Gallace, Boschin, & Spence, 2011).

In the five studies to be presented here we conducted the first systematic investigation of a different form of sound symbolism: associations between phonemes in real first names and personality factors. This new type of sound symbolism is relevant to several important topics and theoretical issues. First, these studies address the extent to which sound symbolism can emerge in the context of existing language. This is an important question as it has broad implications for the relevance of sound symbolism to language processing. Second, this work explores sound symbolic associations for an abstract dimension (i.e., personality), in contrast to the perceptual dimensions that are typically studied. This broadens the scope of sound symbolism and serves as an informative test case for the mechanisms that can give rise to it. Finally, the information gleaned from a name via its sound symbolic associations has relevance for the study of impression formation, as a name is often one of the first pieces of information we receive about a person.

## Sound Symbolism in Real Language

Sound symbolic associations are relevant to the fundamental nature of language; in particular, to the relationship between the form of a word (i.e., its phonology, articulation and orthography) and its meaning. One position is that the relationship is arbitrary, and that the form of a word does not have any kind of special relationship to its meaning (e.g., Hockett, 1963). Consider the word *fun*, for instance: there is nothing particularly "fun" about it. On the contrary, it seems to be comprised of an arbitrarily chosen set of phonemes. However, sound symbolic associations provide one avenue by which a word's form—in particular its phonology—*can* be related to its meaning. For instance, the word *balloon* contains phonemes that are sound symbolically related to roundness; it also refers to a round object. Thus, *balloon* is an example of nonarbitrariness in language.

Instead of conceptualizing arbitrariness and nonarbitrariness as mutually exclusive categories, there has been a recent shift toward viewing them as complementary aspects of language (Dingemanse, Blasi, Lupyan, Christiansen, & Monaghan, 2015; Perniss, Thompson, & Vigliocco, 2010). That is, words can contain both arbitrary and nonarbitrary aspects. For instance, although *balloon* contains phonemes related to roundness (a nonarbitrary property) it is also to some extent arbitrary—there is no reason that the round-associated phonemes in *balloon* had to be arranged in that order. Its partial arbitrariness is also highlighted by the fact that it would be highly unlikely for someone to guess *balloon*'s exact meaning based on its form alone. By this view, nonarbitrariness is present in different amounts throughout the lexicon, and is a general property of language (see Perniss et al., 2010; Perry, Perlman, & Lupyan, 2015). Because sound symbolism contributes to nonarbitrariness, understanding the phenomenon of sound symbolism is a key question for the study of language.

Despite this potential relevance to real language, sound symbolism has largely been examined using nonwords and the extent to which sound symbolism has an effect in real words (i.e., whether the round-associated phonemes in *balloon* affect its processing) is still unclear. Examinations of the maluma/takete effect in existing language have been equivocal (Sidhu & Pexman, 2015; Sučević, Janković, & Ković, 2013; Sučević et al., 2015; Westbury, 2005).



Table 1
*Definitions of Linguistic Terms Used Throughout the Article (Derived From Ladefoged & Johnson, 2010; Reetz & Jongman, 2009)*

| Phoneme term | Examples |
|---|---|
| *Back vowels* are those articulated with the highest point of the tongue relatively close to the back of the mouth. | /u/ as in who'd, /ɑ/ as in hawed |
| *Bilabial consonants* involve the lips coming together in their articulation. | /m/ as in mat, /b/ as in bat |
| *Front vowels* are those articulated with the highest point of the tongue relatively close to the front of the mouth. | /i/ as in heed, /æ/ as in had |
| *High vowels* are those articulated with the tongue relatively close to the roof of the mouth. | /i/ as in heed, /u/ as in who'd |
| *Low vowels* are those articulated with the tongue relatively far from the roof of the mouth. | /æ/ as in had, /ɑ/ as in hawed |
| *Rounded vowels* are those articulated with rounded lips. | /u/ as in who'd, /oʊ/ as in hoed |
| *Sonorant consonants* involve no stoppage of, or turbulence in, the airflow; this includes nasals and approximants. | /m/ as in mac, /l/ as in lack |
| *Stop consonants* involve a stoppage of airflow. | /p/ as in pat, /b/ as in bat |
| *Unrounded vowels* are those articulated without rounded lips. | /i/ as in heed, /æ/ as in had |
| *Voiced consonants* involve the vocal folds being brought close enough together to vibrate. | /b/ as in bam, /d/ as in dam |
| *Voiceless consonants* involve the vocal folds not being brought close enough together to vibrate | /p/ as in pat, /t/ as in tat |

Indeed, some models of word processing lead to the prediction that sound symbolism effects should be attenuated with real language as compared with nonwords. For instance, the dual route cascaded model (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001) of word recognition predicts less extensive phonological processing for real words as compared to nonwords. It also predicts a greater amount of semantic activation for real words, which might interfere with the perceptual/semantic features activated via phonology (e.g., sonorants sound symbolically activating roundness). Testing sound symbolism in real words (in the form of first names) was one of the main goals of this article.

## Phoneme-Personality Sound Symbolism

Another goal of this article was to examine sound symbolism beyond the concrete perceptual dimensions in which it is typically studied. One relevant question is whether sound symbolism also exists between phonemes and more abstract targets (i.e., those that are not tangible, and cannot be experienced with the senses; see Brysbaert, Warriner, & Kuperman, 2014). This is especially challenging given that abstract concepts lack perceptual features that would invite obvious comparisons to the perceptual properties of phonemes. Indeed, there is a large literature concerned with how abstract concepts are learned and represented, given that they do not have obvious ties to sensorimotor experience (for a review, see Borghi et al., 2017). Thus, it is meaningful to examine the extent to which sound symbolism will extend to abstract targets. This can have implications for our understanding of the mechanisms that can enable sound symbolic associations.

There is a rich literature examining the semantic connotations of various phonemes from the mid to late 20th century (e.g., Bozzi & Flores D'Arcais, 1967; Greenberg & Jenkins, 1966; Miron, 1961; Tarte, 1982). Although some of these are indeed abstract in nature (e.g., *pleasant–unpleasant*), others are related to perceptual dimensions (e.g., *abrupt–continuous*). Recent work has shown an association between certain phonemes and the abstract dimensions of social dominance (Auracher, 2017) and valence (Rummer, Schweppe, Schlegelmilch, & Grice, 2014). Note that both of these involve perceptual features, in the posture stimuli used, and the hypothesized mediator of facial expression, respectively.[1]

In the experiments described here, we investigated whether phonemes show a sound symbolic association with the abstract construct of personality. Personality refers to individual differences in patterns of thinking, feeling, and behaving. Language plays a critical role in our understanding of personality. Indeed, according to the lexical hypothesis, individual differences become encoded in human language (Allport & Odbert, 1936; Galton, 1884), and by factor analyzing responses to words and determining which sets of words cluster together, researchers have been able to determine the broad dimensions and structure of personality (e.g., Ashton, Lee, & Goldberg, 2004; Goldberg, 1990; Tupes & Christal, 1992). Personality, particularly at the factor level, represents an ideal domain in which to test abstract sound symbolism. Although individual traits may have salient perceptual features, personality factors are latent constructs, and thus relatively abstract.

An ideal way to investigate this would be in the context of first names, for two main reasons. First, using real first names would be a way of examining whether sound symbolism emerges in the context of real language. As mentioned earlier, there are reasons to believe that sound symbolism effects will be attenuated when using real words. Although names may not have a meaning per se, they are presumed to activate identity-specific semantics, which in turn activate general semantics (see Valentine, Brennen, & Brédart, 1996). For instance, hearing the name *Bob* might bring to mind one's friend Bob who is a zookeeper and could thus also activate semantics related to that profession. Thus, names allow for investigation of whether sound symbolism effects will emerge in the presence of some existing semantic information. Second, there is evidence that individuals will make inferences based on the phonology of a name. For instance, Cassidy, Kelly, and Sharoni (1999) found that individuals are quicker to classify names as female or male if they contain gender consistent phonology (e.g., female names that end in a schwa, as in *Erica*; see also Slepian & Galinsky, 2016). Note that this was not due to sound symbolism per se, but rather the distributional properties of phonemes in the names. However, there is a good deal of evidence that the sound symbolic properties of invented product names can impact perceptions of products. For instance, Lowrey and Shrum (2007) demonstrated that individuals prefer products with names that have sound symbolic associations that are desirable for that product (e.g., sharpness for knives; see also Klink, 2000). Velasco, Salgado-Montejo, Marmolejo-Ramos, and Spence (2014) have also demonstrated that the sound symbolism of product names can impact expectations of taste (for a review of this area, see Spence, 2012).

A link between names and personality also has implications for our understanding of impression formation. Researchers have had a keen interest in increasing our understanding of how people form impressions of others. A number of factors have been examined in that regard, including but not limited to facial features (e.g., Vernon, Sutherland, Young, & Hartley, 2014), ethnicity (e.g., Cottrell & Neuberg, 2005), and gender (e.g., Oh, Buck, & Todorov, 2019). Another area that has received interest is how names guide these impressions, as a name is one of the first things we learn about somebody in various contexts, including a job application, a blind date, or an e-introduction. For instance, names have been investigated as predictors of perceptions of intelligence and competence (Young, Kennedy, Newhouse, Browne, & Thiessen, 1993), teacher expectations of a student's achievement motivation (Anderson-Clark, Green, & Henley, 2008), and resume call-backs in the job search (Bertrand & Mullainathan, 2004). In looking at why names can have an impact on these perceptions, research has examined characteristics of a name such as: ethnicity (Bertrand & Mullainathan, 2004), formality (Leirer, Hamilton, & Carpenter, 1982), and pronounceability (Laham, Koval, & Alter, 2012). In a series of studies that are close to the work at hand, Mehrabian and Piercy found that names differ in their semantic connotations, and that this is driven in part by their length (Mehrabian & Piercy,

[1] Other studies showing abstract associations of phonemes include preferences for labels whose phonemes are articulated with an approach vs. avoidance sequence (Topolinski, Maschmann, Pecher, & Winkielman, 2014), and the demonstration that high-front vs. low-back phonemes lead to more precise construals (Maglio, Rabaglia, Feder, Krehm, & Trope, 2014). We do not mention these in the main text because they involve a sequence of, rather than individual, phonemes; and an association with cognitive styles rather than dimensions; respectively.

1993a) and spelling conventionality (Mehrabian & Piercy, 1993b). The present set of studies expanded on this work by examining another source of information in names: the sound symbolic associations of the phonemes that they contain.

Although much of the work on sound symbolism has involved associations with perceptual dimensions, there have been some explorations of links between phonemes and particular personality traits. Milán et al. (2013) found that, compared to *bouba*, *kiki* was happy, clever, unpleasant and nervous. Shinohara and Kawahara (2013; see also Kawahara, Shinohara, & Grady, 2015) found that sonorants were associated with cute, soft, and accessible personalities, whereas obstruents were associated with sharp, inaccessible, and blunt personalities.

The studies by Milán et al. and Shinohara and Kawahara used invented words. This reduces the generalizability of these findings because, as discussed previously, there is reason to believe that sound symbolism might operate differently in real words and nonwords. Sidhu and Pexman (2015) found preliminary evidence that real first names may be associated with certain personality traits based on their phonology. They asked participants to generate adjectives that they would associate with someone with a "round and curvy personality" or a "sharp and spiky personality." The adjectives participants generated included *easygoing* and *friendly*, and *determined* and *rigid*, respectively. They then presented a separate group of participants with pairs of gender-matched names, one of which contained consonant phonemes typically associated with round shapes (e.g., *Molly* or *Noel*), and one of which contained consonant phonemes typically associated with sharp shapes (e.g., *Kate* or *Kirk*). Participants were asked which name was more likely to belong to a person possessing one of the previously generated traits. Participants were more likely to indicate that names like *Molly* belonged to people possessing the "round" personality traits, whereas names like *Kate* belonged to people possessing the "sharp" personality traits. However, one might argue that this approach "stacked the deck" in favor of finding an association; in particular, by choosing traits that were most strongly associated with the concepts of roundness and sharpness (see Table 2).

Taken together, there has been some evidence of sound symbolic associations with personality. However, this has been produced in a piecemeal fashion, with each study testing a few specific personality descriptors. In addition, studies have explored

Table 2
*"Round" and "Sharp" Traits Generated by Participants and Used as Stimuli by Sidhu and Pexman (2015) in Their Experiment 2*

| "Round" traits | "Sharp" traits |
|---|---|
| Adaptable | Aggressive |
| Easygoing | Angry |
| Friendly | Determined |
| Funny | Harsh |
| Introverted | Irritable |
| Nice | Jumpy |
| Open | Mean |
| Sensitive | Rigid |
| Unreliable | Sarcastic |
| Versatile | Unfriendly |

traits for which researchers have an a priori reason to expect an association with sonorants or voiceless stops. Thus, there has yet to be a comprehensive and unbiased exploration of sound symbolism and personality space in its entirety. The limited approach of previous work also makes it impossible to make any claims regarding associations between phonemes and higher order factors of personality.

## The Present Study

In the present study we addressed these shortcomings with a thorough exploration of personality space, and one that allowed us to examine relationships with higher order personality factors. We used a full sampling of traits from the six factors of the HEXACO model of personality (Lee & Ashton, 2004). The HEXACO model of personality is a six-factor framework of personality that has been derived from lexical studies (using similar or the same adjective sets to those used to derive the Big Five) and replicated across more than a dozen languages (e.g., Ashton et al., 2004; Lee & Ashton, 2008). This model contains six personality factors: Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness to experience (see Table 3 for a description of each). In comparison to the Big Five, HEXACO Conscientiousness, Openness, and Extraversion factors correspond strongly with their Big Five counterparts. Conversely, Emotionality, and Agreeableness are rotational variants of the Big Five factors of Neuroticism and Agreeableness, with HEXACO Emotionality containing content related to sentimentality and sensitivity, and HEXACO Agreeableness containing content related to anger and hostility (Lee & Ashton, 2004). The largest difference between the HEXACO and Big Five models is the presence of a sixth factor of personality, namely Honesty-Humility. Note that numerous recent studies have supported a six- versus a five-factor model of personality (e.g., Ashton et al., 2004; Lee & Ashton, 2008). To date, the HEXACO model has been used in hundreds of studies (see hexaco.org/references) and possesses a number of practical and theoretical advantages over and above the Big Five (see Ashton & Lee, 2007, for a review).

We examined whether names containing sonorants versus voiceless stops were differentially associated with any of the factors from the HEXACO, in laboratory tasks (Experiments 1, 2, 4, and 5) and in the self-reported personalities of a large adult sample (Experiment 3). We examined these two groups of phonemes (i.e., sonorants vs. voiceless stops) because they have been shown to have distinct sound symbolic associations (e.g., in the maluma/takete effect). Although vowels also contribute to sound symbolism, the limitation of using existing names precluded a fully balanced design manipulating both consonants and vowels.

## Experiment 1

In Experiment 1 we tested for phoneme-personality sound symbolism by examining whether participants were more likely to choose a name containing sonorants versus voiceless stops as belonging to someone who possessed specific personality traits. Together, these traits represented the six factors of the HEXACO.

Table 3
*A Description of Each Factor of the HEXACO, Taken Verbatim From Lee and Ashton (2009)*

| Personality factor | Description |
|---|---|
| Honesty-Humility | Persons with very high scores on the honesty-Humility scale avoid manipulating others for personal gain, feel little temptation to break rules, are uninterested in lavish wealth and luxuries, and feel no special entitlement to elevated social status. Conversely, persons with very low scores on this scale will flatter others to get what they want, are inclined to break rules for personal profit, are motivated by material gain, and feel a strong sense of self-importance. |
| Emotionality | Persons with very high scores on the Emotionality scale experience fear of physical dangers, experience anxiety in response to life's stresses, feel a need for emotional support from others, and feel empathy and sentimental attachments with others. Conversely, persons with very low scores on this scale are not deterred by the prospect of physical harm, feel little worry even in stressful situations, have little need to share their concerns with others, and feel emotionally detached from others. |
| Extraversion | Persons with very high scores on the Extraversion scale feel positively about themselves, feel confident when leading or addressing groups of people, enjoy social gatherings and interactions, and experience positive feelings of enthusiasm and energy. Conversely, persons with very low scores on this scale consider themselves unpopular, feel awkward when they are the center of social attention, are indifferent to social activities, and feel less lively and optimistic than others do. |
| Agreeableness | Persons with very high scores on the Agreeableness scale forgive the wrongs that they suffered, are lenient in judging others, are willing to compromise and cooperate with others, and can easily control their temper. Conversely, persons with very low scores on this scale hold grudges against those who have harmed them, are rather critical of others' shortcomings, are stubborn in defending their point of view, and feel anger readily in response to mistreatment. |
| Conscientiousness | Persons with very high scores on the Conscientiousness scale organize their time and their physical surroundings, work in a disciplined way toward their goals, strive for accuracy and perfection in their tasks, and deliberate carefully when making decisions. Conversely, persons with very low scores on this scale tend to be unconcerned with orderly surroundings or schedules, avoid difficult tasks or challenging goals, are satisfied with work that contains some errors, and make decisions on impulse or with little reflection. |
| Openness | Persons with very high scores on the Openness to experience scale become absorbed in the beauty of art and nature, are inquisitive about various domains of knowledge, use their imagination freely in everyday life, and take an interest in unusual ideas or people. Conversely, persons with very low scores on this scale are rather unimpressed by most works of art, feel little intellectual curiosity, avoid creative pursuits, and feel little attraction toward ideas that may seem radical or unconventional. |



## Method

**Ethics statement.** All experiments reported in this article were approved by the Conjoint Faculties Research Ethics Board at the University of Calgary, and were carried out in accordance with the provisions of the World Medical Association Declaration of Helsinki. All participants gave written (Experiments 1, 2, and 4) or online (Experiments 3 and 5) consent and were debriefed after the experiment.

**Participants.** Participants were 60 undergraduate students (47 female; $M$ age $= 20.75$; $SD = 3.68$) at the University of Calgary who participated in exchange for course credit. This number was nearly double the 32 participants examined by Sidhu and Pexman (2015; Experiment 2). We used the "simr" package (Green & Macleod, 2016) in the statistical software R (R Core Team, 2016) to conduct a power analysis using the data from Sidhu and Pexman (2015), as this is the closest existing experiment to the one we had planned. Using simulation, we determined that a sample size of 60 participants would have had a power of 0.999 to detect an effect of adjective type (i.e., round- vs. sharp-associated), of the size that was observed in those data when random intercepts are included ($b = 0.59$), with $\alpha = .05$. Thus, we were confident that the present experiment had enough power to detect an effect. All participants reported English fluency and normal or corrected to normal vision.

**Materials and procedure.** Trait stimuli were selected based on the loadings of 449 traits onto the six factors of the HEXACO (Lee & Ashton, 2008). For each factor, we chose the three traits that loaded most heavily onto its high and its low ends (i.e., traits indicative of being high or low in that particular personality factor), with the following exceptions. We did not use any traits with multiple loadings (e.g., *warm-hearted* which loaded onto both Agreeableness and Extraversion). We also did not use traits that referred directly to gender (i.e., *masculine/feminine*), that involved the same compound (e.g., *quick-tempered* excluded *hot-tempered*) or that could be interpreted as a political affiliation (i.e., *conservative*). See Table A1 in the Appendix for a list of traits.

Name stimuli were 72 first names (36 male, 36 female) from The Alberta Services list of registered baby names in Alberta in 2014. These norms are available at http://www.servicealberta.ca/Alberta_Top_Babies_Names.cfm. We selected two groups of names that contained consonants with opposing sound symbolic associations (e.g., as in the maluma/takete effect; Nielsen & Rendall, 2011, 2013) and connotative-semantic properties (e.g., Greenberg & Jenkins, 1966). In particular, we chose the sonorants /m/, /n/, and /l/ to constitute one group, and the voiceless stops /p/, /t/, and /k/ to constitute the other. Half of the names of each gender contained at least one of these sonorants[2] and no voiceless stops (i.e., sonorant names); the other half contained at least one voiceless stop and none of these sonorants (i.e., voiceless stop names). Balancing gender of name types was important, as females and males have been found to differ on several personality factors (Lee & Ashton, 2004). The names were presented in same-gender pairs consisting of one name of each type (i.e., one sonorant name and one voiceless stop name). The names in each pair were matched according to frequency, length within one syllable, and location of the sound symbolic phoneme (e.g., a name beginning with a sonorant would be paired with a name beginning with a voiceless stop). We attempted to choose names that included sound symbol-

[2] From this point forward we use the term *sonorants* to refer specifically to those implicated in the maluma/takete effect (i.e., /m/, /n/, and /l/).

ically congruent vowels (i.e., sonorant names with back vowels; voiceless stop names with front vowels). However, because we were constrained by existing names, and the matching efforts mentioned previously, we weren't able to do this perfectly. Nevertheless, sonorant names contained a significantly higher percentage of back vowels ($M = 38.43$; $SD = 34.00$) than did voiceless stop names ($M = 2.78$; $SD = 11.62$), $t(70) = 5.95$, $p < .001$. In addition, sonorant names contained a significantly lower percentage of front vowels ($M = 20.37$; $SD = 29.84$) than did voiceless stop names ($M = 67.59$; $SD = 37.57$), $t(70) = 5.91$, $p < .001$. See Table A2 in the Appendix for name pairs and their frequencies.

Each trial began with the presentation of a fixation cross for 1,000 ms, followed by a blank screen for 500 ms. A trait was then presented in the center of the screen with two paired names presented in the bottom left- and right-hand corners of the screen. Participants were instructed to think of these names as people they had never met and to indicate, based on the names, who they thought the adjective would best describe. Responses were made via button press. The names remained on the screen until a response was given, after which a blank screen was presented for 500 ms between trials. Participants saw each name pair once for a total of 36 trials. The pairings of names and traits, the order in which they were presented, and the side of the screen on which a given name appeared, were all randomized and counterbalanced across participants. Next, in a separate task, all participants were asked to rate the familiarity of each presented name on a scale from 1 (*not familiar at all*) to 5 (*extremely familiar*). Participants were given the following examples of individuals whose names would likely be extremely familiar: a family member, a partner, a best friend, or a favorite TV character.

## Results

Data for all experiments, and code for all analyses, can be found at the following online data repository: https://osf.io/r84s2/. The data of in lab experiments were analyzed using mixed effects regressions. Following the suggestions of Barr, Levy, Scheepers, and Tily (2013), analyses included all possible random effects. That is, models always included random subject and item (i.e., presented name[s]) intercepts, as well as random subject and/or item slopes (where appropriate) for any fixed effects included in a model. Models in all experiments were fit using Bayesian parameter estimation. In short, this approach determines the probability that a model's parameters take on different values, given the observed data (viz., the posterior). Following Bayes's theorem, this is proportional to a combination of prior expectations for those parameter values (viz., the prior) and the likelihood that we would have observed our data given different parameter values (viz., the likelihood). In practice, functions describing the prior and the likelihood are combined to create a posterior density function. This is then sampled from,[3] and the resulting distribution can be used to establish an estimate of the parameter, and its 95% credible interval: the range of values with a 95% probability of containing the true value of a given parameter. When a given parameter's credible interval does not include zero, this is considered sufficient evidence for that parameter having a statistically credible effect on the outcome measure.

All models were computed using the statistical software R (R Core Team, 2016) and the package "brms" (Bürkner, 2017), which fits Bayesian mixed effects models using the Stan programming language. Analyses were run using 20 sampling chains, each with 2,000 iterations; the first 1,000 of these were treated as warmups, resulting in 20,000 posterior samples. In cases where the parameters of interest had an effective sample size lower than 10,000 (Kruschke, 2015), the model was rerun with additional chains until this threshold was met. Because of the lack of previous literature on the topic, models were fit using a generally accepted weakly informative prior for fixed effects (i.e., a Cauchy distribution centered at zero, with a scale of two and a half) and intercepts (i.e., a Cauchy distribution centered at zero, with a scale of 10; Gelman, Jakulin, Pittau, & Su, 2008). To implement these priors, all continuous predictors and outcome variables were scaled to have a mean of zero and a standard deviation of 0.50; all binary predictors were effects coded and (when necessary; i.e., when there were unequal numbers in each group and thus the predictor did not already have a mean of zero) shifted to have a mean of zero, and to differ by one between their two values (Gelman et al., 2008). We used the package default weakly informative prior for random effects (i.e., half Student's t distribution with three degrees of freedom). All $\hat{R}$ values were $\leq 1.01$, indicating that the analysis had reached convergence (i.e., additional sampling would not have led to different results; Gelman & Rubin, 1992).

In the present experiment, we analyzed trials presenting traits from each of the six personality factors separately using mixed effects logistic regressions and interpreted the models' intercepts. Our dependent variable was whether participants chose the sonorant versus the voiceless stop name. On trials presenting traits from the high end of a factor, selecting the sonorant name was coded as "1" whereas selecting the voiceless stop name was coded as "0." This coding was reversed for trials presenting traits from the low end of a factor. Thus, the intercepts of these models reflected the combined likelihood of participants choosing the sonorant name as being higher in a given factor and choosing the voiceless stop name as being lower in a given factor. Our results indicated that participants were more likely to select the sonorant (voiceless stop) name as being higher (lower) in Emotionality [95% credible interval, presented for untransformed data; 0.10, 0.67], Agreeableness [0.34, 0.98], and Conscientiousness [0.09, 0.58]. In particular, the odds were 1.46 times higher for Emotionality, 1.92 times higher for Agreeableness, and 1.41 times higher for Conscientiousness (see Table 4).

In a set of supplementary analyses we examined if participants' reported familiarity with the names, and/or the gender of the names presented on a given trial (effects coded; female names = 0.5; male names = −0.5), affected the likelihood of choosing one name over the other. Each of the previous models was rerun with these predictors, as well as their interaction, included. A familiarity score was computed for each trial by taking the difference in familiarity between the name whose selection would be coded "1" (e.g., the sonorant name on trials involving a high end trait) and whose selection would be coded "0" (e.g., the voiceless stop name on trials involving a high end trait). Both measures had a mean of zero in trials for each personality factor, allowing us to examine the effect of their inclusion on the models' intercepts. Emotionality

[3] In particular, this method used a No-U-Turn Sampler (Hoffman & Gelman, 2014).

Table 4
*Resulting Intercepts of Logistic Regressions Predicting the Likelihood of Selecting a Sonorant (Voiceless Stop) Name for Traits From the High (Low) End of Each Personality Factor, in Experiment 1*

| Factor | Intercept | *SE* | 95% CIs |
|---|---|---|---|
| Honesty-Humility | .26 | .15 | [−.02, .56] |
| Emotionality | .38 | .14 | [.10, .67][a] |
| Extraversion | −.13 | .19 | [−.52, .26] |
| Agreeableness | .65 | .16 | [.34, .98][a] |
| Conscientiousness | .34 | .12 | [.09, .58][a] |
| Openness | .18 | .15 | [−.10, .48] |

[a] 95% credible interval (CI) does not include zero.

[0.11, 0.76], Agreeableness [0.46, 1.52], and Conscientiousness [0.14, 0.69] still had intercepts whose credible intervals did not include zero. Familiarity, gender, and their interaction were not statistically credible predictors in any of the models.

## Discussion

The results of Experiment 1 demonstrated that names containing sonorant versus voiceless stop phonemes were more likely to be judged as belonging to someone who is high in Emotionality, Agreeableness, and Conscientiousness. This was true even after adding name familiarity and name gender to the models.

There are several drawbacks to the approach taken in this experiment. One is that the nature of the task forced participants to consider the relationship between a pair of names. This could serve to highlight relevant differences in their phonology. It could be that certain names only seem like good (or bad) matches for a certain trait when considered in relation to a name with contrasting phonology. The forced choice task was also a rather insensitive measure, unable to capture variations in the extent to which a given name did or did not seem to go with a given trait. In addition, only being able to examine the effect of trial gender on the model's intercept was a rather inelegant way of accounting for the effects of name gender. We addressed these issues in Experiment 2 by presenting participants with a single name on each trial and asking participants to make a continuous rating of the fit of that name with a trait. This allowed us to get a precise measure of each type of name's fit with personality factors in isolation, and to model the interaction between name type and name gender.

# Experiment 2

In Experiment 2, we tested for phoneme-personality sound symbolism by asking participants to rate how well they thought someone with a certain name would be described by a given trait.

## Method

**Participants.** Participants were 60 undergraduate students (45 female; *M* age = 21.63; *SD* = 4.61) at the University of Calgary who participated in exchange for course credit. As this study measured the same construct as Experiment 1 (albeit with a continuous rather than dichotomous outcome variable), we chose to test the same number of participants as in that experiment. Note that one participant's age was not recorded. All participants reported English fluency and normal or corrected to normal vision.

**Materials and procedure.** The name stimuli in Experiment 2 were the same as those used in Experiment 1, except here they were presented one at a time. In addition, Experiment 2 used a Likert scale rating as opposed to a forced choice task. Each trial began with a trait presented on screen for 2,000 ms, followed by a blank screen for 500 ms. A single name then appeared in the center of the screen with the rating scale below it from 1 (*not at all*) to 7 (*extremely*). Participants were instructed to think of the name as an individual that they had never met and to judge how well they thought the trait would describe that person. Participants saw each name once for a total of 72 trials. The 36 traits were presented twice, in a random order each time, once with a sonorant name and once with a voiceless stop name of the same gender (the order of which was counterbalanced across participants). Pairing of traits with female versus male names was counterbalanced across participants.

## Results

We analyzed trials presenting traits from each of the six personality factors separately using mixed effects linear regressions. Our dependent measure was the rated fit between the presented trait and the name. Trials presenting a trait from the low end of a given factor were reverse coded. The type of name presented on a trial (i.e., sonorant vs. voiceless stop) was included as a fixed effect using effects coding (sonorant names = 0.5; voiceless stop names = −0.5). Results indicated that sonorant (voiceless stop) names were judged as being higher (lower) in Agreeableness [0.41, 1.07] and Openness [0.15, 0.74]. Note that this effect was nearly statistically credible for Conscientiousness [0.00, 0.66]. Conversely, voiceless stop (sonorant) names were judged as being higher (lower) in Extraversion [−0.82, −0.15] (see Table 5).

In a set of supplementary analyses, we added name gender (effects coded; female names = 0.5; male names = −0.5), rated familiarity, and all interactions, to each of the models. According to these models, sonorant (voiceless stop) names were still judged as being higher (lower) in Agreeableness [0.41, 1.04] and Openness [0.11, 0.71]. In addition, voiceless stop (sonorant) names were still judged as being higher (lower) in Extraversion [−0.78, −0.11]. Participants also rated more familiar names as being higher in Honesty-Humility [0.01, 0.22] and Extraversion [0.04, 0.25]. Finally, female (male) names were rated as being higher (lower) in Emotion-

Table 5
*Resulting Name Type Coefficients of Linear Regressions Predicting Fit Ratings of Sonorant (Voiceless Stop) Names for Traits From the High (Low) End of Each Personality Factor, in Experiment 2*

| Factor | B | *SE* | 95% CIs |
|---|---|---|---|
| Honesty-Humility | .26 | .15 | [−.04, .56] |
| Emotionality | .22 | .22 | [−.19, .64] |
| Extraversion | −.48 | .19 | [−.82, −.15][a] |
| Agreeableness | .74 | .18 | [.41, 1.07][a] |
| Conscientiousness | .33 | .18 | [.00, .66] |
| Openness | .44 | .15 | [.05, .74][a] |

[a] 95% credible interval (CI) does not include zero.

ality [0.90, 1.54], Conscientiousness [0.44, 1.06], and Agreeableness [0.26, 0.93]. There were no statistically credible interactions.

## Discussion

The results of Experiment 2 indicated that even when names were considered in isolation, sonorant and voiceless stop names had distinct associations with personality factors. In particular, sonorant names were judged as being higher in Agreeableness and Openness, whereas voiceless stop names were judged as being higher in Extraversion. In the next study, we examine a potential implication of this effect: that these associations could actually emerge in the real world, in the personalities of individuals with names containing sonorants or voiceless stops.

# Experiment 3

We next examined whether the effects observed in Experiments 1 and 2 might have real world effects on personality. Recent work has suggested that individuals might adjust their appearance to match stereotypes of their name (Zwebner, Sellier, Rosenfeld, Goldenberg, & Mayo, 2017). Although it seems somewhat implausible, to understand the real-world limits of the effect we observed in the first two laboratory-based experiments reported here we felt we should test whether a similar process could take place with personality, with individuals subtly adjusting their personality to match sound symbolic associations of their names. To do so, we conducted a large-scale study examining relations between sound patterns in individuals' real first names and their personalities, as measured by the HEXACO model of personality.

## Method

**Participants.** There were 1,071 participants who took part online in exchange for financial compensation ($2 USD for approximately 15 min); these participants were recruited through Amazon Mechanical Turk. Participants were excluded if they failed any of our attention checks (19.61% of participants), did not provide their first name (7.75%), skipped more than 5% of items on either personality measure (7.00%) or did not provide their age (1.87%). Our final sample included 843 participants (397 female, 443 male, five other; *M* age = 36.63; *SD* = 11.47). We computed a power analysis using G* Power assuming a very small effect size ($f^2$ = 0.01) and α = .05. With seven predictors in the model, the power to detect an $R^2$ increase caused by a single predictor was equal to 0.83.[4]

**Materials and procedure.** Participants took part online through the website Qualtrics. They completed an adjective-based and a statement-based personality inventory. In the adjective-based inventory, participants were asked to rate how well each of 60 traits applied to them on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). These traits were the same as those used in our previous experiments, with an additional two from the high and the low ends of each factor (i.e., the two with the next highest loadings from Lee & Ashton, 2008, chosen with the same considerations as in Experiment 1). The only exception is that we bypassed several traits from the low-end of Honesty-Humility that related to humility, to include traits related to honesty. The statement-based inventory was the well-validated 100-item HEXACO personality inventory revised (Lee & Ashton, 2016). It consists of 100 statements about the participant that are rated on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Of these, 16 pertain to each of the six personality factors, with an additional four pertaining to the interstitial scale of altruism (not analyzed here). Participants always completed the adjective-based inventory first, followed by the statement-based inventory. The items for each inventory were presented in a random order. Note that self-report measures of HEXACO personality have been shown to correspond with peer-reports (Lee & Ashton, 2006, 2016, 2017).

In addition to these personality inventories, participants were asked to provide their first name and a description of its pronunciation. They were also asked if they had an alternative name (e.g., shortened version of their first name or nickname; henceforth *nickname*), to describe its pronunciation, and to rate on a 5-point scale how often they are addressed by that nickname. Finally, participants completed a demographic questionnaire including age, gender, ethnicity, and education level.

## Results

We first examined the validity of our personality measures. To begin, we computed correlations between participants' scores on each of the six factors as measured by the adjective- or the statement-based inventory measure (see underlined cells in Table 6). Each of these were significant and of a moderate to high effect size. These correlations were also higher than any of the other 30 correlations between adjective- and statement-based scores. In addition, we examined if previously reported gender differences emerged in our data. Lee and Ashton (2004; see also Lee & Ashton, 2006) reported that women self-reported as being higher than men in Honesty-Humility, Emotionality, and Conscientiousness; conversely, men self-reported as being higher than women in Openness to experience. We found that women in our sample indeed scored higher than men on Honesty-Humility [95% credible intervals for gender coefficients; 0.14, 0.27; 0.19, 0.32], Emotionality [0.28, 0.40; 0.36, 0.48], and Conscientiousness [0.01. 0.14; 0.01, 0.15], on both the adjective- and the statement-based measures, respectively. Though we did not find the opposite pattern for Openness, note that this was the smallest effect reported by Lee and Ashton (2004). Thus, we were satisfied with the validity of our personality data. The data also showed acceptable to excellent reliability (see Table 7).

We then created a phonetic transcription for each participant's first name and nickname. When available, the American English transcription from the Carnegie Mellon Pronouncing Dictionary (Weide, 2005) was used, via the website ToPhonetics (https://tophonetics.com/). For names not available in that source, we used participant-reported pronunciation to make a best guess at the names' transcriptions. For participants who rated the frequency by which they go by their nickname as a five out of five, their nickname was used in the analyses instead of their first name. Names were analyzed based on the kinds of consonants they contained; this was quantified in two ways. As in Sidhu and Pexman (2015), we calculated the proportion of total consonant

[4] Note that this power analysis was computed as though the regressions to be run were univariate (rather than multivariate).

Table 6
*Zero-Order Correlations Among Predictor and Outcome Variables in Experiment 3*

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | — | | | | | | | | | | | | | | | | |
| 2. Gender | .12$^{**}$ | — | | | | | | | | | | | | | | | |
| 3. Proportion sonorant | .02 | .18$^{**}$ | — | | | | | | | | | | | | | | |
| 4. Proportion voiceless stop | .01 | −.04 | −.24$^{**}$ | — | | | | | | | | | | | | | |
| 5. Starts with sonorant | .02 | .19$^{**}$ | .59$^{**}$ | −.08$^{*}$ | — | | | | | | | | | | | | |
| 6. Starts with voiceless stop | .02 | .07 | −.17$^{**}$ | .64$^{**}$ | −.29$^{**}$ | — | | | | | | | | | | | |
| 7. Adjective H | .21$^{**}$ | .21$^{**}$ | .05 | .09$^{**}$ | .08$^{*}$ | .07$^{*}$ | — | | | | | | | | | | |
| 8. Adjective E | −.00 | .34$^{**}$ | .09$^{*}$ | .02 | .11$^{**}$ | .05 | .09$^{**}$ | — | | | | | | | | | |
| 9. Adjective X | .11$^{**}$ | −.02 | −.04 | .03 | .00 | .01 | .33$^{**}$ | −.17$^{**}$ | — | | | | | | | | |
| 10. Adjective A | .13$^{**}$ | .06 | −.02 | .10$^{**}$ | .01 | .10$^{**}$ | .54$^{**}$ | .09$^{*}$ | .27$^{**}$ | — | | | | | | | |
| 11. Adjective C | .10$^{**}$ | .08$^{*}$ | −.01 | .04 | −.01 | .07 | .50$^{**}$ | −.14$^{**}$ | .41$^{**}$ | .31$^{**}$ | — | | | | | | |
| 12. Adjective O | .04 | −.01 | −.07$^{*}$ | .04 | −.03 | .03 | .19$^{**}$ | −.05 | .21$^{**}$ | .10$^{**}$ | .21$^{**}$ | — | | | | | |
| 13. Statement H | .27$^{**}$ | .26$^{**}$ | .03 | .05 | .02 | .09$^{*}$ | .47$^{**}$ | .13$^{**}$ | −.00 | .32$^{**}$ | .10$^{**}$ | .05 | — | | | | |
| 14. Statement E | −.02 | .42$^{**}$ | .12$^{**}$ | −.02 | .11$^{**}$ | .04 | .01$^{**}$ | .71$^{**}$ | −.16$^{**}$ | .00 | −.11$^{**}$ | −.07 | .06 | — | | | |
| 15. Statement X | .11$^{**}$ | −.07 | −.06 | .06 | −.03 | .03 | .29$^{**}$ | −.23$^{**}$ | .88$^{**}$ | .26$^{**}$ | .40$^{**}$ | .23$^{**}$ | .01 | −.24$^{**}$ | — | | |
| 16. Statement A | .08$^{*}$ | −.04 | −.02 | .05 | −.01 | .02 | .42$^{**}$ | −.12$^{**}$ | .33$^{**}$ | .74$^{**}$ | .24$^{**}$ | .07$^{*}$ | .35$^{**}$ | −.21$^{**}$ | .37$^{**}$ | — | |
| 17. Statement C | .08$^{*}$ | .08$^{*}$ | −.03 | .06 | −.03 | .06 | .41$^{**}$ | −.13$^{**}$ | .33$^{**}$ | .23$^{**}$ | .81$^{**}$ | .27$^{**}$ | .23$^{**}$ | −.09$^{**}$ | .37$^{**}$ | .22$^{**}$ | — |
| 18. Statement O | .10$^{**}$ | .04 | −.07$^{*}$ | .03 | −.02 | .02 | .14$^{**}$ | .05 | .22$^{**}$ | .06 | .12$^{**}$ | .62$^{**}$ | .11$^{**}$ | −.03 | .24$^{**}$ | .20$^{**}$ | .21$^{**}$ |

*Note*. Correlations between the adjective- and statement-based measures of a personality factor are underlined.
$^{*}$ $p < .05$. $^{**}$ $p < .01$.

phonemes in each name that were sonorants or voiceless stops. In addition, we categorized names based on their initial consonant phoneme (ignoring any preceding vowels), into those beginning with a sonorant, a voiceless stop, or neither (see Slepian & Galinsky, 2016). This was done via two effects coded (and shifted) variables (i.e., names that begin with a sonorant vs. all other names; names that begin with a voiceless stop vs. all other names).

We analyzed the data using six multiple multivariate regressions (i.e., one for each personality factor). The two outcome variables in a given model were a participant's scores on the adjective- and statement-based measures of a single personality factor. This was calculated by taking a mean of ratings on each factor, after reverse coding the appropriate items. The advantage of this approach (i.e., one multivariate regression vs. two univariate regressions for a given factor) is that the covariance in errors between two measures of the same personality factor is taken into consideration. All models also included participants' age and gender. Gender was effects coded (and shifted; female = positive; male = negative). Note that we restricted analyses to individuals who identified as either male or female, as the frequency of the "other" category was not large enough to be analyzed (with only five observations), and we did not wish to force these participants into the male or female categories. Our predictors of interest were our four measures of name phonology, which were included in each model. For zero-order correlations among predictors, see Table 6. The results of these regressions can be found in Table 8. Results indicated only one statistically credible relationship of name phonology on personality: individuals with a higher proportion of voiceless stop consonants in their names tended to have higher scores on the adjective-based measure of Honesty-Humility [0.01, 0.19].

In a supplementary set of analyses, we examined whether the phonemes present in nicknames predicted personalities. Of the 335 participants who supplied a nickname, we eliminated two who did not rate the frequency with which they went by that name, and 13 who rated that frequency a one out of five. For the remaining data, analyses were conducted in the same manner as described for first names. Results indicated one statistically credible relationship between nickname phonology and Honesty-Humility: individuals with a higher proportion of voiceless stop consonants in their names tended to have higher scores on the adjective-based measure of Honesty-Humility [0.04, 0.33]. There were also several statistically credible relationships between nickname phonology and Openness: individuals with a higher proportion of voiceless stop consonants in their nicknames tended to have higher scores on the adjective-based [0.09, 0.40] and statement-based measures of Openness [0.01, 0.32]; also, individuals with nicknames that started with a sonorant consonant tended to have lower scores on the statement-based measure of Openness [−0.41, −0.04], see Table 9.

Table 7
*Mean, Standard Deviation (Calculated Across Subjects), and Reliability for Each of the Personality Inventories Used in Experiment 3*

| Factor | *M* | *SD* | Cronbach's α |
|---|---|---|---|
| Adjective-based inventory | | | |
| Honesty-Humility | 4.12 | .54 | .85 |
| Emotionality | 3.23 | .60 | .77 |
| Extraversion | 3.27 | .87 | .91 |
| Agreeableness | 3.65 | .57 | .78 |
| Conscientiousness | 4.00 | .65 | .89 |
| Openness | 3.70 | .53 | .76 |
| Statement-based inventory | | | |
| Honesty-Humility | 3.50 | .71 | .88 |
| Emotionality | 3.20 | .65 | .86 |
| Extraversion | 3.16 | .77 | .91 |
| Agreeableness | 3.18 | .65 | .89 |
| Conscientiousness | 3.77 | .58 | .86 |
| Openness | 3.58 | .63 | .85 |

## Discussion

The results of this study do not provide much evidence that the phoneme-personality associations of an individual's first name are

Table 8
*Resulting Coefficients of Multivariate Linear Regressions Predicting Participant Scores for Each Personality Factor as a Function of Name Phonology, in Experiment 3*

| | Proportion sonorant | | | Begins with a sonorant | | | Proportion voiceless stops | | | Begins with a voiceless stop | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Factor | B | *SE* | 95% CIs | B | *SE* | 95% CIs | B | *SE* | 95% CIs | B | *SE* | 95% CIs |
| Honesty-Humility | | | | | | | | | | | | |
| Trait measure | .01 | .04 | [−.07, .10] | .05 | .05 | [−.05, .15] | .10 | .05 | [.01, .19][a] | .01 | .06 | [−.11, .13] |
| Statement measure | .01 | .04 | [−.07, .09] | −.02 | .05 | [−.11, .08] | .03 | .05 | [−.06, .12] | .06 | .06 | [−.06, .17] |
| Emotionality | | | | | | | | | | | | |
| Trait measure | .00 | .04 | [−.08, .09] | .06 | .05 | [−.04, .16] | .02 | .05 | [−.07, .10] | .04 | .06 | [−.08, .16] |
| Statement measure | .03 | .04 | [−.05, .11] | .03 | .05 | [−.07, .12] | −.01 | .04 | [−.10, .07] | .04 | .06 | [−.07, .16] |
| Extraversion | | | | | | | | | | | | |
| Trait measure | −.06 | .05 | [−.15, .02] | .06 | .05 | [−.05, .16] | .01 | .05 | [−.09, .11] | .01 | .06 | [−.12, .13] |
| Statement measure | −.05 | .04 | [−.13, .04] | .02 | .05 | [−.08, .12] | .04 | .05 | [−.05, .14] | .01 | .06 | [−.12, .13] |
| Agreeableness | | | | | | | | | | | | |
| Trait measure | −.03 | .04 | [−.12, .05] | .05 | .05 | [−.05, .15] | .06 | .05 | [−.03, .16] | .07 | .06 | [−.05, .20] |
| Statement measure | .01 | .04 | [−.08, .09] | −.01 | .05 | [−.12, .09] | .06 | .05 | [−.03, .16] | −.03 | .06 | [−.15, .10] |
| Conscientiousness | | | | | | | | | | | | |
| Trait measure | −.02 | .04 | [−.11, .07] | .01 | .05 | [−.10, .11] | −.00 | .05 | [−.09, .10] | .08 | .06 | [−.05, .20] |
| Statement measure | −.02 | .05 | [−.11, .07] | −.02 | .05 | [−.13, .08] | .03 | .05 | [−.06, .13] | .03 | .06 | [−.09, .15] |
| Openness | | | | | | | | | | | | |
| Trait measure | −.08 | .05 | [−.17, .01] | .02 | .05 | [−.08, .12] | .02 | .05 | [−.08, .11] | .01 | .06 | [−.12, .13] |
| Statement measure | −.09 | .05 | [−.18, −.00] | .03 | .05 | [−.07, .14] | .01 | .05 | [−.08, .10] | .01 | .06 | [−.11, .13] |

[a] 95% credible interval (CI) does not include zero.

related to their self-reported personality. We only observed one statistically credible relationship—between proportion of voiceless stops and adjective-based Honesty-Humility. Note that this was not an association that we observed in Experiments 1 and 2. The lack of an association between names and self-reported personality is not altogether surprising. While research has shown that individuals might subtly change their appearance to match stereotypes of their names (Zwebner et al., 2017), someone's personality is much less malleable (see Roberts & DelVecchio, 2000). And of course, when parents give a child a name, they do not yet have insight into their personality. However, there was evidence of a link between nicknames containing voiceless stops (sonorants) and high (low) Openness. Note that this too was not an association that emerged in Experiments 1 and 2. Nevertheless, it may be that because nicknames are generally given to individuals later in life, when

Table 9
*Resulting Coefficients of Multivariate Linear Regressions Predicting Participant Scores for Each Personality Factor as a Function of Nickname Phonology, in Experiment 3*

| | Proportion sonorant | | | Begins with a sonorant | | | Proportion voiceless stops | | | Begins with a voiceless stop | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Factor | B | *SE* | 95% CIs | B | *SE* | 95% CIs | B | *SE* | 95% CIs | B | *SE* | 95% CIs |
| Honesty-Humility | | | | | | | | | | | | |
| Trait measure | .05 | .08 | [−.10, .20] | −.05 | .09 | [−.23, .13] | .19 | .08 | [.04, .33][a] | −.18 | .10 | [−.38, .01] |
| Statement measure | .06 | .07 | [−.09, .20] | −.12 | .09 | [−.30, .05] | .05 | .07 | [−.09, .20] | −.00 | .10 | [−.20, .19] |
| Emotionality | | | | | | | | | | | | |
| Trait measure | .01 | .08 | [−.13, .16] | .02 | .09 | [−.16, .20] | .06 | .08 | [−.09, .21] | −.02 | .10 | [−.22, .17] |
| Statement measure | .05 | .07 | [−.09, .19] | −.02 | .09 | [−.19, .14] | .07 | .07 | [−.06, .21] | −.06 | .09 | [−.24, .13] |
| Extraversion | | | | | | | | | | | | |
| Trait measure | −.13 | .08 | [−.28, .03] | .13 | .10 | [−.06, .32] | −.06 | .08 | [−.22, .09] | .06 | .11 | [−.15, .27] |
| Statement measure | −.06 | .08 | [−.22, .10] | .02 | .10 | [−.18, .21] | −.05 | .08 | [−.21, .11] | .01 | .11 | [−.20, .23] |
| Agreeableness | | | | | | | | | | | | |
| Trait measure | −.01 | .08 | [−.16, .14] | .11 | .09 | [−.08, .29] | .10 | .08 | [−.05, .25] | .05 | .10 | [−.15, .26] |
| Statement measure | .06 | .08 | [−.09, .21] | .04 | .10 | [−.15, .22] | −.05 | .08 | [−.20, .11] | .08 | .11 | [−.13, .29] |
| Conscientiousness | | | | | | | | | | | | |
| Trait measure | .02 | .08 | [−.14, .18] | −.08 | .10 | [−.27, .11] | .02 | .08 | [−.14, .17] | .06 | .11 | [−.14, .28] |
| Statement measure | .07 | .08 | [−.09, .22] | −.11 | .10 | [−.30, .08] | .06 | .08 | [−.10, .22] | .05 | .11 | [−.16, .26] |
| Openness | | | | | | | | | | | | |
| Trait measure | −.02 | .08 | [−.17, .14] | −.17 | .10 | [−.36, .02] | .24 | .08 | [.09, .40][a] | −.19 | .11 | [−.40, .02] |
| Statement measure | .07 | .08 | [−.09, .22] | −.23 | .10 | [−.42, −.04][a] | .17 | .08 | [.01, .32][a] | −.14 | .11 | [−.35, .07] |

[a] 95% credible interval (CI) does not include zero.

their personality is more apparent, it is possible for that personality to influence nickname choice. We will elaborate on this in the General Discussion.

A potential implication of these results is that the associations observed in Experiments 1 and 2 do not derive from large scale patterns of real first name sound symbolism in the population. In the next experiment, we test another potential explanation for the results of Experiments 1 and 2: that information associated with the names used as stimuli could have contributed to the effects we observed. We chose to use real names as stimuli in Experiments 1 and 2 in order to examine whether phonology would have an effect even when situated in the context of words with existing semantic information. This approach is contrary to many studies on sound symbolism that use invented nonwords in order to be able to isolate the effects of phonology. Thus, we felt that Experiments 1 and 2 offered a stringent test of name phonology—if phonology had an effect even in the presence of associated information then it must be rather robust. Notably, the fact that we observed an effect of familiarity demonstrates that participants indeed accessed this existing information to some extent. However, the strength of this approach is also a potential downside. That is, using real names creates the possibility that the effects we observed were somehow driven by this existing information. It could be the case, for instance, that there are salient individuals in popular culture who have the names we used, and that this contributed to the observed associations. To examine this possibility, we next ran a version of the task using invented names. This served to isolate name phonology and remove any possible impact of existing semantic or episodic knowledge of certain names.

## Experiment 4

In Experiment 4, we once again tested for phoneme-personality sound symbolism in the lab, using the Likert scale rating task from Experiment 2. In this case, however, participants were presented with invented names (i.e., letter strings that could be pronounced but were not real names) instead of real names. This allowed us to test the extent to which phoneme-personality sound symbolic effects arise from phonology alone, without the influence of episodic knowledge.

### Method

**Participants.** Participants were 60 undergraduate students (46 female; *M* age = 20.97; *SD* = 4.29) at the University of Calgary who participated in exchange for course credit. As this study measured the same construct as Experiments 1 and 2, we chose to test the same number of participants as in those experiments. All participants reported English fluency and normal or corrected to normal vision.

**Materials and procedure.** Each of the names used in Experiment 2 was transformed into an invented name in the following manner. Each sonorant (voiceless stop) in a given name was replaced with another sonorant (voiceless stop). When possible, this was done by rearranging the consonants in a name (e.g., *Abel* to *Aleb*; /eɪbəl/ to /eɪləb/). It was occasionally necessary to replace the vowels in a given name to avoid creating a real name or word. Replacement vowels were always sound symbolically congruent with the consonants of a given name (i.e., back vowels with sonorants; front vowels with voiceless stops; D'Onofrio, 2014). As in Experiments 1 and 2, the vowels of invented names were not perfectly congruent with their consonants. Nevertheless, sonorant names contained a significantly higher percentage of back vowels ($M = 48.15$; $SD = 32.80$) than did voiceless stop names ($M = 1.39$; $SD = 8.33$), $t(70) = 8.29$, $p < .001$. In addition, sonorant names contained a significantly lower percentage of front vowels ($M = 23.15$; $SD = 27.68$) than did voiceless stop names ($M = 71.76$; $SD = 32.08$), $t(70) = 6.88$, $p < .001$. See Table A2 in the Appendix for a list of invented names. A trained linguist ensured that all invented names were phonotactically legal in English.

The procedure was identical to that described for Experiment 2, except that here visual presentation of the invented names was accompanied by an audio recording of their pronunciation (to ensure they were processed with the intended phonology). These recordings were created using Apple's text to speech software. Participants were told that the recordings they would hear would be invented names. In addition, because the stimuli were invented names, the familiarity task was removed. Participants were presented with each invented name once for a total of 72 trials. The 36 traits were presented twice, in a random order each time, once with a sonorant name and once with a voiceless stop name (the order of which was counterbalanced across participants). Finally, we added a gender assignment task in which participants indicated whether they thought each invented name was more likely to be a male or female name via button press.

### Results

Analyses were conducted in the same manner as Experiment 2. Results indicated that sonorant (voiceless stop) names were judged to be higher (lower) in Honesty-Humility [0.07, 0.65], Emotionality [0.27, 1.05], Agreeableness [0.42, 1.14], and Conscientiousness [0.07, 0.76]. Conversely, voiceless (sonorant) stop names were judged as being higher (lower) in Extraversion [−0.66, −0.04] (see Table 10).

In a set of supplementary analyses we also included the gender assigned to a particular name by each participant (which was effects coded and shifted to a mean of zero within trials of each personality factor; female = positive; male = negative), as well as its interaction with name type. According to these models, sonorant (voiceless stop) names were still judged to be higher (lower) in Honesty-Humility [0.01, 0.17], Emotionality [0.09, 0.26], Agreeableness [0.12, 0.28], and Conscientiousness [0.02,

Table 10
*Resulting Name Type Coefficients of Linear Regressions Predicting Fit Ratings of Sonorant (Voiceless Stop) Invented Names for Traits From the High (Low) End of Each Personality Factor, in Experiment 4*

| Factor | B | *SE* | 95% CIs |
|---|---|---|---|
| Honesty-Humility | .36 | .14 | [.07, .65][a] |
| Emotionality | .66 | .20 | [.27, 1.05][a] |
| Extraversion | −.33 | .15 | [−.66, −.04][a] |
| Agreeableness | .76 | .19 | [.42, 1.14][a] |
| Conscientiousness | .43 | .18 | [.07, .76][a] |
| Openness | .00 | .15 | [−.30, .30] |

[a] 95% credible interval (CI) does not include zero.

0.20]; voiceless stop (sonorant) names were still judged to be higher (lower) in Extraversion [−0.18, −0.01]. In addition, names that participants thought were female (male) were judged to be higher (lower) in Emotionality [0.10, 0.29], Agreeableness [0.10, 0.29], and Conscientiousness [0.06, 0.23]. There were no statistically credible interactions between name type and assumed gender.

Finally, we examined whether the relationship between name type and each personality factor was mediated by the perceived gender of each name. This was done at the item level, using the proportion of participants who identified a name as being male as a measure of perceived gender. We used the "mediation" package (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014) in R to perform the analyses. Name type was the predictor variable; the perceived gender of each name was the mediator variable. The rated agreement between each name and traits from a given factor was the dependent variable. The analysis used a quasi-Bayesian Monte Carlo method with 10,000 samples to estimate the indirect path (i.e., from name type to perceived gender to personality factor) and the direct path (i.e., from name type to personality factor) for each factor separately. The results are shown in Table 11. All previous statistically credible results were found to have a significant direct path. All indirect paths were nonsignificant.

## Discussion

Even after eliminating any influence of existing information associated with names, we observed associations between sonorant names and high Honesty-Humility, Emotionality, Agreeableness, and Conscientiousness; and between voiceless stop names and high Extraversion. This suggests the that the phoneme-personality effects we observed are due to qualities of the names' phonemes, rather than real world associations of the names. In fact, we observed a greater number of associations for invented names in Experiment 4 than we did for real names in Experiment 2. On the one hand, it is possible that the addition of auditory information served to enhance the effects. On the other hand, the greater number of sound symbolic effects with invented names may support the interpretation that nonwords are read in a different manner that emphasizes effects of phonology, and/or that the presence of existing information with regards to real names attenuates effects of sound symbolism. Notably, mediational analyses found no evidence of these results being mediated by the perceived gender of the names. This helps narrow in on sound symbolism as a primary cause of these effects, rather than associations between name phonology and gender. We next explored another potential mediating factor in these effects: differences in the likability of sonorant versus voiceless stop names.

Table 11
*Results of Mediational Analysis in Experiment 4*

| Personality factor | Indirect path | Direct path |
|---|---|---|
| Honesty-Humility | .01 [−.05, .08] | .28 [.07, .50][a] |
| Emotionality | .02 [−.10, .15] | .38 [.21, .55][a] |
| Extraversion | .01 [−.04, .06] | −.27 [−.49, −.05][a] |
| Agreeableness | .02 [−.10, .15] | .41 [.24, .59][a] |
| Conscientiousness | .02 [−.09, .14] | .25 [.05, .45][a] |
| Openness | .01 [−.04, .06] | .00 [−.23, .23] |

*Note*. Analysis was performed at the item level, with name type as the independent variable, and perceived name gender as a mediator variable.
[a] 95% confidence interval does not include zero.

# Experiment 5

We next collected ratings of the likability of each name and invented name used in lab, in Experiments 1, 2, and 4, and examined the viability of likability as a mediating factor for the observed phoneme-personality associations. One might propose that some of the effects observed thus far (in particular, sonorant names being more agreeable and conscientious) could reflect an overall bias to simply prefer sonorant names and associate them with positive traits. That is, that the phoneme-personality associations observed in Experiments 1, 2, and 4 could simply be explained as a valence effect, without requiring the nuance of invoking specific personality factors.

## Method

**Participants.** Based on previous lexical-semantic ratings tasks (e.g., Brysbaert et al., 2014; Warriner, Kuperman, & Brysbaert, 2013), we set a target sample size of 20 ratings per name. Our sample of convenience consisted of 27 undergraduate students at the University of Calgary who participated in exchange for course credit. All participants reported English fluency and normal or corrected to normal vision. We excluded four participants who reported not being able to hear the audio files on a postexperiment questionnaire. This left a total of 23 participants whose data were analyzed (20 female, one nonbinary; $M$ age = 19.35; $SD$ = 1.58).

**Materials and procedure.** The ratings were collected using the online survey platform Qualtrics. Participants were shown all 72 invented names from Experiment 4, along with the audio file of their pronunciation, in a random order. Participants were instructed to think of the name as belonging to an individual that they had never met and to judge how likable they think that person would be. Each name appeared along with a rating scale below it from 1 (*very unlikable*) to 7 (*very likable*). Participants then performed the same task for all of the names presented in Experiment 2, again in a random order. These were only presented visually.

## Results

We analyzed likability ratings for names and invented names in separate mixed effects linear regressions. Our dependent variable was likability rating. The type of name presented was effects coded (sonorant = .5; voiceless stop = −.5), as was the gender of the name (shifted in the case of invented names, female names = positive; male names = negative; not shifted in the case of real names, female names = .5; male names = −.5). Invented name gender was based on the average number of participants in Experiment 4 who classified a name as male or female, using 50% as a cutoff. We also included an interaction between these predictors. In the case of invented names, we only observed an effect of gender such that female names were rated as more likable than male names [0.07, 0.33]. The results for real names indicated that round names were rated as more likable than sharp names [0.01, 0.20], with an interaction suggesting that this was greater [0.01, 0.32] for female names.

We next examined whether the relationship between name type and each personality factor was mediated by the rated likability of

Table 12
*Results of Mediational Analyses in Experiments 2 and 4*

| Personality factor | Indirect path | Direct path |
|---|---|---|
| Experiment 2 | | |
| Honesty-Humility | .04 [−.04, .13] | .12 [−.13, .36] |
| Emotionality | .04 [−.04, .13] | .08 [−.17, .32] |
| Extraversion | .13 [.03, .25][a] | −.47 [−.68, −.26][a] |
| Agreeableness | .01 [−.07, .09] | .44 [.23, .67][a] |
| Conscientiousness | .03 [−.05, .12] | .22 [−.01, .46] |
| Openness | −.04 [−.13, .03] | .36 [.13, .60][a] |
| Experiment 4 | | |
| Honesty-Humility | .00 [−.04, .05] | .29 [.08, .51][a] |
| Emotionality | .02 [−.02, .09] | .38[.17, .60][a] |
| Extraversion | .04 [−.03, .13] | −.30 [−.52, −.08][a] |
| Agreeableness | .04 [−.03, .12] | .40 [.20, .60][a] |
| Conscientiousness | .05 [−.04, .15] | .22 [.02, .43][a] |
| Openness | −.01 [−.06, .03] | .02 [−.22, .25] |

*Note*. Analyses were performed at the item level, with name type as the independent variable, and name likeability as a mediator variable.
[a] 95% confidence interval does not include zero.

each name. This was done at the item level, in the same manner as the mediational analysis in Experiment 4. The results are shown in Table 12. All statistically credible effects from Experiments 2 and 4 were found to have a significant direct path and, with one exception, a nonsignificant indirect path. In Experiment 2, we discovered a significant indirect path for Extraversion, but this was in the opposite direction as the direct path (i.e., inconsistent mediation; MacKinnon, Fairchild, & Fritz, 2007). That is, sonorant names were rated as being higher in likability, and more likable names were rated as being higher in Extraversion. However voiceless stop names were judged as being higher in Extraversion.

## Discussion

We found no effect of name type on likability for invented names but found that real sonorant names were rated as being more likable than real voiceless stop names. This effect was greater for female names. However, we found no evidence of likability mediating the effects observed in Experiments 1, 2, and 4. Thus, the relationships observed between phonemes in names and personality are not reducible to a valence effect. Notably, we discovered a statistically significant direct path for each of the significant name-personality sound symbolism findings in Experiments 2 and 4 using a different statistical approach (i.e., item level mediational analysis vs. trial level mixed effects Bayesian regression) demonstrating that those effects are robust across different analytical techniques.

## General Discussion

The purpose of the present study was to examine if there are sound symbolic associations between certain phonemes and personality factors. In Experiments 1, 2, and 4 we investigated whether first names containing sonorants versus voiceless stops were differentially associated with personality factors from the HEXACO model. We did this by asking participants to choose between a pair of names as being most likely to possess a certain trait (Experiment 1), to rate the fit between an individual name and trait (Experiment 2) and to rate the fit between an individual invented name and trait (Experiment 4). Across these diverse procedures, we found evidence that sonorants and voiceless stops were indeed associated with different personality factors (see Figure 2). The most robust associations were between sonorant names and high Agreeableness (Experiments 1, 2, and 4), Emotionality

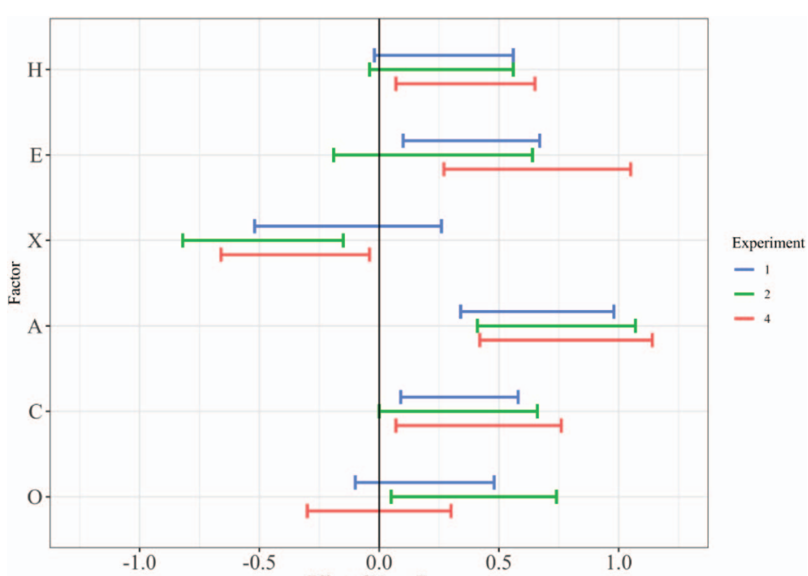


*Figure 2*. The results of Experiments 1, 2, and 4, for each personality factor. The *x*-axis corresponds to the 95% confidence intervals for intercepts of each model in Experiment 1 and the coefficients of the name type predictors in Experiments 2 and 4. Positive values indicate that sonorants (voiceless stops) were associated with traits from the high (low) end of a factor; negative values indicate the opposite. See the online article for the color version of this figure.

(Experiments 1 and 4), and Conscientiousness (Experiments 1 and 4). We also found a robust association between voiceless stop names and high Extraversion (Experiments 2 and 4). Although previous papers have investigated associations with isolated personality traits, the work here represents a comprehensive description of the relationships between sonorants/voiceless stops and broader personality space.

Although the patterns of results we observed were generally consistent across experiments, there were some differences between experiments, and this may simply be due to random variation. Alternatively, it could be that there is something systematic at play. For instance, the lone association between voiceless stops and high levels of a factor (i.e., Extraversion) only emerged when single names (rather than pairs) were presented (i.e., in Experiments 2 and 4, but not in 1). Although there may be something informative to such a pattern, we are wary of over interpretation.

It is also important to note that vowels may have contributed to the effects we observed, as sonorant names tended to have a higher percentage of back vowels, while voiceless stop names tended to have a higher percentage of front vowels. Thus the types of consonants and vowels in each name were not independent and we cannot make inferences about their individual contributions in isolation. It is noteworthy, however, that previous work on the maluma/takete effect has suggested that consonants are more influential than vowels (Nielsen & Rendall, 2011; Ozturk, Krehm, & Vouloumanos, 2013). Nevertheless, although the focus here was on sonorant and voiceless stop consonants, future research might examine the effects of a variety of phonemes, potentially taking an unconstrained big data approach (as in Westbury, Hollis, Sidhu, & Pexman, 2018).

A notable result is that the phoneme-personality associations emerged for real word stimuli in Experiments 1 and 2. This provides evidence that sound symbolism effects can emerge for real words with existing associated information. Although that has been replicated in the case of name-shape associations (Sidhu & Pexman, 2015; Sidhu, Pexman, & Saint-Aubin, 2016), it is less well established for name-personality associations. This latter type of association is particularly noteworthy, because although existing name information may not interfere with a round/sharp shape decision, it would be much more relevant to a decision about personality (i.e., recalling your friend Molly likely has little impact on a decision between a rounded and a jagged silhouette but could be much more influential on a decision regarding Agreeableness). Importantly, these results are not restricted to real names, as we also observed phoneme-personality associations with invented names in Experiment 4. This supports the associations being due to the phonemes' qualities, rather than real world associations of the names. Indeed, the fact that more associations were observed with invented names in Experiment 4 than with real names in Experiments 1 and 2 supports the notion that existing information can *attenuate* effects of sound symbolism. Nevertheless, the finding that sound symbolism can affect the processing of real words has broad implications for language processing, as sound symbolically associated perceptual and/or semantic features could affect this process. Of course, future research will be needed to explore this beyond name stimuli.

In Experiment 3, we examined whether these associations emerged in a large-scale analysis of self-reported personality in the real world. That is, we examined whether the proportion and/or initial appearance of sonorants and/or voiceless stops in a person's name predicted their self-reported scores on the HEXACO factors, testing for sound symbolic associations like those observed in the lab. We did not find any evidence of this. In fact, we found evidence of only one association: individuals with a higher proportion of voiceless stops scored slightly higher on the adjective-based measure of Honesty-Humility. We are inclined to interpret this as a Type I error, at least until the association is replicated. Interestingly, we found several pieces of evidence to suggest that there may be an association between voiceless stops (sonorants) in nicknames and high (low) Openness. Note that this is not an association we observed in lab.[5] Nevertheless, nicknames provide a more plausible instance in which to find a relationship between names and personality, because they are often given later in life (and/or must endure to later in life) and thus can be influenced by an individual's personality. Future research should explore this in a larger sample before any conclusions are drawn. It would also be important for research to distinguish between different types of nicknames (e.g., shorter versions of a first name, kinship terms). We did not have the necessary information to do so here.

## Mechanisms for Phoneme-Personality Sound Symbolism

The present results suggest that phonemes have sound symbolic associations beyond the perceptual dimensions typically studied (e.g., size and shape), extending to the relatively more abstract dimensions of personality. It is notable that personality was studied here at the factor level. That is, phonemes were shown to go along with traits that loaded onto the same higher order abstract factor, suggesting an association with that higher order property. This fits with recent work showing a sound symbolic association between vowels and the abstract dimensions of social dominance (Auracher, 2017) and emotion (Rummer et al., 2014). It is also consistent with work showing that some perceptual sound symbolic associations may be driven by higher order abstract properties (Tzeng, Nygaard, & Namy, 2017). Demonstrating sound symbolism for abstract dimensions is important because it greatly broadens the purview of sound symbolism. Although the same core set of perceptual dimensions (e.g., shape and size) have been well studied as associated dimensions in sound symbolism, there are many potential abstract dimensions that have yet to be explored.

Abstract sound symbolism provides something of a challenge to explain, given phonemes' lack of perceptual features. Exploring the possible mechanisms by which phonemes could be associated with abstract dimensions is informative as it broadens the scope of

[5] Indeed this runs counter to what was observed in Experiment 2. We had proposed that individuals might subtly alter their personality to match the stereotypes associated with their names. However, there could be other processes by which the phoneme-personality associations of a person's name affect their personality. Some of these could result in a personality that is opposite to the associations of the phonemes in one's name. For instance, having a name that is associated with low Openness could lead individuals to behave in a way that runs counter to those expectations. It is also important to note that the in-lab experiments used a restricted set of names that were controlled for length and frequency, whereas Experiment 3 sampled from an unconstrained set of names. This might also lead to a discrepancy in findings. Of course, this is purely speculative, and we believe that the effects observed in Experiment 3 should be replicated before they are interpreted further.

mechanisms that could underlie sound symbolism. Sidhu and Pexman (2018) laid out several potential mechanisms for sound symbolism (see Table 13) and we will discuss here how two of these in particular (i.e., statistical co-occurrence and shared properties) could account for the effects we observed.

One explanation that could be generated via the statistical co-occurrence account is that one tends to, for instance, encounter individuals with a sonorant name having a highly Agreeable personality. Over time repeated exposure to this co-occurrence might be internalized and lead to a phoneme-personality association. However, the results from the large-scale personality analysis in Experiment 3 suggest that such a pattern does not exist in the population at large. Thus, we do not believe that phoneme-personality associations derive from such a large-scale co-occurrence. One might speculate that co-occurrences could exist in names besides real first names, especially when these names are given to individuals in light of their personality. For example, if agreeable fictional characters tended to be given sonorant names, this could represent a statistical co-occurrence. One might even speculate that a small number of extremely well-known fictional exemplars (or perhaps cultural icons) might go a long way to creating an association. A co-occurrence could also arise through nicknames if, for instance, sonorant nicknames tended to be given to those with agreeable personalities. Although we found no evidence of nickname phonology reflecting any of the patterns we observed in Experiments 1, 2, or 4, that analysis was low powered due to only a subset of our respondents providing a nickname. If such co-occurrences did exist in nicknames, they could contribute to phoneme-personality associations. Nevertheless, such a mechanism assumes an association exists to begin with (i.e., for many individuals to be given congruent nicknames, an association must already exist to drive such a pattern), and thus could not explain the origin of the associations observed here. However fictional or nickname patterns could be the final link in a causal chain that ultimately creates the association in an individual, or perhaps serve to "signal boost" the association. This highlights the fact that multiple mechanisms could play a role in creating these associations, at different points in causation.

There may be other manners in which phoneme features and personality factors could co-occur (i.e., outside of name stimuli) that could explain the origin of these effects. One possibility could be the tendency to use particular tones in certain emotional contexts. For instance, adults in distress tend to use harsh and punctuated voicings (Rendall, 2003). This tendency might lead to an association between soft, nonpunctuated phonemes and traits related to the opposite of distress (e.g., perhaps those of high Agreeableness). Another possibility might be that the phoneme-personality associations observed in Experiments 1, 2, and 4 are mediated by the statistical co-occurrence of certain phonemes and gender. That is, certain phonemes being more common in female or male names (see Cassidy et al., 1999), could lead to those phonemes becoming associated with stereotypically female or male personalities, respectively. However, note that the perceived gender of invented names did not mediate the effect of name type in Experiment 4.

Besides statistical co-occurrence accounts, it could be that phonemes and personality factors share some property in common. Because phonemes and personality are of a fundamentally different nature (i.e., acoustic/articulatory stimuli and abstract constructs), this would likely involve some amount of metaphor. Kawahara et al. (2015) speculated that the link between sonorants/obstruents and approachable/unapproachable personalities had to do with the acoustic properties of the phonemes relating to either personality metaphorically. That is, the abruptness of obstruents could metaphorically capture an unapproachable personality whereas the smoother sonorants could capture an approachable personality. Something similar could be invoked to explain the associations here. For instance, acoustic smoothness could metaphorically map onto smooth social interactions with highly agreeable individuals. Quick changes in acoustics (i.e., for voiceless stops) could metaphorically map onto energetic properties of highly extraverted individuals. Of course, these suggestions are

Table 13
*Potential Mechanisms Underlying Sound Symbolic Associations From Sidhu and Pexman (2018)*

| Mechanism | Description |
|---|---|
| Statistical co-occurrence | Phonemes (or component features of phonemes; e.g., high pitch, a component feature of high-front vowels) co-occurring with certain kinds of stimuli in the world might lead to an internalization of those patterns and thus an association. For instance, smaller things tend to resonate at a higher frequency, potentially explaining the association between high-front vowels (which have a higher fundamental frequency) and small objects (see Spence, 2011). |
| Shared properties | Phonemes and associated stimuli could share some property in common, be it perceptual or conceptual. Note that this shared property might require some element of metaphor or analogy in order for it to apply across different modalities. For instance, the abrupt onset of airflow when articulating a voiceless stop might lead to associations with the abrupt changes in direction in the outline of a sharp shape (see Kawahara & Shinohara, 2012). |
| Neural factors | The brain may be structured in such a way as to create an association between stimuli from different modalities. For instance, there may be a neural link between hand grasp posture and articulatory muscles. This might lead to an association between objects inviting smaller grips, and the smaller articulations of high-front vowels (see Vainio, Schulman, Tiippana, & Vainio, 2013). |
| Evolutionary factors | Evolution may have led to organisms developing associations between certain kinds of stimuli, if those associations provided a survival advantage. For instance, organisms might be predisposed to associate higher pitches with the smaller organisms producing those pitches (Ohala, 1994). |
| Language patterns | Words for certain types of properties may disproportionately contain some types of phonemes more than others. Individuals might then internalize that pattern and come to associate these phonemes with such a property. For example, the onset *gl-* (i.e., a phonestheme; see Bergen, 2004) appears in many words related to light, and individuals make use of this word when asked to create words related to that property (Magnus, 2000). |

highly speculative and would require future research. Nonetheless, some evidence for this interpretation comes from studies on the connotative-semantic properties evoked by different types of phonemes. For instance, the sounds of sonorants evoke connotations of mellowness, passivity and delicacy; while voiceless stops evoke connotations of harshness, activity and ruggedness (Bozzi & Flores D'Arcais, 1967; Greenberg & Jenkins, 1966). These may serve to connect sonorants with high Agreeableness and Emotionality; and voiceless stops with high Extraversion and low Emotionality. Note that many of the mechanisms described so far can be invoked to explain an association between phonemes and some, but not all, of the associated personality factors. This could suggest that there are multiple mechanisms at play in the associations we observed.

As another possibility, it may be that phoneme-personality effects are determined at a higher level of abstraction (see Tzeng et al., 2017). That is, that phonemes and personality factors could both be associated with some higher order property. Although our results here suggest that this higher order factor is not likability, future research might explore other possibilities such as the two higher order properties suggested by Osgood, Suci, and Tannenbaum (1957) in addition to *valence*: *potency* (i.e., strong-weak) and *activity* (i.e., active-passive).

Lastly, future research might examine whether the phoneme-personality associations found here actually mediate perceptual sound symbolism effects. Recent work has suggested that some perceptual sound symbolism associations are mediated by shared higher order semantic properties (Tzeng et al., 2017). It may be that the personality factors studied here are those shared properties, or at least are similar in meaning to those properties. While purely speculative, it is interesting to note that round shapes like those used in maluma/takete experiments are rated as being peaceful, tender, relaxed, and friendly; whereas the sharp are rated as being aggressive, unfriendly, and tough (Lindauer, 1990). This overlaps with some of the personality factors associated with sonorants and voiceless stops.

## Real World Implications

An association between phonemes and the abstract dimension of personality has implications for the study of iconicity (i.e., words whose forms map onto their meanings). Much of this work has explored cases in which the form of a word resembles some perceptual property (cf. Akita, 2010). For instance, ideophones (see Dingemanse, 2018) whose forms can convey sensory meanings via sound symbolism (e.g., the Japanese words *goro* and *koro* meaning a heavy and a light object rolling, making use of phoneme-weight sound symbolism). However, the results we observed here suggest that iconicity can also exist for more abstract meanings. Further, iconicity has been shown to benefit word learning (see Imai & Kita, 2014). Given the difficulty children have learning abstract language (see Ponari, Norbury, Rotaru, Lenci, & Vigliocco, 2018), the results we observed present a potential avenue for future research with regards to the acquisition of abstract language. That is, future work might look into how iconicity could be used to ground certain abstract meanings and thus bootstrap their acquisition (see Imai & Kita, 2014; Perniss, Lu, Morgan, & Vigliocco, 2018).

In addition, previous work has shown that impressions can be influenced by various features of a name (e.g., length, conventionality). The present studies suggest that another such feature is the sound symbolic associations of the phonemes in a name. Of course, we must remember that participants' decisions in these experiments were made in the context of impoverished laboratory tasks. Indeed, participants had very little else on which to base their decisions, besides the phonology of the presented names. We expect that to the extent that individuals have additional information on which to base their judgments the effects of phonology on personality judgments would be attenuated. Nevertheless, there are everyday situations in which individuals are judged based on very little besides their name: for instance, in online communication. Future research should investigate the extent to which first impressions or resume evaluations can be influenced by the sound symbolism of a first name. Advertising could also make use of these associations when choosing names for products (see Klink & Athaide, 2012), or characters in advertisements.

Lastly, the associations observed in Experiments 1, 2, and 4 could have real world effects when individuals *choose* a name for targets with certain personalities. The most obvious instance of this would be when an author chooses a name for a character. They may—consciously or unconsciously—select a name that is congruent with the character's personality, in order to highlight that personality for the audience (see Elsen, 2017; Kawahara, Noto, & Kumagai, 2018; Smith, 2006). Future research might examine the extent to which the associations observed here are present in works of fiction, as well as the impact of congruent/incongruent names on the reader's experience of that fiction. It would also be interesting to explore the extent to which these associations affect differences in naming trends between boys and girls. For instance, research has shown that sonorants are more common in female versus male names (Sidhu & Pexman, 2015). This could be related to sonorants being associated with stereotypically female personality qualities such as high Agreeableness (see Huddy & Terkildsen, 1993).

## Conclusion

We investigated whether phonemes have sound symbolic associations beyond the perceptual effects typically studied, using the more abstract dimensions that comprise the construct of personality. Across three laboratory studies we found sound symbolic associations for the phonemes in first names, with sonorants showing an association with high Emotionality, Agreeableness, and Conscientiousness; and voiceless stops showing an association with high Extraversion. These results suggest that any theory of sound symbolism should take into consideration associations between phonemes and more abstract dimensions.

## Context

The experiments presented here were motivated by findings reported in previous work conducted by David M. Sidhu and Penny M. Pexman (i.e., Sidhu & Pexman, 2015). Our goal was to conduct a more precise and thorough investigation of the reported associations between the phonemes in first names and personality traits. In the present study we explored associations between phonemes and personality factors from an established model of personality (i.e., the HEXACO). This was a collaboration with Joshua S. Bourdage, who does a great deal of work on the HEXACO model of personality. In related work, David M. Sidhu and Penny M. Pexman have begun to explore the mechanisms that underlie sound symbolism: in a recent review article we outline five potential mechanisms for sound symbolism (i.e., Sidhu & Pexman, 2018). We were also interested to explore whether these mechanisms could apply to a more abstract form of sound symbolism.

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(*Appendix follows*)

# Appendix

## Experimental Stimuli

Table A1

*Trait Stimuli Used in Experiments 1, 2, and 4*

| Trait | Factor | Direction |
|---|---|---|
| Honest | Honest-Humility | High |
| Sincere | Honest-Humility | High |
| Trustworthy | Honest-Humility | High |
| Conceited | Honest-Humility | Low |
| Self-centered | Honest-Humility | Low |
| Snobbish | Honest-Humility | Low |
| Emotional | Emotionality | High |
| Sensitive | Emotionality | High |
| Sentimental | Emotionality | High |
| Fearless | Emotionality | Low |
| Rugged | Emotionality | Low |
| Unemotional | Emotionality | Low |
| Lively | Extraversion | High |
| Outgoing | Extraversion | High |
| Social | Extraversion | High |
| Antisocial | Extraversion | Low |
| Dull | Extraversion | Low |
| Withdrawn | Extraversion | Low |
| Agreeable | Agreeableness | High |
| Cooperative | Agreeableness | High |
| Peaceful | Agreeableness | High |
| Aggressive | Agreeableness | Low |
| Blunt | Agreeableness | Low |
| Quick-tempered | Agreeableness | Low |
| Hard-working | Conscientiousness | High |
| Organized | Conscientiousness | High |
| Thorough | Conscientiousness | High |
| Careless | Conscientiousness | Low |
| Disorganized | Conscientiousness | Low |
| Irresponsible | Conscientiousness | Low |
| Complex | Openness | High |
| Insightful | Openness | High |
| Philosophical | Openness | High |
| Conventional | Openness | Low |
| Narrow-minded | Openness | Low |
| Simple | Openness | Low |

Table A2

*Name Stimuli Used in Experiments 1 and 2, Along With Their Frequencies and Invented Name Transformations Used in Experiment 4*

| Sonorant name | Frequency | Invented name | Voiceless stop name | Frequency | Invented name |
|---|---|---|---|---|---|
| Abel | 30 | Aleb | Eric | 42 | Erip |
| Allen | 2 | Ammel | Hector | 3 | Hepker |
| Anne | 4 | Ull | Rita | 1 | Reepa |
| Joanna | 18 | Noaja | Erica | 7 | Ekira |
| June | 10 | Nuje | Etta | 5 | Eppa |
| Lanah | 1 | Namah | Patty | 1 | Teeka |
| Laurel | 3 | Maurem | Christie | 1 | Triski |
| Lauren | 55 | Mauren | Katie | 38 | Tatie |
| Lewis | 19 | Sewill | Chris | 9 | Triss |
| Linus | 5 | Nisul | Curtis | 15 | Turkis |
| Lois | 4 | Mois | Kasey | 3 | Tasey |
| Lorne | 3 | Norle | Kirk | 1 | Tirp |
| Lou | 1 | Oul | Ted | 1 | Ked |
| Luna | 20 | Nula | Petra | 9 | Tekra |
| Lyle | 5 | Nyme | Titus | 13 | Kipus |
| Mara | 5 | Rama | Kathy | 2 | Thaky |
| Marla | 1 | Marma | Katia | 1 | Takia |
| Megan | 27 | Negam | Kate | 49 | Pate |
| Miles | 32 | Mooles | Tucker | 27 | Keeter |
| Milo | 15 | Nilo | Tate | 18 | Pake |
| Mona | 4 | Lona | Trista | 2 | Trispa |
| Morris | 3 | Romis | Terry | 4 | Reppi |
| Moses | 7 | Somis | Pierce | 12 | Kierce |
| Myah | 6 | Lua | Tracy | 3 | Satry |
| Nathan | 167 | Thanen | Carter | 202 | Tarker |
| Noam | 1 | Loal | Kipp | 2 | Keek |
| Noel | 9 | Luel | Kurt | 6 | Treek |
| Noelle | 11 | Loenne | Pippa | 4 | Teepa |
| Norah | 32 | Morah | Tessa | 33 | Seka |
| Nya | 6 | Loa | Tia | 8 | Eeka |
| Owen | 164 | Owem | Jack | 198 | Kaj |
| Renee | 9 | Neray | Greta | 10 | Tregga |
| Ronin | 20 | Norin | Victor | 28 | Tikver |
| Rosanne | 1 | Noraz | Yvette | 1 | Eetev |
| Warren | 8 | Warrim | Garrett | 13 | Garek |
| Will | 7 | Wum | Zach | 6 | Kaz |

*Note*. Real names are shown in the pairs in which they were presented in Experiment 1.

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