Journal of Personality and Social Psychology
2014, Vol. 106, No. 6, 885–896

0022-3514/14/$12.00 DOI: 10.1037/a0036477

Oral Approach–Avoidance: Affective Consequences of Muscular Articulation Dynamics

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Can mouth movements shape attitudes? When people articulate different consonants (e.g., B or K) they press the tongue and the lips against various spots in the mouth. This allows for construction of words that feature systematic wanderings of consonantal stricture spots either from the front to the rear (inward; e.g., BENOKA) or from the rear to the front (outward; e.g., KENOBA) of the mouth. These wanderings of muscular strictures resemble the oral kinematics during either deglution (swallowing-like, inward movement) or expectoration (spitting-like, outward movement). Thus, we predicted that the articulation of inward and outward words induces motivational states associated with deglutition and expectoration—namely, approach and avoidance—which was tested in 9 experiments (total $N = 822$). Inward words were preferred over outward words, being labeled as nonsense words (Experiments 1, 4, 5, 6, and 9), company names (Experiment 2), or person names (Experiments 3, 7, and 8), with control words falling in between (Experiment 5). As a social–behavioral consequence, ostensible chat partners were more often chosen to interact with when having inward compared to outward names (Experiment 7). The effect was found in German-speaking (Experiments 1–5) and English-speaking (Experiment 6) samples, and it occurred even under silent reading (all experiments) and for negatively labeled targets (names of villains; Experiment 8). Showing articulation simulations as being the causal undercurrent, this effect was absent in aphasia patients who lacked covert subvocalizations (Experiment 9).

Keywords: approach–avoidance, articulation, embodiment, metaphors, phonation

Supplemental materials: http://dx.doi.org/10.1037/a0036477.supp

Bodily states shape affect and motivation in various ways, because emotional as well as motivational states involve inherent sensorimotor representations of behavioral tendencies (Higgins, 1997; Russell, 2003; Strack & Deutsch, 2004). Further, this link between affective states and bodily action tendencies is bidirectional (Chen & Bargh, 1999; Neumann, Förster, & Strack, 2003). In some cases the bodily impact on affect is intuitively apparent. For instance, a well-known study on the facial-feedback hypothesis found that cartoons were rated as funnier when participants contracted the smiling muscle than when they did not (Strack, Martin, & Stepper, 1988). In this case, the contraction of the smiling muscle invoked the positive affect with which it is directly conditioned in everyday life—we often smile when we have fun. In other cases, the bodily impact is more indirect. In their classical demonstration, Cacioppo, Priester, and Berntson (1993) let participants execute either arm flexion or arm extension while watching affectively neutral Chinese ideographs. It turned out that subsequently participants evaluated those ideographs more positively for which they had executed flexion than extension movements (also see Centerbar & Clore, 2006). This effect is not due to direct affect-motor conditioning—we do not always reach out with our arms each time we see something positive—but to the indirect activation of concordant motivational states of approach and avoidance that are automatically linked with these arm movements (Centerbar & Clore, 2006; Chen & Bargh, 1999; however, for strategic and verbal mechanisms, see Eder & Klauer, 2009; Eder & Rothermund, 2008).

In the extensive literature on bodily influences on affective states, several bodily effectors have been investigated. Most predominantly, the focus was on the fingers, hands, and arms (e.g., Cacioppo et al., 1993; Chen & Bargh, 1999; Foroni & Semin 2012; Leder, Bär, & Topolinski, 2012); the face in the

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This research was supported by the Deutsche Forschungsgemeinschaft (DFG, TO 705/1-1, Str 264/26-1). We thank Anita Körner, Lea Boecker, Amelie Backfisch, Theresa Geiling, Katharina Schatte, Anna Matthey, and Tobias Weber for their logistic support. We also thank Elisabeth Königstein for valuable discussions and support in running pilot studies for Experiment 3.

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emotion domain (e.g., Foroni & Semin, 2009, 2011; Neumann & Strack, 2000; Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009; Strack et al., 1998); and rarely also whole-body movements or postures (e.g., Koch, Holland, Hengstler, & van Knippenberg, 2009; L. Schubert, Schubert, & Topolinski, 2013; Sparenberg, Topolinski, Springer, & Prinz, 2012; Stepper & Strack, 1993). From the perspective of these research domains, the articulatory effectors, particularly the lips and the tongue, are only other muscles of the body that might feature their specific affect-motor representations. And they do, which is argued in the following.

Shared Muscular Dynamics in the Mouth: Ingestion and Articulation

Both onto- and phylogenetically the earliest and most important anatomical function of the mouth is ingestion—the intake of foods and liquids (Duffy, 2007; Hejnol & Martindale, 2008; A. J. Rosenthal, 1999; Rozin, 1996). This intake is performed via deglutition, like in swallowing, sucking, or slurping, which in its oral phase engages lips and tongue that coordinate to propel food and liquid from the oral cavity into the pharynx and the esophagus (A. J. Rosenthal, 1999). This propulsion of the food bolus from the front to rear necessarily involves a sequence of muscle contractions starting in the front of the mouth—the lips—over the front of the tongue to the rear of the tongue, not unlike peristalsis of the esophagus (Goyal & Mashimo, 2006). The food-related functions of the mouth, however, do not only involve deglutition of edible substances but also necessarily the expectoration of inedible or even harmful substances, for instance during spitting, coughing, puffing, or vomiting (Rozin, 1999). Expectoration has the physical function of propelling substances from the pharynx or the oral cavity outside the mouth via the lips. Biomechanically, this muscular activity necessarily entails a sequence of muscle tensions starting in the rear of the mouth—the root of the tongue—over the middle and front of the tongue to the lips (Goyal, & Mashimo, 2006). Thus, deglutition entails an in-going, and expectoration entails an out-going peristaltic wandering of muscle contractions in the oral muscle system.

Recall that flexor and extensor arm movements activate concordant motivational states (Cacioppo et al., 1993). Note also that the environmental correlation between positivity and swallowing/incorporation (vs. negativity-spitting/excorporation) is likely much stronger than between positivity and flexing (vs. negativity and extending). Thus, it is possible that executing muscular contractions that in their sequence either resemble deglutition (muscle contractions wandering from the front to the rear of the mouth), or expectoration (muscle contractions wandering from the rear to the front of the mouth) would trigger the according motivational states of positive affect/approach, and negative affect/avoidance, respectively. In its most trivial realization, this hypothesis would predict that individuals would prefer incidental neutral stimuli when they watch them while, say, drinking water, rather than spitting.

However, the oral muscle system is also involved in another, evolutionarily more recent function in humans, namely, language—via articulation (Steklis & Harnad, 1976). Rozin (1999) already emphasized this dual function: "The human mouth, evolved for food and fluid intake and air input and output, and co-opted in later human evolution as a vocal output. The tongue and teeth, critical for speech production, evolved for purposes of handling food" (p. 110). Combining the functions of ingestion and articulation, we argue in the following that muscular dynamics of deglutition and expectoration can be induced by *articulatory* means.

Articulation is a highly complex neuromuscular activity of the active articulatory effectors lips and tongue (Inoue, Ono, Honda, & Kurabayashid, 2007; Ladefoged & Maddieson, 1996). This sensorimotor orchestration is so complex that the largest parts of the famous sensory homunculus make up the lips and the tongue (Penfield & Jasper, 1954). The basic manner of articulation, that is, the production of a specific phoneme, however, is very simple and similar for all of the more than hundred existing phonemes across languages (e.g., Crystal, 2010; Titze, 2008). A phoneme is generated by modulating or (partly) obstructing the airflow from the lungs outside the mouth; and this stricture of the airflow is realized by the lips or tongue executing some kind of muscle contraction (e.g., Ladefoged, 2001; Titze, 2008). For instance, the phoneme [p] as in English s*p*in is produced by pressing the lips together, or the phoneme [k] as in English s*k*ip is produced by pressing the back of the tongue at the soft palate. While the generation of vowels requires only a modulation of the airflow and often involves large muscle system (for instance, opening the whole mouth for [a]), the generation of consonants requires a complete stricture and involves very specific muscle parts (e.g., specific parts of the tongue).

The place of consonantal articulation, that is, the spot where the muscular stricture occurs in the mouth, varies on the sagittal plane—from the front to the rear. It starts with the lips (e.g., labials such as [b] and [p]) over the front part of the tongue (alveolars, such as [d] or [t]), to the rear of the tongue (velars and uvulars such as [k]). Because consonants can flexibly be arranged in words, this sagittal distribution of consonantal stricture spots allows a fascinating possibility: the unobtrusive induction of muscular contractions that either wander from the front to the rear, or from the rear to the front, respectively, of the mouth. Consider, for instance, the surname POLLOCK (the painter). When articulating this name, first the lips are pressed together (voiceless bilabial stop [p]), then the front of the tongue is pressed against the palate (alveolar lateral approximant [l]), and finally the back part of the tongue is pressed against the palata (voiceless velar stop [k]). Thus, the stricture spots wander *inward* into the body. The tongue itself does not move forward, but the muscular tensions wander inward, such as during in-going peristalsis. Now consider the surname KAHLO (another painter). Here, the consonantal stricture spots wander from the back of the mouth outward to the front of the tongue, like an out-going peristalsis.

Oral Approach–Avoidance and Its Affective Consequences

Such in-going and out-going transitions of consonantal stricture spots bear a sensorimotor similarity with the muscular dynamics during deglutition and expectoration (Goyal & Mashimo, 2006). Consequently, we predicted that the mere articulation of inward words (featuring consonantal stricture spots wandering from the front to the rear of the mouth) would induce an affective and motivational state associated with deglutition, namely, a positive state of approach. In contrast, the articulation of outward words (featuring consonantal stricture spots wandering from the rear to the front of the mouth) would induce an affective and motivational state associated with expectoration, namely, a negative state of avoidance. To clarify and demarcate this approach from arm flexion and extension (Cacioppo et al., 1993), note again that this is not about moving the tongue forward and backward in the mouth (the tongue also does not move forward during spitting and backward during swallowing) but instigating muscular contractions that wander inward or backward in the oral cavity, like in-going or out-going peristalsis.

Oral muscle dynamics have been already shown to elicit affective consequences, namely, in the domain of *oral motor fluency* and in *phonetic symbolism*. Regarding *motor fluency*, for instance, Song and Schwarz (2009) showed that mere pronunciation efficiency yielded higher preference for easy-to-pronounce compared to hard-to-pronounce target words (for related preference effects regarding other motor domains than the mouth, see, e.g., Cannon, Hayes, & Tipper, 2010; Casasanto, & Chrysikou, 2011; Topolinski, 2010, 2013; Van den Bergh, Vrana, & Eelen, 1990). Moreover, Topolinski and Strack (2009c, 2010; also see Topolinski, 2012; Topolinski, Lindner, & Freudenberg, 2013) demonstrated that one underlying mechanism of the *mere exposure effect* (Zajonc, 1968; for a review, see Moreland & Topolinski, 2010), that is, increased preference for repeated over novel words, draws on the motor fluency of subvowel pronunciation simulations. Indirectly related, McGlone and Tofighbakhsh (2000) showed that rhyming aphorisms are more likely to be judged as being true than non-rhyming aphorisms. With rhyming being the partial repetition of parts of syllables, this effect can also be conceptualized as (partial) mere exposure and thus pertains to oral fluency.

On the other hand, *phonetic symbolism* (Sapir, 1929; see also Fitch, 1997) or *sound symbolism* (Hinton, Nichols, & Ohala, 2006) refers to the phenomenon where an arbitrary linguistic sound implicitly conveys certain characteristics, such as size, color, touch, or emotion of the denoted object. For instance, the phonation (voicing) of some vowels decreases the volume of the oral cavity because the tongue is raised and therefore such vowels sound high (for instance, [i] as in SWEET). In contrast, the phonation of other vowels increases the oral cavity volume because the tongue is lowered and therefore such vowels sound low (e.g., [o] or [u] as in POP or LOOP). This role of such differences is revealed in frequency analyses of the generated sounds (Morton, 1994). Generally, high vowels are associated with little, fast, or light denoted objects, while low vowels are associated with large, steady, or heavy objects (e.g., Coulter & Coulter, 2010; Klink, 2000). For instance, Lowrey and Shrum (2007) found that fictitious brand names for hammers (denoted features being heavy and steady) were preferred when featuring low than high vowels, but brand names for knifes (denoted features being sharp and light) were preferred when featuring high than low vowels. Related to this is the *Bouba/kiki-effect* (Sapir, 1929), where participants more likely map nonsense words with rounded vowels (BOUBA) to rounded shapes, and words with unrounded vowels (KIKI) to angular shapes (Maurer, Pathman, & Mondloch, 2006; Ramachandran, & Hubbard, 2001). In sum, phonetic symbolism refers to the classic notion of *onomatopoeia*, so that the sound of a word resembles the denoted object.

In contrast to these earlier contributions, the current hypothesis does not pertain to articulatory ease or word sound, but to physical moving dynamics during articulation. To prevent any influence of the tongue position during vowel articulation, we completely controlled for vowel articulation in the present series of experiments. Moreover, we argue that for any articulatory effects to occur an overt pronunciation, that is, a verbal utterance, is not even necessary, but a mere silent reading is sufficient, since pronunciation is also bodily simulated during reading (cf. the concept of *simulation* in embodiment theory; e.g., Barsalou, 1999; Niedenthal et al., 2009; T. Schubert & Semin, 2009; Semin & Smith, 2008). Supporting this, in the literature on phonetic symbolism, it has been found that word sound shows matching effects to the denoted objects even if the words are only silently read (Coulter & Coulter, 2010; Klink, 2000). Recently, a direct support of automatic subvocal pronunciation during silent reading was provided by Topolinski and Strack (2009c) using selective motor interference. Thus, in most of the present experiment the target words were read silently.

In the following nine experiments, we tested whether inward/outward consonantal dynamics would induce according approach–avoidance related attitudes and also investigated the assumed underlying mechanisms. The first six experiments demonstrated and then replicated the basic effect in very similar designs. Therefore, we report these experiments jointly.

Experiments 1–6

A line of six experiments should provide initial demonstrations and replications of the impact of inward and outward transitions in consonantal articulation on preference. To show the robustness and generalizability of this effect, the experiments varied in materials, labeling of the target words, methodological details, and sample characteristics (e.g., native language). Experiments 1–3 used relatively large samples but small stimulus pools of inward and outward words and labeled the words as nonsense words or names. Experiment 4 introduced a larger stimulus pool that controlled more thoroughly for material effects.

Experiment 5 included, in addition to the inward and outward words, a baseline condition using words with no systematic direction of consonantal movement. This is important because the usual phonation structure of actual words does not feature systematic wanderings of consonantal stricture spots. Thus, Experiment 5 helped determine whether inward words are more positive or outward words are more negative than usual phonation.

Experiment 6 replicated the effect with a slightly modified stimulus pool in an English speaking sample (while Experiments 1–5 addressed German speaking samples). The basic method and the methodological differences between the single experiments are described in the following (for an overview, see Table 1).

Method

Power analyses for required sample sizes. Because we did not know the effect size of this completely novel effect, we tested a large student sample in Experiment 1 ($N = 171$). Then, we used the effect size of the observed effect in Experiment 1 (Cohen's $d = 0.27$; correlation between DVs, $r = .70$) to calculate the required sample size to replicate this effect two-sided with a power of 0.80, yielding a required sample size of $N = 53$ ($G^{*}Power$; Faul, Erdfelder, Lang, & Buchner, 2007; Lakens, 2013). Regarding this

Table 1
Samples, Materials, and Results of Experiments 1–6 (Standard Errors Are in Parentheses)

Experiment	Sample[a]	Stimulus pool and number of stimuli presented	Target label	Consonantal stricture direction: Inward	Outward	Baseline	Statistics for the pairwise-comparison between inward and outward
1	N = 171 German psychology undergraduates 118 women, 50 men, 3 unknown M_{age} = 24 years, SD = 5	Pool A (20 stimuli) 10 inward 10 outward	Nonsense words	4.56 (0.09)	4.24 (0.09)		$t(170) = 5.20, p < .001$ $d = 0.27$ 95% CI [0.20, 0.44]
2	N = 110 German psychology undergraduates 88 women, 22 men M_{age}= 23 years, SD = 4	Pool A (20 stimuli) 10 inward 10 outward	Names of gourmet food companies	5.72 (0.12)	5.46 (0.13)		$t(109) = 3.00, p = .003$ $d = 0.20$ 95% CI [0.09, 0.44]
3	N = 150 German volunteers from various backgrounds 65 women, 85 men M_{age} = 41 years, SD = 19	Pool B (20 stimuli) 10 inward 10 outward	Surnames of foreign politicians	5.53 (0.09)	5.22 (0.09)		$t(149) = 3.89, p < .001$ $d = 0.28$ 95% CI [0.15, 0.46]
4	N = 86 German volunteers from various backgrounds 60 women, 26 men M_{age} = 23 years, SD = 5	Pool C (120 stimuli) 10 inward 10 outward	Nonsense words	5.14 (0.14)	4.70 (0.13)		$t(85) = 4.88, p < .001$ $d = 0.35$ 95% CI [0.26, 0.61]
5	N = 40 German volunteers from various backgrounds 28 women, 12 men M_{age} = 22 years, SD = 3	Pool C (180 stimuli) 30 inward 30 outward 30 baseline	Nonsense words	4.83 (0.15)	4.12 (0.17)	4.42 (0.14)	$t(39) = 4.88, p < .001$ $d = 0.69$ 95% CI [0.41, 1.00]
6	N = 36 U.S. undergraduates 31 women, 5 men M_{age} = 21 years, SD = 2	Pool D (282 stimuli) 25 inward 25 outward	Nonsense words	4.46 (0.16)	4.21 (0.16)		$t(35) = 2.66, p = .012$ $d = 0.26$ 95% CI [0.6, 0.44]

Note. CI = confidence interval.
[a] The individuals in the German samples were from the university or city area of Würzburg. The individuals in the U.S. sample in Experiment 6 were from the University of California, San Diego.

criterion, Experiments 2–3 were highly over-powered. Starting with Experiment 4, we used a much larger stimulus pool that reduced material-specific effects and gained a larger effect size (Cohen's d = 0.35, while being 0.20–0.28 in Experiments 1–3) requiring only N = 30 to replicate. Because the later studies (starting Experiment 5) used this larger stimulus pool as well as more items per subjects, these later studies involve smaller samples than the first studies but were also still *over*-powered.

Participants. Sample characteristics are displayed in Table 1. Experiment 3 addressed a more representative sample with age varying across life span. Experiment 6 addressed an English speaking sample, while the other addressed German speaking individuals. Altogether, Experiments 1–6 featured 593 individuals.

Materials. To demonstrate the robustness of the present manipulation, we used four different pools of stimuli. Generally, stimulus words were created the following way. Groups of consonants from three anatomically clearly distinct articulatory places in German articulation were used, namely, front (labial: B, M, P), middle (alveolar: D, L, N, S, T), and rear (velar–uvular: G, K, R).[1] Then, consonant sequences for inward words were created by sampling one random letter from each consonant group in the sequence front–middle–rear, for instance, M–N–K. Then, a random vowel was inserted after each consonant (without vowel repetition within a word), for instance, MENIKA. Crucially, from these inward words, outward words were created by simply reversing the consonantal sequence and leaving the vowel sequence intact, for instance, MENIKA to KENIMA. From those words, words that featured meaningful syllables were discarded. We used different pools of such words in Experiments 1–6.

Pool A. In Experiments 1 and 2, we used only 10 exemplary inward and 10 outward words. To induce some variation in length, for three words, an additional syllable was added using the most rear consonant R and a random vowel, for instance, BATIKERO. Resulting stimuli were 10 inward words (*Balugor, Batikero, Buleka, Madogu, Menika, Mesukiro, Musagi, Panokare, Patugi, Podakeri*) and 10 outward words (*Ragulob, Rakitebo, Kuleba, Gadomu, Kenima, Rekusimo, Gusami, Rakonape, Gatupi, Rokadepi*).

Pool B. For Experiment 3, we used the same arbitrary stimulus generation procedure as for Pool A, but this time we created shorter words with 2–3 syllables only, namely, 10 inward words (*Bageri, Beleke, Bidaro, Boke, Manega, Manero, Mesogi, Pare,*

[1] Note that in German language, the most frequent articulation of the letter R is the phonemes [R] or [ʁ] (cf. French R), both being articulated as uvular phonemes, that is, in the rear of the mouth—in contrast to the usual English articulation of R [ɹ] as alveolar phonemes in the front of the mouth.

Penaro, Poluge) and 10 different outward words (*Gasepa, Genebe, Gole, Kademo, Kenomi, Ragebi, Rame, Resabo, Ritapo, Rodume*).

Pool C. For Experiment 4 and all remaining experiments (except Experiment 6), we constructed a large stimulus pool involving all possible combinations of consonants. Specifically, the consonant groups we sampled from were front (labial: B, M, P, W), middle (alveolar: D, L, N, S, T), and rear (velar–uvular: G, K, R). From these three groups, all possible inward combinations of consonants (front-middle-rear) were generated, resulting in 60 consonant strings. In these 60 strings, random vowels were inserted after each consonant (without vowel repetition within a word, avoiding words with resulting German meaning), yielding 60 inward words. The matching outward words were generated by reversing the consonantal sequence but leaving the vowel sequence intact, for instance, BATIKU~ KATIBU (see the online supplemental materials for the complete list of these stimuli, left and middle columns).

For Experiment 5, which tested a baseline, we derived words with unsystematic transitions of consonantal articulation places by the following means. For each of the 60 outward words (the same result would have been derived when starting with the inward words), the first and the second consonant, or the second and the third consonant, respectively (alternating from stimulus to stimulus in the list), were simply switched in their places—for instance, from KILOBE (outward) to LIKOBE (unsystematic). The resulting stimuli were thus a mixture of inward and outward transitions (see the online supplemental materials).

Pool D. Experiment 6 replicated the inward–outward effect in an English speaking sample. However, there are differences between German and English in consonantal phonation. For instance, while the letter R is usually a uvular phoneme in German ([R] or [ʁ]; cf. French R) being generated with the back of the tongue pressing against the rear soft palate, it is generally pronounced as an alveolar phoneme in English ([ɹ]) being generated with the front of the tongue. Thus, we modified the stimulus pool C using consonants that have well-demarcated articulation spots in the front, middle, and rear, of the mouth, respectively, for English articulation. Therefore, the consonant groups we sampled from were front (labial: B, F, M, P; i.e., the letter W from the German pool was substituted by F, since in English pronunciation W is pronounced as [/w/], which involves the whole tongue, while F [f] as voiceless labiodental fricative is generated with the lower lip and upper teeth, thus solely in the front), middle (alveolar: D, L, N, S, T), and rear (velar–uvular: K; that is, G and R were dropped since their English pronunciations are not always velar). Every possible consonant combination was realized, and random vowels were inserted in between the consonants (e.g., BILEKO KILEBO). Then, words that contained meaningful syllables in English were discarded. By this procedure, n_i = 125 inward words and n_i = 157 outward words were generated, thus yielding a stimulus pool even larger than Pool C (see the online supplemental materials).

Procedures. In Experiments 1 and 2, the stimulus words were printed in one random order on a paper–pencil questionnaire. The remaining experiments were PC-directed and presented each target word for 2,000 ms with a complete randomization of stimulus sequences. The numbers of presented stimuli per category (inward vs. outward) are displayed in Table 1. When the number of items presented was smaller than the stimulus pool from which the items were sampled (Experiments 4–6), items were randomly sampled from the pool anew for each participant.

In all experiments, participants were instructed to read the target words silently and to spontaneously rate their preference for these words on a scale ranging from 0 (*I do not like it at all*) to 10 (*I like it very much*)—except in Experiment 6 using a scale from 1 to 9—either by marking the scale printed below each word in the paper–pencil questionnaires in Experiments 1–2 or by typing in the respective number using the keyboard in the PC-directed Experiments 3–6. No further particular instruction was given. For instance, it was *not* instructed that participants should focus on certain features of the words (such as their sound). The target words were labeled differently between the Experiments (see Table 1). In Experiments 1, 4, 5, and 6, the words were labeled as nonsense words, and participants were simply asked how much they liked each of these meaningless words. In Experiments 2 (company names) and 3 (politician surnames), the words were labeled as names, and participants were asked how much they liked each name as a name of the given category.

After the ratings, participants provided demographics, namely, gender and age, as well as native language in Experiment 6. The resulting rating tasks took between 2 and 5 min and were administered in the end of several data collection campaigns with larger experimental sessions involving other unrelated tasks (except Experiment 6—there this word rating was the only task in the session).

Debriefings. Experiments 3 and 6 implemented a funneled debriefing after the ratings, in which participants were asked (1) what they had based their preference ratings on; (2) whether they had detected anything conspicuous or suspicious, or systematic features in the target words; and (3) whether they had realized that some of the words featured consonants that during articulation wander from the front to rear of the mouth and vice versa. No participant reported a valid suspicion or affirmed the third question.

Results

Due to programming of the experiment software, in some PC-directed experiments it was possible that participants could mistype their response, that is, erroneously type in numbers exceeding the scales or even letters. These responses were discarded (Experiment 4: 1 out of 1,720—0.06%; Experiment 5: 4 out of 3,600—0.1%). For each experiment, the crucial dependent measure was the averaged preference ratings. The condition means, results of the single comparisons between inward versus outward words, as well as the effect sizes for each experiment are displayed in Table 1. To summarize, inward words were liked more than outward words in each of the experiments. In Experiment 3, using a sample with large variance in age (see Table 1), the correlation between the effect size and age was $r = .007$, *ns*.

Baseline in Experiment 5. Experiment 5 added a baseline condition and had thus a more complex design than the simple inward versus outward comparisons on the other experiments. In Table 1, only the comparison between inward and outward words for this experiment is displayed. A 3 (Consonantal Stricture Spot Transitions: inward, outward, unsystematic; within) analysis of variance (ANOVA) yielded a significant effect, $F(2, 38) = 12.19$, $p < .001$, $\eta_p^2 = .39$. Simple planned comparisons found that inward words ($M = 4.83$, $SE = 0.15$) were liked more than both unsystematic words ($M = 4.42$, $SE = 0.14$), $t(39) = 3.74$, $p = .001$, $d = 0.46$, 95% CI [0.19, 0.63], and outward words ($M = 4.12$, $SE = 0.17$), $t(39) = 4.88$, $p < .001$, $d = 0.69$, 95% CI [0.41, 1.00]. Furthermore, unsystematic words were liked more than outward words, $t(39) = 2.49$, $p = .017$, $d = 0.31$, 95% CI [0.06, 0.54].

Meta-analysis of Experiments 1–6. The designs and dependent measures of these experiments were similar enough to be combined in a joint analysis (R. Rosenthal, 1978). We inserted all data into a joint ANOVA using study as between factor (*blocking*; R. Rosenthal, 1978). This 2 (Consonantal Stricture Spot Transitions: inward, outward; within) × 6 (Experiment; between) ANOVA yielded a main effect of consonantal direction, $F(1, 587) = 80.32$, $p < .001$, $\eta_p^2 = .12$; a main effect of experiment, $F(1, 587) = 80.32$, $p < .001$, $\eta_p^2 = .17$; and a marginal interaction, $F(5, 587) = 1.94$, $p = .086$, $\eta_p^2 = .02$. Across all experiments, inward words ($M = 5.12$, $SE = 0.05$) were preferred over outward words ($M = 4.77$, $SE = 0.05$), $t(592) = 9.62$, $p < .001$, $d = 0.27$, 95% CI [0.27, 0.42]. The interaction was constituted by the fact that Experiment 5 showed a stronger inward–outward effect than the other experiments, as is also evidenced by its effect size being more than twice as large (see Table 1). This is probably due to the large item number used in that experiment (also see Table 1).

Discussion

Across six experiments involving 593 participants, two native languages, different stimulus sets and varying labels of the target words, we found the predicted impact of consonantal articulation wanderings on spontaneous attitudes. Although featuring the same consonants and the same vowel sequence, words were preferred when their consonantal articulation spots wandered from the lips inward to the throat compared to when they wandered from the throat outward to the lips. Presumably, this occurred because the action associated with inward words simulates a deglutition movement associated with incorporation and approach, while the action associated with outward words simulates an expectoration movement associated with avoidance. The affective response stemming from this oral simulation of approach and avoidance was obviously used for the current preference judgments.

This effect occurred both when the denoted object was food-related (e.g., Experiment 2) and when it was nonsense or inedible (e.g., Experiment 1 framing the targets as simple nonsense words). Importantly, it also generalized to person perception (i.e., person names in Experiment 3). Experiment 5 showed that a baseline condition with words that featured a mixture of inward and outward transitions fell between inward and outward words, which suggests that systematic inward transitions induce positive affect, and outward words induce negative affect compared to usual articulation. The next experiment should generalize this effect to a more socially relevant behavioral consequence.

Experiment 7

The present effect of consonantal articulation dynamics should be generalized to a behavioral measure that demonstrates more ecologically valid consequences in everyday life. Thus, we examined possible name effects in a choice of interaction partners in an ostensible online chat forum.

Method

Participants. $N = 99$ students of various disciplines of the University of Würzburg in Germany (57 women, 42 men; mean age = 23 years, $SD = 5$) took part for candy reward.

Materials and procedure. The large stimulus Pool C was used. Participants were informed that the experiment investigates chatting behavior and they should first choose possible chatting partners from a larger pool of users that are currently online. In each of the following 30 trials, two usernames were presented (right and left on the PC screen), of which one was always an inward word and one was always an outward word (with the presentation sides of inward and outward words randomized). Participants indicated their preferred choice of the right or left name by pressing the respective right or left response key. After these choices, participants were informed that due to a technical error the actual chatting forum could not be started and were thanked and compensated.

Results and Discussion

The crucial dependent measure was simply the likelihood with which participants chose the inward word name as interaction partner. This likelihood was 52.31% ($SE = 0.009$), which was reliably above the chance likelihood of 50%, $t(98) = 2.49$, $p = .015$, $d = 0.25$, 95% CI [0.005, 0.042]. Although this effect is small numerically (2%), its effect size is in the range of the previous experiments and demonstrates a behavioral consequence of consonantal articulation direction in a social interaction choice. The goal of the next experiment was to test for matching effects of the articulatory movement with the meaning of the denoted objects.

Experiment 8

So far we have emphasized that evaluation of an arbitrary, novel name can be influenced by the mere direction of articulatory movement. Note, however, that these studies were context-free. That is, the words were always labeled as being nonsense, neutral, or mildly positive. So what about clearly positive and negative objects? One possibility is that articulatory induced oral kinematics would induce context-free affect, and that irrespective of the valence of the denoted object inward words would be preferred over outward words. Another possibility would be a matching between the object's and the oral movements' meanings. Specifically, actions related to approach–avoidance motivations interact with, and can flexibly match, the current attitude object (Higgins, 1997). Thus, the valence from the action-object match can overrule the valence from the direction itself (Centerbar & Clore, 2006; Cretenet & Dru, 2004; Neumann et al., 2003). This account would predict a preference for inward over outward words for positive, but a preference for outward over inward words for negative stimuli. Finally, a simple cognitive tuning account might also be applied (Schwarz, 2002). Given that also brief stimuli can induce affective valence (Topolinski & Deutsch, 2012, 2013; Topolinski & Reber, 2010), the condition with the target words being labeled as negative attitude objects might induce a negative mood reducing heuristic processing and thus preventing articulatory effects, because participants control for such heuristic influences (for further discussions on such phasic dynamics, see Topolinski & Strack, 2009b).

The present study should test these possible predictions by implementing inward and outward words with their denoted objects being of positive and negative valence. Thus, we labeled the words as names for heroes and villains in an ostensible online strategy game.

Method

Participants. $N = 100$ students of various disciplines of the University of Würzburg in Germany (50 women, 50 men; mean age = 22 years, $SD = 4$) took part for candy reward.

Materials and procedure. The large stimulus Pool C was used. Participants were informed that for an implementation of a computer strategy game in future research investigating strategic behavior and collaboration we were interested in proper names of the acting characters. Half of the participants were asked to rate the words as possible names for positive characters doing good things (heroes), and the other half as possible names for negative characters doing evil things (villains), $n = 50$ each. Each participant received 30 inward and 30 outward names presented for 1,000 ms, each randomly sampled from the larger stimulus pool in random order. The scale again ranged from 0 (*I do not like it at all as a name for a hero/villain*) to 10 (*I like it very much as a name for a hero/villain*).

Results and Discussion

Mistyped responses (exceeding the scale or involving letters) were discarded (8 of 6,000—0.1%). A 2 (Consonantal Stricture Direction: inward, outward; within) × 2 (Semantic Label: hero, villain; between) ANOVA found only a main effect of consonantal stricture direction, $F(1, 98) = 6.94$, $p = .010$, $\eta_p^2 = .07$ (other Fs < 1). Inward words were marginally preferred over outward words in the group that rated ostensible names of heroes ($M_{\text{inward}} = 4.64$, $SE = 0.14$ vs. $M_{\text{outward}} = 4.48$, $SE = 0.15$), $t(49) = 1.73$, $p = .09$, $d = 0.16$, 95% CI [−0.03, 0.36], and were reliably preferred in the group that rated ostensible names of villains ($M_{\text{inward}} = 4.57$, $SE = 0.21$ vs. $M_{\text{outward}} = 4.43$, $SE = 0.20$), $t(49) = 2.15$, $p = .036$, $d = 0.10$, 95% CI [0.01, 0.27].

Inward words elicited more positive attitudes than outward words for both positive and negative social targets, which suggests that the affect triggered by articulation dynamics is used in a context-independent manner to guide the spontaneous target judgments. It is possible that the current induction of object-valence was rather mild, but the conditional means do not even show a trend of modulation. This evidence also shows the robustness of the present articulation effect, because it occurs even in the presence of independent information about the stimulus valence, especially negative valence ("this is a villain"), which tends to reduce heuristic influences (Schwarz, 2002).

Experiment 9

In this final experiment, we sought to demonstrate a strict boundary condition of the present articulatory effect investigating its most basic underlying process. As argued above, the core psychological mechanism required for consonantal articulation manipulations to influence attitudes are automatic pronunciation simulations during reading (cf. Topolinski & Strack, 2009c). Without these underlying subvocalizations, the motor system does not covertly represent the consonantal stricture spots in the first place, and thus the current inward-outward wanderings of those spots are not simulated neither. Thus, we predicted that the current effect is absent for aphasia patients, for whom the crucial language-related brain areas that translate the sight of a letter into subvocalizations are impaired—and consequently pronunciation simulations are distorted or absent (e.g., Goodglass, Kaplan, Weintraub, & Ackerman, 1976; Jacquemot, Dupoux, & Bachoud-Levi, 2011). Thus, these patients see the target words, but they do not simulate their pronunciation (for subvocalizations in complete anarthria, also see Cubelli & Nichelli, 1992).

In recent experimental research, the performance of aphasia patients has been used in a similar manner of demonstrating boundary conditions of established verbal effects, such as semantic priming, implicit memory, or verbal short-term memory (e.g., Curran, Schacter, & Galluccio, 1999; Jacquemot et al., 2011; Knott, Patterson, & Hodges, 2000). Accordingly, we predicted a sharply reduced or even absent articulation effect in an aphasia patient sample. In addition, we implemented a nonverbal control task (mere exposure for visual stimuli) that should not be impaired.

Method

Participants. $N = 33$ (12 women, 21 men; $M_{\text{age}} = 61$ years, $SD = 10$, range = 35–71) clients of an aphasia outpatient department in Bavaria (*Aphasikerzentrum Würzburg*, Würzburg, Germany) took part in reward for small gifts (candy, chocolate). All participants were long-term patients diagnosed with aphasia according to their clinical records.

Materials and procedure. Due to logistic constraints and patients' abilities, we implemented the brief, 20-item paper–pencil questionnaire used in Experiment 1 with the following modifications. To render the preference report easier and more illustrative for the patients, we modified the answer scale into a 6-point bipolar scale using smileys and frowneys to indicate the positive and negative poles of the scale, respectively. We extended the questionnaire by a nonverbal control task, a visual mere exposure procedure (Topolinski & Strack, 2009c). On the first pages of the questionnaire, five Chinese ideographs were depicted, and patients were asked to report their preference for these ideographs. Then, also serving as a study-test filler for the visual mere exposure paradigm, the 10 inward and 10 outward words followed in one random order similar for all patients. Then, in one random order similar for all patients, the five ideographs from the study phase randomly mixed in sequence with five novel ideographs were depicted (similar to Topolinski & Strack, 2009c). For all images and words, participants were asked to report their preference, either by marking the respective scale unit with a pencil or by pointing to the unit (and then the experimenter marked the unit). In addition, participants reported their age, gender, mood, and arousal on the questionnaire.

Results and Discussion

A 2 (Effect: articulation effect, visual mere exposure; within) × 2 (Manipulation: inward words/old ideographs, outward words/

new ideographs; within) ANOVA on the *z*-standardized preference ratings found a main effect of the manipulation, $F(1, 32) = 11.41$, $p = .002$, $\eta_p^2 = .26$, and an interaction between effect and manipulation, $F(1, 32) = 5.14$, $p = .03$, $\eta_p^2 = .14$. While the patients preferred repeated ($M = 3.98$, $SE = 0.20$) over novel ideographs ($M = 3.57$, $SE = 0.23$), $t(32) = 3.49$, $p = .001$, they showed no preference difference for inward ($M = 4.08$, $SE = 0.20$) compared to outward words ($M = 4.03$, $SE = 0.18$), $t = 0.43$, $p = .67$.

Likely due to absent subvocalizations (Cubelli & Nichelli, 1992; Jacquemot et al., 2011; Knott et al., 2000), this clinical patient sample did not show the articulatory effect, while it still showed implicit memory effects in a visual domain. We acknowledge that the power of the present patient sample was only 0.73 to detect the articulation effect (given the effect size d_z of 0.40 we found for this paper–pencil questionnaire on a large sample in Experiment 1). However, given the numerical descriptives, ratings for inward and outward words differed only in the second decimal place, which suggests that the effect would also not occur in larger samples. Nevertheless, the current neurophysiological evidence should be interpreted with caution.

General Discussion

Our research combined two functions of the oral muscle system. The evolutionarily oldest function –ingestion (involving the two basic approach avoidance responses of deglutition and expectoration) and the phylogenetically more recent function—human language. This was done to induce oral approach and avoidance responses via articulatory means. What made this possible was an exploitation of the simple biomechanical fact that the same muscular effectors are used by both ingestion and language. We found that words featuring consonant sequences requiring muscle strictures wandering from the front of the mouth (the lips) to the rear (the rear tongue)—thus resembling muscle dynamics as during deglutition—were preferred over words with a rear-front consonantal stricture dynamic—resembling muscle dynamics as in expectoration (Goyal & Mashimo, 2006; Ladefoged, 2001; Titze, 2008). This effect was found when the words had no meaning (e.g., Experiments 1 and 4), but also when they referred to person names (Experiments 2, 7, and 8) or ostensible brands (Experiment 2), and occurred even when participants read the words silently (all experiments) and for negative targets (Experiment 8).

Regarding the underlying mechanisms of this phenomenon, we argue that during (silent) reading the pronunciation of the words is covertly simulated (Topolinski & Strack, 2009c), resulting in inward and outward wandering of consonantal stricture spots. Demonstrating that covert simulations are a causal pre-requisite for this effect to occur, we found no such effect in a clinical patient sample of aphasia patients who lack such subvocalizations (Experiment 9). Furthermore, we argue that these oral wanderings (resembling oral deglutition and expectoration dynamics) activated the according motivational states of approach and avoidance (Chen & Bargh, 1999). The concomitant affective responses linked to these motivational states were then used as judgmental cues for preference ratings of otherwise neutral and meaningless target words. However, this last link remains a speculation (see the next section). We found these effects in German and English speaking samples, which suggests a universal mechanism independent of native language.

This novel articulatory effect has a variety of theoretical and practical implications (for further reaching implication, see the next sections). As immediate applied consequences, marketing and advertising might exploit this effect in branding, the pharmaceutical industry might consider it in designing names for generica, parents might consider it in name-giving of their children, and Internet users might consider it when choosing their usernames (see the social consequences in Experiment 7). In the following, we sketch out some theoretical implications and future research avenues after addressing alternative explanations.

Alternative Explanations and Limitations

In our present hypothesizing, we argue that articulatory inward and outward wanderings of consonantal stricture spots trigger positive and negative affect due to their biomechanical resemblance with oral deglution and expectoration (Goyal & Mashimo, 2006; Ladefoged, 2001), which is intuitively appealing and bolstered by the present evidence. However, we do not directly demonstrate this link, though note that earlier work on push-pull movements and approach–avoidance orientations also did not directly demonstrate this match but derived this hypothesis from ecological reasoning (Higgins, 1997). Therefore, it is possible that positive and negative affect are triggered by articulation dynamics by other than consumption-related motivational means.

One possibility is that inward compared to outward articulation dynamics are more common in everyday life, since we much more often swallow than spit, for instance. Thus, inward wanderings feel more familiar than outward wanderings and may thereby trigger positive affect. However, it has to be noted that normal articulation of verbal language entails a bulk of ever changing inward and outward wanderings, so the mouth is used to generate both outward and inward wanderings. Given that humans swallow around 600 times (Lear, Flanagan, & Moorrees, 1965) but utter 16,000 words per day (Mehl, Vazire, Ramírez-Esparza, Slatcher, & Pennebaker, 2007), verbal utterance with its necessary inward *and* outward wanderings is much more common than swallowing, which renders it unlikely that inward wanderings are more trained than outward wanderings.

Another possibility is that the basic muscle mechanics of inward and outward wanderings differ in their complexity or required neuromuscular orchestration and thereby trigger affect. Since an objective measure of neurophysiological complexity is pending (Goyal & Mashimo, 2006), we cannot rebut this possibility. However, the available data from some of the present PC directed experiments provide response times of the ratings participants rendered. If inward words are simply processed easier than outward words, this might speed up response times of the eventual ratings. However, we did not find a reliable difference in response times for inward versus outward words in any of the data sets (all *p*s $> .2$). However, also note that this is a very coarse test of processing fluency, because reading fluency is only one of many factors that influence these response times (for more precise fluency measures in reading, see Topolinski & Strack, 2009a, 2009d). Future research might directly investigate this by assessing overt pronunciation latencies. However, we deem the current interpretation as the most parsimonious one.

Finally, the present research used artificially designed words that entailed clear systematic inward and outward wanderings.

These wanderings are less common in natural language. To generalize the present account, future research should address natural words and the basic occurrence of inward and outward wanderings in natural language.

Onomatokinesia—When the Articulation Movement Influences the Meaning

In this section, we offer some further, more general speculations that might stimulate future research. Already in the earliest accounts of modern psychology, the oral domain featured important psychological functions transcending the basic functions of ingestion and language. In Freud's (1905/1962) well-known notion of the *oral phase*, the early hedonic experiences in oral haptics and ingestion were conceived as being determining later personality structure. Emphasizing the epistemic function of oral exploration, Piaget (1929) proposed that in the earliest phase of his model of developmental stages of the mind, the most important reflex of the newborn is to put everything into the mouth to explore it with oral haptics (cf. Steiner, 1973; Topolinski & Türk Pereira, 2012). Later, Rozin (1996, 1999) emphasized the generative evolutionary role of what he called the "food system" in grounding different emotions and even higher cognition.

Going beyond this, the current research connects articulatory dynamics to the notion of *embodiment* (e.g., Barsalou, 1999; Meier, Schnall, Schwarz, & Bargh, 2012; Niedenthal et al., 2009; T. Schubert & Semin, 2009) in showing that affectively neutral articulatory motor kinematics themselves, independent from their motor fluency or the sounds they would generate in overt articulation, can bear embodied metaphors (Landau, Meier, & Keefer, 2010). In the present case, these oral kinematics featured metaphors for deglutition and approach versus expectoration and avoidance. For this completely novel phenomenon, inspired by the classic Ancient Greek notion of onomatopoeia (the sound makes the name or meaning) we introduce the notion of *onomatokinesia*, that is, the articulation movement makes the meaning.

For future research, various further instances of onomatokinesia are viable, with the common idea that some feature of articulatory motor dynamics of a word's phonation bear metaphorical resemblance to some feature of the object the word denotes. Starting with the current kinematics, consonantal inward-outward wandering might not only signify deglutition and expectoration, but also extraversion and introversion of target persons, loudness of objects, or even moving forward or backward in time (cf. Miles, Karpinska, Lumsden, & Macrae, 2010). Furthermore, specific phoneme kinematics resemble certain oral behaviors, which might increase preferences when articulation kinematics and denoted oral behavior match. For instance, the uvular phonation of R ([R] or [ʁ]) is the same kinematic as during gargling (for instance, with mouthwash). Thus, brand names for mouthwash should be preferred when containing uvular consonants. Furthermore, phonation of alveolar consonants, such as [n], [t], [d], or [l], generally involves lifting the tip of the tongue to press it against the palate. This movement closely resembles the oral ingestion behavior of licking (for instance, in consuming ice cream). Thus, brand names for ice cream should be preferred when they contain such tongue-lifting consonants (Topolinski, Rohr, Schneider, Boecker, & Winkielman, 2014). In the final part, we consider the current inward-outward effect as a possible measure of approach–avoidance.

Oral Approach–Avoidance: Cross-Modal Compatibility Effects and a New Implicit Measure?

We argue that the basic motoric dynamic that drives the present effects are the inward and outward wandering of consonantal stricture spots, which is evidenced by the biomechanical means of articulating the specific consonants we implemented in the target words. In future research, it should be explored whether these oral muscle dynamics of inward and outward might show compatibility effects with push–pull movements of the arm (e.g., Chen & Bargh, 1999; Eder & Klauer, 2009; Eder & Rothermund, 2008; Van Dantzig, Zeelenberg, & Pecher, 2009). Specifically, oral inward (sagittally from front to rear, in direction to the body) should be compatible with pull movements of the arms (moving the arm toward the own body), while oral outward (from rear to front, away from the body) should be compatible with push movements (moving the arm away from the body). This would state the novel case of cross-modal compatibility matching.

Furthermore, beyond this motor-to-affect link (cf. Centerbar & Clore, 2006; Chen & Bargh, 1999), the reversed causal link, affect-to-motor, is also plausible (Neumann et al., 2003; as is true for manual tasks; Eder & Rothermund, 2008). This could be achieved by simply measuring pronunciation speed of inward and outward words (e.g., in semantic priming, cf. Barch et al., 1996). We speculate that inward words would be pronounced faster in response to positive compared to negative stimuli, and vice versa for outward words, because stimulus valence would activate according motivational approach–avoidance states and respective oral deglutition and expectoration motor programs.

Furthermore, it is plausible that even tonic motivational states might be induced via articulatory dynamics. Just as tonic approach–avoidance states have been induced via arm movements, reading a list of inward versus outward words might induce longer lasting motivational states and may affect more indirect dependent measures, such as creativity (e.g., Friedman & Förster, 2000). This also might be investigated in future research.

To conclude, the present study has shown that words with consonant sequences that resemble muscle dynamics as during deglutition were preferred over words with consonant sequences that resemble muscle dynamics as during expectoration. Simulation of saying the word might activate such oral muscle patterns, which induces motivational states of approach and avoidance.

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Received July 23, 2013
Revision received February 24, 2014
Accepted February 25, 2014 ■