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Matching between oral inward–outward movements of object names and oral movements associated with denoted objects

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ABSTRACT
In eight experiments, we explored matching effects between oral approach–avoidance movements triggered by word articulation and meaning of the objects the words denoted. Participants (total $N = 1264$) rated their liking for words that featured consonantal muscle stricture spots either wandering inwards (e.g., BODIKA, resembling ingestion movements) or outwards (e.g., KODIBA, resembling expectoration movements). These words were labelled as names for various objects. For objects the use of which entails ingestive oral actions (lemonade and mouthwash) inward words were preferred over outward words. For objects that trigger expectorative oral actions (toxical chemical, pill, and bubble gum) this preference was attenuated or even reversed (outward words were liked more than inward). Valence of the denoted object did not play a role in these modulations. Thus, the sagittal direction of mouth movements during silent reading meaningfully interacted with direction of oral actions associated with the denoted objects.

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Basic motivational states of approach and avoidance (Higgins, 1997; Russell, 2003; Strack & Deutsch, 2004) can be induced by bodily means when executing body movements that are motivationally linked to approach and avoidance (Chen & Bargh, 1999; Neumann, Förster, & Strack, 2003; Strack, Martin, & Stepper, 1988). For instance, executing arm flexion (ecologically linked to approach) compared to arm extension (ecologically linked to avoidance) while watching affectively neutral stimuli induces positive attitudes towards these stimuli (Cacioppo, Priester, & Berntson, 1993; Centerbar & Clore, 2006; for a bi-directional link, see also Chen & Bargh, 1999; Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010; Rotteveel & Phaf, 2004; but see, for strategic and verbal mechanisms, Eder & Klauer, 2009; Eder & Rothermund, 2008; Markman & Brendl, 2005; Lavender & Hommel, 2007; Seibt, Neumann, Nussinson, & Strack, 2008; van Dantzig, Zeelenberg, & Pecher, 2009). Most recently, a novel way of inducing such approach–avoidance states bodily was introduced, namely by means of oral motor kinematics (Topolinski, Maschmann, Pecher, & Winkielman, 2014). This approach exploited the simple biomechanical fact that the mouth serves two completely independent functions, namely ingestion and articulation (Rozin, 1999), and certain motor patterns are quite similar across these two functions.

The oral function of ingestion serves two basic responses, namely the intake of edible foods and liquids via deglutition and the ejection of inedible or even harmful substances via expectoration (Hejnol & Martindale, 2008; Rosenthal, 1999; Rozin, 1996). On a muscular level, deglutition such as during drinking a liquid involves a sequence of muscle contractions starting in the front of the mouth, the lips, wandering across the sagittal lane of the tongue to the throat, like an *inward peristalsis* (Goyal & Mashimo, 2006). In contrast, expectoration such as during spitting involves a reversed sequence of muscle strictures wandering from the rear of the mouth to the front, like an *outward peristalsis* (Goyal & Mashimo, 2006). Since deglutition of edible substances is a positive approach and expectoration of harmful substances is a negative avoidance response, oral inward wandering of muscle

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strictures are likely to be linked to approach motivation, and oral outward wanderings to avoidance motivation.

As a second function, the oral muscle system serves language production, by means of *articulation* (Rozin, 1999; Steklis & Harnad, 1976). Across all languages, articulation is realised by obstructing the airflow from the lungs outside the mouth. This obstruction is done by exerting strong and well-localised muscle strictures of the tongue and the lips at certain spots in the mouth (Inoue, Ono, Honda, & Kurabayashid, 2007; Ladefoged, 2001; Titze, 2008). For instance, the consonant B is produced by pressing the lips together, or the consonant K is produced by pressing the rear back of the tongue at the rear soft palate. This well-localised exertion of stricture spots is particularly strong for consonants, while the articulation of vowels entails only a coarse modulation of the airflow and involves larger motor systems, namely also the jaws and the whole facial musculature.

Crucially, the spots on which consonantal strictures are exerted are well specified for each consonant and vary across the sagittal plane of the mouth, that is, from the front to the rear. To give some illustrations, while the labial P is produced with the lips, the alveolar D is produced with the front tip of the tongue, and the uvular K is produced with the rear back of the tongue (International Phonetic Association, 1999). By arranging consonants in a systematic way on this sagittal dimension, words can be construed that feature systematic inward wanderings of consonantal stricture spots, as in BODEKA, and systematic outward wanderings, such as in KODEBA. Biomechanically, these consonantal inward and outward wanderings resemble the inward and outward peristalses executed during ingestion and expectoration (Goyal & Mashimo, 2006). Since the latter are highly motivationally charged, it is plausible to assume that inward/outward wanderings of consonantal stricture spots activate ingestion/expectoration-like muscle movements that can activate approach/avoidance states.

This was tested by Topolinski et al. (2014) using nonsense words that featured either an inward wandering of consonantal stricture spots (e.g., MENIKA) or an outward wandering (e.g., KENIMA). Participants were asked to read the words and indicate their preference for them. In eight experiments, participants reported higher liking for inward than for outward words, replicable across different stimulus pools and two languages (German and English). As the authors argued, this occurred because the articulatory induction of inward kinematics triggered ingestion-related positive states of approach, while outward kinematics triggered expectoration-related negative states of avoidance. Interestingly, this effect occurred even under silent reading, presumably because articulation kinematics are covertly simulated during reading, and no overt vocalisation is necessary (see also Stroop, 1935; Topolinski & Strack, 2009; see, for the basic concept of sensorimotor simulation, Barsalou, 1999; Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009; Schubert & Semin, 2009; Semin & Smith, 2008). These subvocal simulations of articulation movements seem to be the causally responsible mechanism, which is suggested by the finding that the in–out effect is absent for aphasia patients lacking subvocalisations (Topolinski et al., 2014, Experiment 9; see also Topolinski & Bakhtiari, submitted for publication).

Matching with features of the denoted object

One obvious question is how this articulatory approach–avoidance effect interacts with certain features of the denoted object. The two most relevant criteria in this vein are the valence of the object (positive and negative), and the possible (oral) action tendencies these objects involve.

Matching with object valence. Previous research has shown that actions related to approach–avoidance motivations can interact with the valence of the current attitude object (Higgins, 1997). Critically, the valence from the action-object match can modulate the basic main effect of the approach–avoidance movement itself, as was shown in research targeting the affect-motor direction, that is, the modulation of movement efficiency by object valence (Centerbar, Schnall, Clore, & Garvin, 2008; Cretenet & Dru, 2004, 2008; Dru & Cretenet, 2008; Eder & Klauer, 2007; Milhau, Brouillet, Heurley, & Brouillet, 2012). For instance, Centerbar and Clore (2006) found that both arm flexion and extension movements can induce positive attitudes when they matched the initial a priori valence of a stimulus (see also Cretenet & Dru, 2004, 2008; Dru & Cretenet, 2008). Thus, avoidance movements and negative stimuli can also elicit positive affect, namely if they match, which is also in line with the more recent theoretical model of *Affective Monitoring* (Phaf & Rotteveel, 2012). Also, recent meta-analyses cast further doubt on the main effect of approach–avoidance movements (approach elicits positive and avoidance elicits negative effect under all conditions) on affect in questioning the assumption that the link between approach and positive affect is really automatic: rather, it seems to be mediated by intentions to actually interact with the attitude object (Laham, Kashima, Dix, & Wheeler, 2015; Phaf, Mohr, Rotteveel, & Wicherts, 2014).

Applied to the current phenomenon, the articulatory in–out effect might show matching effects with the valence of the denoted object. Specifically, it is possible that for negative objects outward words are preferred over inward words because negative objects elicit aversive states which match outward oral motor kinematics. This was already initially tested in Topolinski et al. (2014, Experiment 8) by presenting inward and outward words to participants and labelling these words as names of heroes (positive) and villains (negative) in an ostensible computer game. This induction, however, had no modulating impact on the in–out effect, with inward words being preferred over outward words for both positive and negative person targets. Moreover, Topolinski, Zürn, and Schneider (2015) examined the in–out effect on consumer attitudes when labelling these words as brand names for various products. They used the same stimuli and design as Topolinski et al. (2014). Among these products was also pest control, which is a rather negatively associated product. Still, the authors found higher preference for inward over outward words when these were labelled as brand names for pest control.

Still, it could be possible that these previous inductions—the valence of abstract persons or ingestion-unrelated products—were not strong enough to modulate the basic in–out effect. Finally, their actual valence may vary depending on context and goals (e.g., a winsome villain in a movie, a useful pest control). Thus, stronger valences and more direct links to organismic ingestion functions might yield an impact on the in–out effect, which was tested in Experiments 1 and 2.

Matching with oral affordances and ingestion intentions. Beyond valence, the automatic action tendencies evoked by an object, called *affordances* (Gibson, 1977), can show matching effects with concurrent body movements (e.g., Leder, Bär, & Topolinski, 2012; Phaf & Rotteveel, 2012). In the domain of hand movements, for instance, positive affect is elicited when current hand movements match the grip affordances by an object that is simultaneously presented (Cannon, Hayes, & Tipper, 2010). To name another example, Sparenberg, Topolinski, Springer, and Prinz (2012) identified such motor matching effect as the underlying mechanism for mimicry. Note that such matching effects are independent from object valence and can also be found for completely neutral objects and stimuli (e.g., Dreisbach & Fischer, 2012; Fazendeiro, Chenier, & Winkielman, 2007; Phaf & Rotteveel, 2009). Moreover, apart from automatically elicited affordances, temporarily activated implementation intentions can also modulate approach–avoidance behaviour (cf, Eder, 2011; Eder, Müsseler, & Hommel, 2012). Applied to the present articulatory in–out effect, it is thus possible that the oral affordances associated with an object (to-be-swallowed, to-be-spat out), and the activated oral implementations intentions, independent from valence, might show matching effects with the consonantal direction of inward and outward words, which was tested in Experiments 3–6.

Power analysis for required sample sizes, stopping rule, and data treatment

Using *G*Power* (Faul, Erdfelder, Lang, & Buchner, 2007) and conservatively assuming a small effect size of the present 2 × 2 interaction, that is, $\eta_p^2 = .02$ (Cohen, 1988), resulting $f = 0.14$, the required sample size to detect this interaction with a power of 0.80 was $N_{required} = 100$. This sample size was met for all but Experiment 5 (due to logistic reasons). For all experiments, analyses were run only after the full final sample size had been collected. We report all data exclusions (if any), all manipulations, and all measures in the studies.

Experiments 1a–1c

These experiments explored possible matching effects between inward und outward articulation and features of the denoted objects. We chose lemonades (ingestion related) and toxical chemicals (expectoration related) as object labels. Two onsite laboratory studies involving German-speaking samples (Experiments 1a and 1b) and a follow-up online replication involving English-speaking samples (Experiment 1c) were conducted. In all experiments, participants received inward and outward words and silently read and evaluated them. Object was was manipulated in a between-subjects fashion. Because the experiments were very similar in design and materials, we report them jointly.

Method

Participants. In Experiment 1a, $N = 173$ (94 female, 79 male, mean age 24, SD = 4), and in Experiment 1b, $N = 213$ (104 female, 109 male, mean age 24, SD = 5) German-speaking on-site volunteers from various professional backgrounds participated for €7 reward (for a larger experimental battery including other tasks). They were all from the city area of Würzburg (Southern Germany) and were recruited via a local mini-job online market. In Experiment 1c, $N = 194$ US English-speaking online participants were recruited through Amazon's Mechanical Turk website (102 female, 92 male, mean age 36, SD = 12) participated for a reward of $0.25.

Materials. We used the stimuli already provided in Topolinski et al. (2014). These stimuli had been constructed in the following way. Three groups of consonants with well-specified front, middle, and rear oral locations in the respective German and English articulation were used. These consonants slightly varied between the German and English stimulus pool, because there are differences in the articulation spots between these languages. For instances, while R and G are always velars/uvulars (i.e., rear consonants) in German articulation, their articulation spots vary in English depending on surrounding vowels (e.g., G in GEORGE vs. GARGLE). For each stimulus sampling, it was made sure that the respective consonants had unambiguous location spots in the respective languages. The resulting consonants were front (labial: German B, M, P, W, V; English B, F, M, P), middle (alveolar: German D, L, N, S, T; English: D, L, N, S, T), and rear (velar-uvular: German G, K, R; English: K). From these three groups, all possible inward combinations of consonants (front–middle–rear) were generated, for instance, B–D–K. Then, random vowels were inserted after each consonant, yielding inward words, for instance, BODEKA. Outward words were generated by simply reversing the consonant sequence in the inward words, thus from BODEKA to KODEBA. Resulting words that featured meaningful syllables in the respective languages (e.g., BUSAKE, featuring BUS and USA) were eliminated.

In Experiment 1a, 18 inward words (*Bageri*, *Mesogi*, *Boke*, *Poluge*, *Manega*, *Pare*, *Beleke*, *Bidaro*, *Manero*, *Penaro*, *Baseru*, *Menaki*, *Pagari*, *Wenaro*, *Banegu*, *Podari*, *Maneso*, and *Bolagi*) and 18 outward words (*Ragebi*, *Kenomi*, *Gole*, *Rodume*, *Gasepa*, *Rame*, *Genebe*, *Ritapo*, *Kademo*, *Resabo*, *Ramebu*, *Kesawi*, *Ganadi*, *Relabo*, *Namebu*, *Konabi*, *Rasemo*, and *Gonabi*) were taken from the small stimulus pool designed for German articulation in Topolinski et al. (2014, Experiments 1 and 2). In Experiment 1b, the large stimulus pool for German articulation provided in Topolinski et al. (2014, Experiments 4–9) featuring 60 inward and 60 outward words was used. In Experiment 1c, a large stimulus pool designed for English articulation from Topolinski et al. (2014, Experiment 6) was used featuring 125 inward and 125 outward words. The stimuli can be found in the supplemental material of Topolinski et al. (2014).

Note on vowels. The present manipulation entailed only consonantal and not vowel articulation spots. This was done because muscle strictures during vowel articulation are not well localised but rather engage the whole mouth and face (Ladefoged, 2001, 2006). For instance, there are so-called front (e.g., E) and back (e.g., O) vowels. This distinction, however, pertains only to the movement of the tongue neglecting other oral actions. For instance, the phoneme /u/ like in LOOP is a back vowel because the rear back of the tongue is moved to the rear, however, its phonation also requires strong lip pursing (try to articulate /u/ with your mouth wide opened), a substantial motor action in the front of the mouth. Concluding, vowels can hardly be assigned to exclusive location spots unequivocally.

Procedure. In all experiments, participants were asked to read the presented words silently and then evaluate them spontaneously. Crucially, a random half of them was informed that these were candidates for brand names for lemonades (Experiments 1a–1c: $n = 85$, $n = 71$, $n = 93$) while the other half was told that these were brand names for toxic chemicals (Experiments 1a–1c: $n = 88$, $n = 142$, $n = 101$; see data exclusions in the Results section),[1] with participants randomly assigned to this between-subjects factor. Before the task started, a picture of a lemonade jug, or a bottle with a skull-and-crossbones tag was presented to prime the respective object vividly. Then, in the test block, the words were presented in random order re-randomised anew for each participant with a presentation time of 1000 ms each (Experiments 1a and 1b) or being presented until the

[1]Because particularly the in-out effect for chemicals was interesting and a possibly absent effect in this condition should not be due to lacking power, we arbitrarily collected double as many participants for the chemical than for the lemonade group in Experiment 1b.

participant had rendered their ratings (Experiment 1c). After each presentation of a word, participants should type in a number from 0 (*I do not like it at all as a brand name for lemonades/chemicals*) to 10 (*I like it very much as a brand name for lemonades/chemicals*) in Experiments 1a and 1b, or should click on a respective button on this same scale (Experiment 1c). In Experiment 1a, participants received 18 inward and 18 outward trials; in Experiment 1b, participants received 20 inward and 20 outward trials randomly sampling from the larger stimulus pool; and in Experiment 1c, participants received 20 inward and 20 outward trials randomly sampling from the large pool.

After these ratings, participants reported demographics. In Experiment 1c, participants were also asked for which product they had been rating the names (to check if they had taken the task seriously) and if they had participated in a similar experiment before. The tasks took less than 5 minutes. Experiments 1a and 1b were implemented as part of larger batteries of conceptually unrelated tasks (creativity measures, evaluating neutral geometric figures). Experiment 1c was an online experiment solely featuring this task.

Debriefing. In Experiment 1a, we conducted a funnelled debriefing after the task. Participants were asked (1) what they had based their preference ratings on, (2) whether they had detected any systematic features in the target words, and (3) whether they had realised that some of the words featured consonants that during articulation wander from the front to the rear of the mouth and vice versa. No participant reported a suspicion or comment that indicated awareness of the present articulation manipulation.

Results

Because Experiments 1a–1c are very similar in their design, we first collapsed over experiments. Because participants typed in their responses in Experiments 1a and 1b, they sometimes mistyped responses, being either letters, signs, or numbers exceeding the provided scale. These responses were discarded (<1%). In Experiment 1c, 41 of the 235 participants who started the experiment were discarded because they did not answer all questions, did not report correctly for which product they had rated names, or indicated they had participated in a similar experiment, leaving a total of 194 participants.

All means are displayed in Figure 1. Collapsed over experiments, a 2 (consonantal stricture direction: inwards, outwards; within) × 2 (object label: lemonade, chemical; between) × 3 (Experiment: 1a–1c; between) ANOVA found a main effect of consonantal stricture direction, $F(1, 574) = 9.61$, $p = .002$, $\eta_p^2 = .02$, with inward words ($M = 3.95$, SE = .07) generally receiving higher liking ratings than outward words ($M = 3.86$, SE = .07).

Crucially, an interaction surfaced between consonantal stricture direction and object label, $F(1, 574) = 4.86$, $p = .028$, $\eta_p^2 = .01$. For participants for whom the words were labelled as brands for lemonades, inward words were liked more ($M = 3.80$, SE = .11) than outward words ($M = 3.64$, SE = .12), $t(248) = 2.97$, $p = .003$, $d_z = .19$, 95% CI [.05, .26]. In contrast, in the groups with the words labelled as brands for toxic chemicals, inward words ($M = 4.06$, SE = .09) and outward words ($M = 4.02$, SE = .09) did not differ in liking ratings, $t < 1$, $p = .37$.

Besides this crucial interaction, a main effect of object label surfaced, $F(1, 574) = 5.36$, $p = .021$, $\eta_p^2 = .01$. Generally, words with a lemonade label received *lower* likings ($M = 3.72$, SE = .11) than words with a chemical label ($M = 4.04$, SE = .09). Finally, and unexpectedly, also a three-way interaction between consonantal stricture spot, object label, and experiment surfaced, $F(2, 574) = 13.44$, $p < .001$, $\eta_p^2 = .05$, which prompted separate analyses.

Experiment 1a. A 2 (consonantal stricture direction: inwards, outwards; within) × 2 (object label: lemonade, chemical; between) ANOVA found solely an interaction, $F(1, 171) = 26.77$, $p < .001$, $\eta_p^2 = .14$. In the group with the words labelled as brands for lemonades, inward words were liked more ($M = 3.26$, SE = .15) than outward words ($M = 3.01$, SE = .15), $t(84) = 3.36$, $p = .001$, $d_z = .36$, 95% CI [.10, .39]. In contrast, in the group with the words labelled as brands for toxic chemicals, inward words were liked *less* ($M = 3.30$, SE = .16) than outward words ($M = 3.54$, SE = .16), $t(87) = 4.12$, $p < .0001$, $d_z = .44$, 95% CI [.12, .34].

Experiment 1b. The same ANOVA found a main effect for consonantal stricture direction, $F(1, 211) = 5.19$, $p = .024$, $\eta_p^2 = .02$, and an interaction, $F(1, 211) = 5.66$, $p = .018$, $\eta_p^2 = .03$. In the lemonade group, inward words were liked more ($M = 3.79$, SE = .13) than outward words ($M = 3.55$, SE = .14), $t(70) = 2.40$, $p = .019$, $d_z = .28$, 95% CI [.04, .44]. In the chemical group, no difference was found between inward ($M = 4.05$, SE = .12) and outward words ($M = 4.05$, SE = .12), $t < 0.1$.

Experiment 1c. The similar ANOVA found a main effect for consonantal stricture direction, $F(1, 192) =$

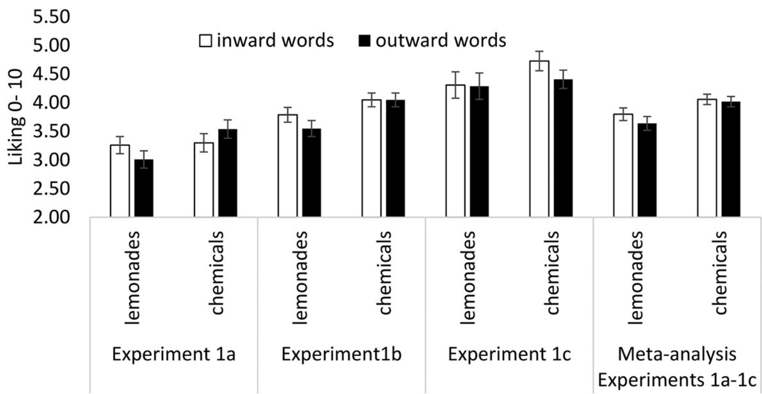

Figure 1. Liking ratings in Experiments 1a–c as a function of articulation direction and object label. Error bars indicate ±1 SEM.

7.15, $p = .008$, $\eta_p^2 = .04$, and again an interaction, $F(1, 192) = 5.77$, $p = .017$, $\eta_p^2 = .03$. In the lemonade group, no difference occurred between inward words ($M = 4.31$, SE = .23) and outward words ($M = 4.29$, SE = .23), $t < 0.2$. In contrast, in the chemical group, inward words were liked more ($M = 4.73$, SE = .17) than outward words ($M = 4.41$, SE = .16), $t(100) = 3.96$, $p < .001$, $d = 0.39$, 95% CI [.16, .48].

Discussion

Collapsed over Experiments 1a–1c, we indeed found an interaction between consonantal kinematics and object: inward words were preferred over outward words when these words were denoted as a lemonade, but no difference between inward and outward words or even a reversal occurred when these words denoted a toxic chemical. Note again that this occurred under silent reading.

We interpret this finding as a matching effect between articulatorily induced approach–avoidance states and the object meaning (cf., Centerbar et al., 2008; Cretenet & Dru, 2004, 2008; Dru & Cretenet, 2008; Eder & Klauer, 2007; Milhau et al., 2012), so that inward relative to outward was less positive and outward relative to inward was less negative for chemicals than for lemonades (although note that these contrasts could not become significant due to the main effect of higher liking for chemicals than for lemonades).

An alternative interpretation might be *cognitive tuning*, that is, the phenomenon that individuals are less prone to heuristic and intuitive cues (such as the present articulation manipulation) under negative compared to positive affective states (e.g., Bless, 2001; Schwarz, 2002). The negatively valenced object chemicals might have induced a brief negative affect (cf., Topolinski & Deutsch, 2012, 2013) that rendered participants more systematic and less spontaneous in their ratings. However, names for chemicals were liked *more* than names for lemonades, which renders a negative mood induction rather unlikely.

The main effect that participants generally reported higher likings of all words for chemicals than for lemonades deserves some more discussion. This effect is probably due to the rather exotic and complicated nature of the presently used stimulus words and the fact that chemicals usually have complicated and odd-sounding names (cf., Song & Schwarz, 2009). Although not relevant for the in–out effect itself, this sideline finding shows yet another form of matching effect that goes beyond a simple main effect of the intrinsic valence of a denoted object. From a mere valence account, one would predict that generally words for chemicals are liked less than words for lemonades since the former object category is simply more negative than the latter. However, in the present case, a matching between complicated names and negative chemicals (that usually have complicated names) led to positive affect.

Despite the meta-analytical pattern, the findings were somewhat mixed across the individual experiments. While Experiments 1a and 1b with German onsite participants found the default in–out effect for lemonades and an attenuated or even reversed effect for chemicals, Experiment 1c with an English online sample found no effect for lemonades, but the default preference for inward over outward words for chemicals. Particularly, this flipping of effects in the online survey was unexpected. This can be due to incidental oral side activities of the online participants. Also, we did not check specifically whether English was the mTurkers' native language. It is possible that those participants with English as a second language still subvocalised the target words in their native language, for which the consonantal articulation spots might have been different from in English phonation, blurring the results even more.[2] Despite all these issues with this online survey data, we retained them in the present manuscript to avoid a file drawer issue and to inform future examinations about the delicacy of the effect.

The next experiment should replicate this interaction in a within-subjects design to increase the effect size.

Experiment 2

Inward and outward names for lemonades and toxic chemicals were rated in a within-subjects designs in an onsite laboratory sample.

Method

Participants. $N = 100$ (68 female, 32 male, mean age 27, $SD = 6$) German-speaking onsite volunteers from various professional backgrounds participated for €10 reward (for a larger experimental battery including other tasks). They were again recruited from a local mini-job online market and were from the larger city area of Würzburg (Southern Germany).

Materials and procedure. Experiment 1b (with the large German stimulus pool) was replicated in a within-subjects design. In the lab sessions, foods and beverages, chewing gum, or talking were not allowed. Participants were told that they would receive possible brand names for lemonades and toxic chemicals and should rate them by typing in a number from 0 (*I do not like it at all as a brand name for lemonades/chemicals*) to 10 (*I like it very much as a brand name for lemonades/chemicals*). Randomly changing from trial to trial, participants received either an inward or outward word together with either a picture of a lemonade jug or of a bottle with a skull-and-crossbones tag, with 15 trials for each cell of this 2×2 design, resulting in 60 trials altogether. Word stimuli were randomly sampled anew for each participant. The sequence of trials was completely randomised.

Results and discussion

Mistyped responses were again discarded ($< 1\%$). A 2 (consonantal stricture direction: inwards, outwards; within) $\times$ 2 (object label: lemonade, chemical; within) ANOVA found a main effect of consonantal stricture direction, $F(1, 99) = 5.26$, $p = .024$, $\eta^2_p = .05$, a marginal main effect of object label, $F(1, 99) = 3.74$, $p = .056$, $\eta^2_p = .04$, and an interaction between consonantal stricture direction and object label, $F(1, 99) = 4.77$, $p = .031$, $\eta^2_p = .05$ (see Figure 2). In trials in which the denoted object was a lemonade, inward words ($M = 4.42$, $SE = .16$) were preferred over outward words ($M = 4.15$, $SE = .15$), $t(99) = 3.05$, $p = .003$, $d_z = .31$, 95% CI [.10, .46]. However, in trials in which the denoted object was a toxic chemical, the liking ratings did not differ between inward ($M = 4.54$, $SE = .18$) and outward words ($M = 4.54$, $SE = .17$), $t < 0.1$, $p = .96$. The marginal main effect of object label was again constituted by the fact that generally words for chemicals ($M = 4.54$, $SE = .17$) received actually marginally *higher* liking ratings than words for lemonades ($M = 4.29$, $SE = .15$). Thus, these findings completely replicate the findings from Experiments 1a–1c.

Experiment 3

The findings thus far show a matching effect between object features and the articulation in–out effect. However, in the object categories, we used (lemonades and toxical chemicals) both valence and oral affordances were confounded. Lemonades are both positive and to be ingested, and chemicals are both negative and to be expectorated. Furthermore, individuals so rarely experience having a toxical chemical in their mouth that no oral affordances, or oral implementation intentions (cf., Eder, 2011) might be elicited at all, explaining the absent in–out effect. Thus, the remaining experiments attempted at disentangling valence and oral affordances more closely using other objects (cf., Cannon et al., 2010; Phaf & Rotteveel, 2012).

For this purpose, we sought objects for which valence was not confounded with oral action tendencies. Since in pilot tests we could not establish ingestion- vs. expectoration-related stimuli that were completely similar in valence (see Materials section), we decided to pit valence and oral affordance

[2]We thank Hans Phaf for pointing us to this issue of native language.

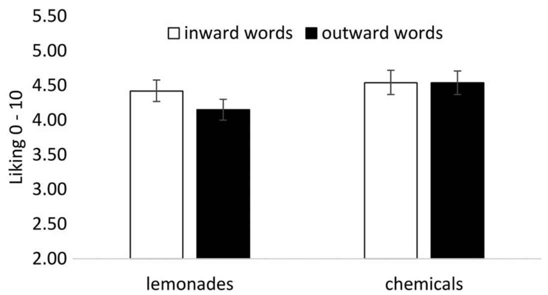

Figure 2. Liking ratings in Experiment 2 as a function of articulation direction and object label. Error bars indicate ±1 SEM.

against each other and chose *mouthwash* and *pill* as objects. We theorised that the oral affordance of mouthwash is expectoration, since its use involves eventual spitting out (but see the pilot study in Experiment 5 showing that this assumption is rather wrong), while the oral affordance of a pill is ingestion, since its very use is to swallow it. Valence ratings revealed that the product mouthwash was more positively evaluated than the product pill. Thus, in these two categories, valence and oral affordance run against each other. If valence alone was driving the modulations in Experiments 1 and 2, we would expect a larger in–out effect for mouthwash than for pill. If oral affordance or ingestion intention would be the driving mechanism of the matching effects, then the in–out effect should be larger for pills than for mouthwash. To further test the role of valence, we assessed participants' preference ratings for these products to test whether these individual preferences would correlate with the size of the in–out effect.[3]

Method

Participants. $N = 105$ (81 female, 23 male, mean age 24, $SD = 1$) German-speaking online participants from various professional backgrounds took part to be included in a lottery for two €10 gift vouchers as financial compensation. They were recruited via postings on various internet platforms and social media sites.

Pilot material tests. To find ingestion- and expectoration-related neutral objects, we let participants rate the valence of four hygiene and pharmaceutical products. $N = 112$ German-speaking online subjects who did not participate in the main experiment rated the following products on a scale from 0 (*very negative*) to 10 (*very positive*). They received tooth paste (German ZAHNPASTA) and mouth rinse German MUNDSPÜLUNG), both expectoration related, as well as pill (German TABLETTE) and antacid (German MITTEL GEGEN SODBRENNEN), both ingestion related. The resulting valence ratings were toothpaste $M = 8.14$, $SD = 1.54$, mouth rinse $M = 6.18$, $SD = 2.15$; pill $M = 4.88$, $SD = 2.55$; and antacid $M = 4.37$, $SD = 2.29$. All these ratings differed significantly from each other (all $ps < .001$). Thus, we could not establish stimuli that were similar in valence but different in oral affordance. However, it turned out that the two expectoration-related products, tooth paste and mouth rinse, were actually more positive than the two ingestion-related products, pill and antacid. Because we were mainly interested in the effect of oral affordances, we chose the two products with moderate valence ratings, namely mouth rinse and pill, to not let the valence difference be too strong.

Materials and procedure. As words, we used the large German stimulus pool from Topolinski et al. (2014). Participants were again told that they would be presented with possible names for mouthwash (German MUNDSPÜLUNG) and for pill (German TABLETTE) and should silently read them and then rate them by clicking a scale from 0 (*I do not like it at all*) to 10 (*I like it very much*). Products were manipulated in a block-wise fashion (sequence counter-balanced across participants). To activate a representation of the object-related oral affordance, in the beginning of each of the two blocks, a picture of the respective product was presented and participants were asked to briefly imagine how they usually deal with or use the respective product. Then, 30 inward and 30 outward words were presented in each block in random order re-randomised anew for each participant (thus, participant received 120 words altogether). In the end of each block, participants were asked to report what product the ratings were about. After the ratings, participants were asked to evaluate the products mouthwash and pill on a scale from 0 (*very negative*) to 10 (*very positive*). Then, they reported demographics.

Valence ratings. Similar to the pilot, participants in the main experiment rated the product mouthwash as being more positive ($M = 6.28$, $SE = .17$) than the product pill ($M = 4.69$, $SE = .23$), $t(99) = 5.76$, $p < .001$.

[3]We thank Hans Phaf for pointing us to this issue.

Results

Five participants failed to report the correct product category after their ratings, their data were discarded (an inclusion led to the same results). A 2 (consonantal stricture direction: inwards, outwards; within) × 2 (object label: mouthwash, pill; within) ANOVA found a main effect of object label, $F(1, 99) = 18.61$, $p < .001$, $\eta_p^2 = .16$, indicating that names generally received higher ratings for pills ($M = 4.82$, SE = .10) than for mouthwash ($M = 4.45$, SE = .11). Crucially, an interaction was found between consonantal stricture direction and object label, $F(1, 99) = 10.10$, $p = .002$, $\eta_p^2 = .09$ (other Fs < 1), which is shown in Figure 3. In trials in which the names were labelled as mouthwash, inward words ($M = 4.52$, SE = .12) were preferred over outward words ($M = 4.37$, SE = .11), $t(99) = 2.70$, $p = .008$, $d_z = .27$, 95% CI [.04, .25]. In contrast, in trials in which the names were labelled as pills, the liking ratings did not differ between inward ($M = 4.79$, SE = .1) and outward words ($M = 4.86$, SE = .10), $t = 1.28$, $p = .20$.

Because we had ratings of the general valence for a given product for each participant, we analysed the correlation between this individual valence rating and the amount of the in–out effect (liking for inward words minus liking for outward words) for that product for a given participant. If valence would be driving factor, the individual in–out effect should be higher than the more positive a participant rated a given product. These correlations were $r(100) = -.12$, $p = .25$, for mouthwash, and $r(100) = .11$, $p = .30$, for pill.

Discussion

This experiment attempted at pitting object valence and object oral affordance against each other. Mouthwash, the use of which involves eventual expectoration, led to the basic in–out effect, while pill, the use of which involves swallowing, attenuated the in–out effect to non-significance (even to a reversed effect descriptively). This can be seen as evidence that the matching effects in Experiments 1 and 2 were due to valence and not to oral affordances. However, we did not find a correlation between individual preferences for these two products and the amount of the in–out effect for words denoting these products on an individual level, which casts doubt on the valence hypothesis.

Similar to the findings in Experiments 1 and 2, we found that names were generally rated more

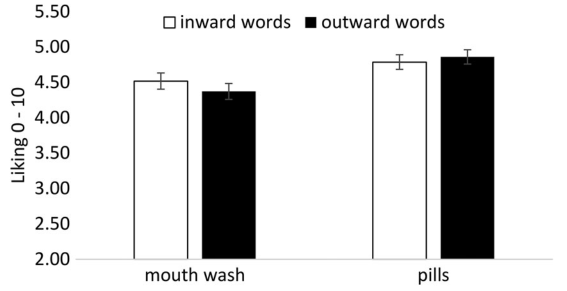

Figure 3. Liking ratings in Experiment 3 as a function of articulation direction and object label. Error bars indicate ±1 SEM.

favourable for the product that is itself more negative: names received higher ratings for pills than for mouthwash. Again, as we already argued in Experiments 1a–1c, this interesting sideline effect is also a matching effect, since the names of pharmaceutical products (such as pills) are generally more complicated than names for hygiene products (such as mouthwash). This matching effect, however, is not grounded on the objects' intrinsic valence. The next study should replicate all the products thus far in a complete within-subjects design.

Experiment 4

Before further exploring the contributions of object valence and oral object affordances, this experiment replicated all the objects thus far in a within-subjects design.

Method

Participants. $N = 102$ (71 female, 31 male, mean age 20, SD = 1) German-speaking freshmen during matriculation enrolment at the University of Cologne were tested in a laboratory experiment for €2 compensation.

Materials and procedure. We again used the large German stimulus pool from Topolinski et al. (2014). Participants were again told that they would be presented with possible names for four different products. They were told that in the beginning of each trial the respective product category would be signified by an image of that product. Then, in random order, the four products, lemonade, mouthwash, pill, and chemical, were introduced by naming that product (*One of the products will be …*) and showing an image of that product. For each product, participants were asked to briefly imagine how they would

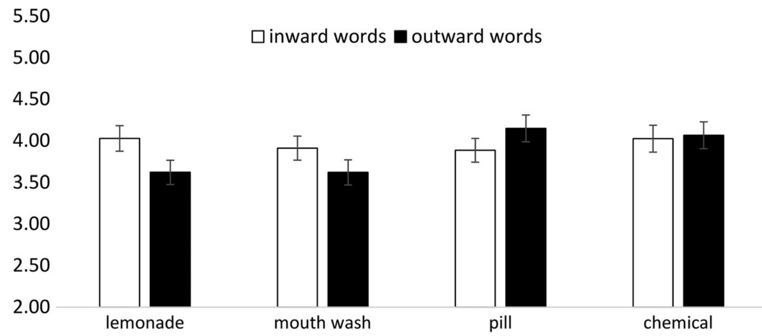

Figure 4. Liking ratings in Experiment 4 as a function of articulation direction and object label. Error bars indicate ±1 SEM.

use or handle the respective product, to activate the according oral affordance. After this, the crucial rating phase started. In each trial, first the image of the product was shown for 1000 ms on the top of the screen. Then, the target word (inward or outward) was presented additionally to the image for 1000 ms. Then, both the image and the word disappeared and a response box occurred in which participants were to type in their rating from 0 (*I do not like it at all*) to 10 (*I like it very much*). Participants received 30 trials for each product, each with 15 inward and 15 outward words. This resulted in 120 trials altogether. The sequence of trials and the sampling of target words were completely randomised and re-randomised anew for each participant. After these ratings, participants were asked to report a valence rating for each of the products, on a scale from 0 (*very negative*) to 10 (*very positive*), and finally demographics.

Valence ratings. The valence ratings for the products were lemonade $M = 7.97$, SE = .19, mouthwash $M = 5.99$, SE = .19, pill $M = 4.75$, SE = .25, and chemical $M = 2.63$, SE = .23. Lemonade and mouthwash were rated as more positive than pill and chemical, *ts* > 4.4, *ps* < .001.

Results

The programming software again allowed for mistyped responses (as in Experiment 2). Mistyped responses were discarded (< 1%). A 2 (consonantal stricture direction: inwards, outwards; within) × 2 (object: lemonade, mouthwash, pill, chemical; within) ANOVA on the averaged liked ratings found a main effect of consonantal stricture direction, $F(1, 99) = 5.68$, $p = .019$, $\eta^2_p = .05$, and a main effect of object, $F(3, 99) = 3.31$, $p = .023$, $\eta^2_p = .09$. This effect was again constituted by the fact that words received generally more positive ratings for pills and chemicals ($M = 4.03$, SE = .14) than for lemonade and mouthwash ($M = 3.79$, SE = .13). Moreover, a strong interaction surfaced between consonantal stricture direction and object, $F(3, 99) = 11.38$, $p < .001$, $\eta^2_p = .26$.

Figure 4 shows the means for each of the products. Planned comparisons showed a preference for inward over outward words for lemonade, $t(101) = 4.13$, $p < .001$, $d_z = .41$, 95% CI [.21, .60], and for mouthwash, $t(101) = 3.65$, $p < .001$, $d_z = .36$, 95% CI [.13, .45]; a preference for outward over inward words for pills, $t(101) = 3.07$, $p = .003$, $d_z = .30$, 95% CI [.09, .43], and no effect for chemicals, $t = 0.48$, $p = .63$. This pattern completely replicates the findings from Experiments 1 to 3.

Again, we correlated the individual valence ratings for each target object from each participant with the individual amount of the in–out effect for that participant for given object. These correlations were for lemonade $r(102) = .05$, $p = .65$, for mouthwash $r(102) = .11$, $p = .29$, for pills $r(102) = -.21$, $p = .034$, and for chemicals $r(102) = -.03$, $p = .78$. Thus, again, these subject-level analyses showed no meaningful relations.

Discussion

The present experiment replicated the findings from the earlier experiments. While we found robust in–out effects for lemonade and mouthwash, we did not find these effects or even reversed effects for pills and chemicals (see Figures 1–4). The first interpretation of these results so far is that this matching between articulatory kinematics and object meaning is driven by mere valence: the positive objects lemonade and mouthwash produce the in–out effect, while the negative objects pill and chemicals do not (positivity and negativity as found in participants' general ratings of these object categories).

However, this prima facie interpretation is questioned by the fact that we did not find correlations between the amount of the in–out effect per participant/per object and participants' individual valence ratings for the objects (Experiments 3 and 4). Furthermore, particularly the object affordances for the two crucial objects that seemingly pit valence and affordance against each other, namely mouthwash and pill (Experiments 3 and 4), might be questioned. We had theorised that mouthwash has an expectoration affordance because its use involves spitting out this liquid after rinsing the mouth. However, of course, the initial stages of mouthwash use are ingestion related (taking the liquid into the mouth and moving it in the mouth). Thus, it is possible that the affordance or oral intention associated with this object are rather ingestion related (see note 3). Furthermore, although, of course, a pill is to be swallowed eventually, its immediate automatic valence is negative and aversive, since pills are usually bitter and orally uncomfortable (Yamamoto et al., 2014), and this might activate an initial rudimentary expectoration reflex that individuals have to overcome to swallow pills (Sakuma & Kida, 2010; Schiele, Schneider, Quinzler, Reich, & Haefeli, 2014).

Thus, our choice of objects might have been suboptimal to test valence against affordance effects. Therefore, in the next experiment, we used mouthwash again, but probed the oral affordances individuals actually represent regarding this object, and used a novel comparison object, namely bubble gum.

Experiment 5

In this experiment, we compared the object mouthwash against bubble gum. As discussed in the previous section, it is possible that for mouthwash the final oral action of spitting out is not readily salient in naive individuals, and consequently mouthwash is actually not expectoration related. We tested this in a pilot test where we asked an independent group of participants to simply describe the oral actions they perform when using mouthwash, in which only 30% mentioned the expectoration phase, while all participants mentioned the ingestive early stages of intake into the mouth. This means that the primary oral implementation intention of mouthwash seems to be oral intake (to serve its purpose of rinsing out the mouth in the first place). Furthermore, we used bubble gum as a comparison category for which we hypothesised that its primary oral implementation intention is actually expectoration related: a bubble gum is chewed, but its intentional purpose is to produce bubbles by blowing the gum outside through the lips, which also involves spitting-like lip pursing (Worrall, Holmes, & Robbins, 1999). Supporting this, in a pilot test (see next section), we found that 60% of participants mentioned spontaneous representations of oral outward actions regarding bubble gum.

Method

Pilot study probing salience of object-related oral intentions. To probe what oral actions naive individuals actually associate with the two objects mouthwash and bubble gum, respectively, we asked $N = 148$ individuals to describe precisely what they usually do with the respective object. For mouthwash, the product was described as *Mundwasser zur Mundhygiene* (mouth rinse for mouth hygiene); for bubble gum, the product was described as *Kaugummi zum Blasen machen wie Hubba Bubba* (a chewing gum to blow bubbles like Hubba Bubba, a brand name that has become the generic name for bubble gum in Germany). The task war part of a larger experimental session. Participants typed in their descriptions via the computer keyboard, with the sequence of the two objects counter-balanced across participants.

These descriptions were rated by two independent raters on whether they contain the mentioning of oral inward and outward action verbs. Disagreements in ratings were solved via discussion. For both products inward verbs were, for instance, the German verbs *in den Mund nehmen/stecken* (take it into the mouth), *spülen* (rinse), or *kauen* (chew). For mouthwash, outward verbs were German verbs such as *spucken/ausspucken* (spit/disgorge). For bubble gum, outward verbs were German verbs such as *blasen/pusten* (blow), or also (*Luft*) *rauspressen* [squeeze out (air)]. For bubble gum, the capitalised word *Blase*(*n*) (meaning the noun bubbles, not the verb to blow) did not count, since this noun was already mentioned when labelling the product in the first place.

For both mouthwash and bubble gum, 100% of the participants mentioned oral inward action verbs. For mouthwash, only 29.73% ($SD = 0.45$) of the participants mentioned an oral outward verb, but for bubble gum, 60.14% ($SD = 0.49$) mentioned an oral outward verb, which was reliably different from each other, Wilcoxon signed rank test $z = 4.94$, $p < .001$.

Participants. $N = 87$ (71 females, 31 males, mean age 26, SD = 9) German-speaking online volunteers were tested in an online experiment. As compensation, they had the chance to win one of two AMAZON vouchers of €10 value each.

Materials and procedure. Using the same word stimuli as in the previous experiments, participants were told that they would be presented with possible names for two different products, namely mouthwash and bubble gum, in two separate blocks (sequence counter-balanced across participants). In the beginning of each block, the product was described and participants were asked to briefly imagine how they would use the given product. For the bubble gum, the instruction emphasised that it was not a usual chewing gum but a gum to blow bubbles with. In each block, participants received 30 inward and 30 outward words in random order and were again asked to rate their preference of the word as a brand name for the product on a scale from 0 (*very negative*) to 10 (*very positive*). In the end, they were asked to evaluate each product generally: "Please report how positive or negative you find MOUTHWASH/BUBBLE GUM in general", again on a scale from scale from 0 (*very negative*) to 10 (*very positive*).

Valence ratings. Mouthwash was rated as being less positive ($M = 5.75$, SE = .24) than bubble gum ($M = 6.48$, SE = .25), $t(86) = 2.74$, $p = .007$.

Results and discussion

A 2 (consonantal stricture direction: inwards, outwards; within) × 2 (object: mouthwash, bubble gum; within) ANOVA found a main effect of consonantal stricture direction, $F(1, 86) = 5.43$, $p = .022$, $\eta^2_p = .06$, that was qualified by an interaction between consonantal stricture direction and object, $F(1, 86) = 22.25$, $p < .001$, $\eta^2_p = .21$ (main effect object $F < 1$). In trials in which the words denoted mouthwash, inward words ($M = 4.56$, SE = .17) were preferred over outward words ($M = 4.27$, SE = .16), $t(86) = 4.52$, $p < .001$, $d_z = .49$, 95% CI [.17, .43]. In contrast, in trials in which the words denoted bubble gum, there was no such difference, but rather a tendency that inward words ($M = 4.46$, SE = .16) were *less* preferred than outward words ($M = 4.56$, SE = .16), $t(86) = 1.73$, $p = .087$ (see Figure 5).

On a participant level, the correlation between participant's general evaluation of mouthwash and the in–out effect for mouthwash trials was $r(87) = -.12$,

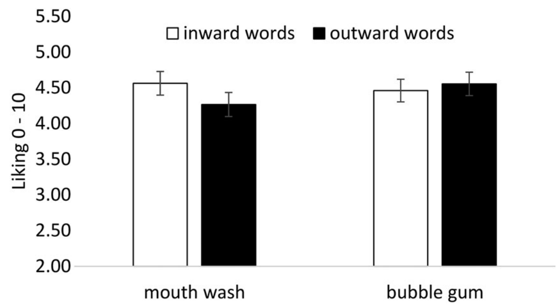

Figure 5. Liking ratings in Experiment 5 as a function of articulation direction and object label. Error bars indicate ±1 SEM.

$p = .29$, the correlation between the general evaluation of bubble gum and the in–out effect for bubble gum trials was $r(87) = -.02$, $p = .84$.

Although bubble gum as a product was evaluated as being more positive than mouthwash, it did not elicit an in–out-effect on words denoting it, but even a marginal reversal of this effect, while mouth still provoked a strong in–out-effect (as in Experiments 3 and 4). We attribute this pattern to the fact that for mouthwash the salient oral affordance or intention is ingestive in nature (taking mouthwash into the mouth to use it; as supported by the pilot test), while for bubble gum the salient oral affordance or intention is expectorative or at least sagittally outwards (blowing gum bubbles; see also pilot test). Again, the subjective positivity of a product did not correlate with the in–out effect itself.

In the final experiment, we explored the impact of situationally induced oral expectoration and ingestion intentions on preference for inward and outward words.

Experiment 6

Going beyond oral actions associated chronically with a given object, we induced oral inward and outward implementation intentions temporarily within the experiment (cf., Eder, 2011; Eder et al., 2012 Eder, Rothermund, & Proctor, 2010). We used a gum as an object with which one can execute both ingestion movements (chewing on it and feeling the taste) and expectoration movements (blowing bubbles). We held the object itself constant: every participant received the same sort of fruity gum.

Method

Participants. $N = 290$ (223 females, 67 males, mean age 22, SD = 4) German-speaking volunteers were tested in a laboratory experiment for a compensation of €2. *Materials and procedure*. We used the same word stimuli as in the previous experiments. In the beginning of the task, participants received a fruity sugarless chewing gum (Mentos Full Fruit chewing gum) of medium size. Participants were told that this is a product test in which they should first taste a novel gum and then answer some questions about it. First, participants were asked to chew the gum intensely for 3 minutes. This was done to decrease the appetising and ingestion-activating fruit taste of the gum. Then, $n = 156$ randomly assigned participants were asked to try to make at least 10 bubbles with the gum in a time of 2 additional minutes given. The other random half ($n = 133$) was asked to chew on the gum and focus on its taste for 2 minutes (timing prompted by the PC). To assure that chewing participants did not hear the bubble blowing sounds by blowing participants, the between-subject manipulation was randomly changed from session to session. Due to logistic problems (ending shifts of changing research assistants, unequal occupation of the four-seat laboratory), this also led to an uneven number of participants in the two conditions. Then, all participants were asked to remove the gum from their mouth (1 participant from the blowing group did not follow this instruction, the data were discarded). Then, participants received 15 inward and 15 outward words in random sequence on the PC screen and were asked to evaluate these words as possible brand names for the gum they just used on a scale from 0 (*very negative*) to 10 (*very positive*). In the end, also to justify the cover story of a product test, they were asked to report how pleasant the gum had been for them, again on a scale from scale from 0 (*very negative*) to 10 (*very positive*).

Valence ratings. Ten participants mistyped their response when rating how pleasant the gum had been for them, no data was available for them. There was no significant difference in this gum evaluation between the chewing group ($M = 7.03$, SD = 1.94) and the blowing group ($M = 6.63$, SD = 2.30), $t < 1.6$, $p = .12$.

Results and discussion

In four trials (< 1%) participants mistyped their rating. A 2 (consonantal stricture direction: inwards, outwards; within) × 2 (oral action: chewing, blowing; between) ANOVA tendency for a main effect of consonantal stricture direction, $F(1, 285) = 2.27$, $p = .13$, $\eta^2_p = .01$. The interaction between consonantal stricture direction and oral intention was also only approaching marginal significance, $F(1, 285) = 2.38$, $p = .12$, $\eta^2_p = .01$ (main effect oral action $F < 1$, $p = .77$). Despite this missing interaction, we conducted single comparisons within each group. In the chewing group, inward words ($M = 3.70$, SE = .11) were preferred over outward words ($M = 3.56$, SE = .13), $t(131) = 2.13$, $p = .035$, $d_z = .19$, 95% CI [.01, .27]. In contrast, in the blowing group, there was no difference between inward words ($M = 3.58$, SE = .11) and outward words ($M = 3.58$, SE = .11), $t < 1$, $p = .98$ (see Figure 6).

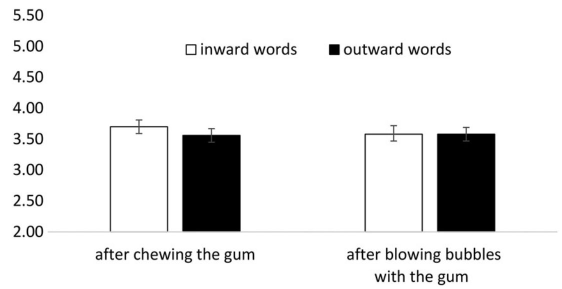

Figure 6. Liking ratings in Experiment 6 as a function of temporarily induced oral implementation intentions. Error bars indicate ±1 SEM.

The in–out effect did not correlate with the evaluation of the product, neither in the chewing group, $r(129) = -.01$, $p = .66$, nor in the blowing group, $r(148) = -.04$, $p = .66$.

Concluding, the present data can tentatively be treated as first supporting evidence that also ingestion and expectoration intentions that are only situationally activated for a given object can modulate the articulatory in–out effect. However, the present manipulation was not strong enough to provoke a significant interaction, and future research is needed here employing stronger (e.g., longer) inductions of oral implementation intentions.

General discussion

With the present studies we examined the novel case of approach–avoidance states induced by articulation patterns of words—and matching effects between these articulation patterns with features of the denoted objects (for earlier research on such matching effects in other motor domains, see, e.g., Cannon et al., 2010; Centerbar & Clore, 2006; Cretenet & Dru, 2004, 2008; Dru & Cretenet, 2008; Phaf & Rotteveel, 2012; Sparenberg et al., 2012). We found replicable matching effects (note that Experiments 2 and 4 are direct

Table 1. Meta-analytic effect size measures for all products that have been implemented more than once across Experiments 1–5.

Product	d_z	N for d_z	95% CI	t-Test
Lemonade	.28	358	.20–.37	$t(357) = 6.43$, $p < .001$
Chemical	−.07	432	−.20–.05	$t(431) = -1.17$, $p = .24$
Mouthwash	.23	289	.13–.34	$t(288) = 4.31$, $p < .001$
Pill	−.16	202	−.34–.02	$t(201) = -1.70$, $p = .09$

Note: The direction of the effect is preference for inward words minus preference for outward words. Positive values signify a preference gain for inward over outward, while negative values signify a preference gain for outward over inward. Note that Experiment 1c was not included because it involved English-speaking participants (see Discussion of Experiment 1c).

replication studies) and thus a modulation of the in–out effect reported by Topolinski et al. (2014): while consonantally inward-going words are preferred over outward-going words when they denote a lemonade or mouthwash, no such effect or even a reversal (outward words are preferred over inward words) occur when these words denote toxical chemicals, pills, or bubble gum. The meta-analytic pattern is depicted in Table 1.

The underlying psychological factor that drove these modulations of the in–out effect is the oral affordance, or oral implementation intention associated with an object (cf., Eder, 2011). Lemonade as well as mouthwash (see Pilot study in Experiment 5) are associated with ingestion, while toxical chemicals, pills, and bubble gum (see Pilot study in Experiment 5) are associated with oral expectoration actions (or might be not associated with any oral action at all in the case of chemicals). The valence of the denoted object does not play a role in this interaction. For instance, when pit against each other in a within-subject design, bubble gum was rated as being more positive than mouthwash, but did not evoke an articulatory in–out effect, but mouthwash did. Furthermore, in none of the present experiments that assessed individual valence ratings of the denoted object, there was a correlation between these valence ratings and the amount of the in–out effect.

Besides this being the first demonstration of a movement-object interaction outside the manual motor domain, the present evidence also informs the ongoing debate on the underlying mechanisms of matching effects in general. As for the manual domain, also in the oral domain actual action tendencies and not mere valence drive approach–avoidance effects (e.g., Laham et al., 2015; Phaf et al., 2014). Although Experiment 6 provided some initial evidence that such oral action tendencies can be situationally induced as oral implementation intentions (cf., Eder, 2011; but the interaction was not significant), future research shall more thoroughly investigate this possibility.

The present link between articulation kinematics and ingestion behaviour stimulates a variety of future research questions. For instance, the simulation of a consumption-related behaviour can increase or decrease the likelihood for consumption under certain conditions, just as chewing gum makes people hungry (Topolinski & Türk Pereira, 2012), while imagining eating candies can make people saturated (Morewedge, Huh, & Vosgerau, 2010). Consonantal stricture direction of words might be used as an induction of ingestion-like movements that affects later actual food consumption. Moreover, oral kinematics can themselves serve as an indirect attitude measure, for instance, by measuring the pronunciation speed for inward and outward words when these words denote positive and negative attitude objects. The prediction would be inward (outward) words are pronounced faster (slower) for positive compared to negative attitude objects. Such an oral approach–avoidance paradigm could be used in future research to assess implicit attitudes free from strategic and verbal mechanisms that usually affect arm movement paradigms (Eder & Klauer, 2009; Eder & Rothermund, 2008; Markman & Brendl, 2005; Lavender & Hommel, 2007). For instance, while arm movement paradigms require some instruction which arm movement is to be rendered in a given trial, which allows verbal labelling effects, the oral movement in an oral approach–avoidance paradigm is directly triggered by the presented nonsense word. Future research might exploit this new possibility in assessing approach–avoidance tendencies orally.

Concluding, oral inward and outward movements during articulation reliably interacted with oral movement tendencies evoked by the denoted object in the way of a matching effect on preference.

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Disclosure statement

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