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The influence of articulation dynamics on recognition memory[☆]

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ABSTRACT

Previous research has demonstrated an effect of consonantal direction on preference, showing that words following inward articulation dynamics (e.g., EMOK or OPIK) are generally liked more than words following outward dynamics (e.g., EKOM or OKIP). The present studies extended this line of research by hypothesizing an effect of consonantal direction on recognition memory, specifically familiarity. In a total of 7 experimental studies ($N = 1043$), we tested and confirmed this hypothesis, consistently finding increased hits and false alarms for inward compared to outward pseudo-words. This difference was found to be based on a higher perceived familiarity for inward compared to outward pseudo-words. Alternative explanations of an affirmation tendency or a recollection advantage were ruled out in Experiments 4 and 5. Experiments 6a and 6b examined the role of articulation fluency and liking as potential mediators of the effect, but found that neither mediated the influence of consonantal direction on familiarity. Thus, the in-out familiarity effect documented here seems to be a phenomenon that is distinct from the previously described in-out preference effect.

1. Introduction

In the context of recognition memory, familiarity can be described as the diffuse feeling of knowing something or someone without being able to recall an actual previous encounter (e.g., Brown & Marsh, 2009; Cleary, 2004; Cleary, 2008; Mandler, 1980). This feeling is typically evoked when a stimulus has been presented before and it therefore increases with repeated exposure (e.g., Coane, Balota, Dolan, & Jacoby, 2011). But there are also superficial stimulus features that can create a sense of familiarity: For example, the positivity or attractiveness of a stimulus enhances its perceived familiarity (e.g., Garcia-Marques, Mackie, Claypool, & Garcia-Marques, 2004; Monin, 2003). In a similar way, the perceptual fluency of a stimulus, manipulated by visual clarity, for instance, can induce familiarity (e.g., Johnston, Dark, & Jacoby, 1985; Whittlesea, 1993; Whittlesea, Jacoby, & Girard, 1990). These effects are independent of actual previous exposure, meaning that they occur in completely new stimuli as well as in previously presented ones. We can therefore speak of an *illusion* of familiarity in this case, given that a new stimulus cannot actually be familiar, but is nevertheless perceived as such. Both the fluency of a stimulus as well as its perceived familiarity have in turn been shown to increase its liking (e.g., Lee, 2001; Reber, Winkielman, & Schwarz, 1998; Winkielman & Cacioppo, 2001). Previous research therefore indicates that there are close (bi-directional) connections between liking, fluency, and familiarity.

In an unrelated line of research, a new effect on stimulus likability

has recently been identified: Topolinski, Maschmann, Pecher, and Winkielman (2014) showed that the consonantal articulation dynamics of a (pseudo-)word influence how much people like these words. The effect is based on the fact that every consonant can be defined by its specific place of articulation in the mouth on a sagittal plane from the lips to the throat (e.g., Ladefoged, 2001; Maddieson, 1984). A word with multiple consonants can consequently follow an inward (from the front of the mouth to the back) or an outward (from the back of the mouth to the front) directed movement when it is being articulated. Topolinski et al. (2014) created pseudo-words following these dynamics and found that people generally prefer inward wandering over outward wandering pseudo-words. The authors assumed approach-avoidance motivations to underlie the effect: Inward consonantal patterns resemble the oral movements of eating and drinking, two inherently approach related actions; outward consonantal patterns resemble oral movements of spitting, coughing or even vomiting, which are clearly avoidance related. Bakhtiari, Körner, and Topolinski (2016), however, recently showed that the preference for inward over outward pseudo-words (in-out preference effect) could be at least partially explained by articulation fluency. Their experiments found that inward stimuli were perceived as easier to pronounce than outward words, and that this difference in articulation fluency partially, albeit not fully, mediated the effect on liking ratings.

Given the previously described connection between liking, fluency, and familiarity, we claim that the effects of consonantal dynamics are

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not limited to stimulus preference, but that they extend to familiarity in recognition memory. Specifically, we assume that inward pseudo-words elicit higher feelings of familiarity than outward pseudo-words. In addition, we are interested in the differential roles of liking and fluency as potential mediators of such an effect.

1.1. The in-out preference effect – an overview

As briefly described above, the in-out preference effect draws on the principle that each consonant is characterized by a specific place of articulation, which is the location in the mouth where the active articulator (i.e., the tongue or the lips) touches the passive articulator (e.g., the teeth or the hard/soft palate). Topolinski et al. (2014) proposed that because of these different places of articulation, pronouncing a word with multiple consonants could produce certain articulatory dynamics. The word *book*, for example, starts with a bilabial consonant ([b]) and ends with a velar consonant (e.g. [k]) and therefore would be articulated *inwards*, from the front of the mouth to the back. A word starting with a velar consonant and ending with a bilabial consonant, on the other hand, for example the word *gap*, wanders *outwards*, from the back of the mouth to the front. As previously stated, an inward articulatory movement thereby resembles the ingestion of food and liquids (Rozin, 1996). Eating and drinking are usually experienced as positive and pleasurable because these actions satisfy our basic needs (e.g., Topolinski & Boecker, 2016b; Experiment 1). Typical oral outward movements, on the other hand, occur during acts of excretion, such as spitting, coughing, or vomiting (Goyal & Mashimo, 2006). These are usually reactions to something negative that needs to be expelled from the body (Rozin, 1999), for example a disgusting taste, food being stuck in the trachea (Fontana & LAVORINI, 2006; Pitts, 2014) or rotten or poisonous substances in the stomach (Horn, 2008; Mitchelson, 2004; cf. Fessler & Arguello, 2004). Some of these actions, such as coughing and vomiting, are even involuntary, meaning they are automatic reactions of the body to something potentially harmful. This stark contrast of positive versus negative associations with oral inward and outward movements led Topolinski et al. (2014) to assume that pseudo-words following a consonantal inward pattern (e.g., PUDOKA) should be liked more than words following an outward pattern (e.g., KUDOPA). In a number of experiments on native German and native English speaking samples (with pseudo-words adjusted to English phonation for the latter), Topolinski et al. (2014) found that people indeed liked inward pseudo-words more than outward pseudo-words.

This in-out preference effect has consistently been shown across studies on different types of stimuli, both when stimuli were presented auditorily or in written format, and in English, German and Portuguese speaking samples, by several independent research groups (e.g., Godinho & Garrido, 2016; Kronrod, Lowrey, & Ackerman, 2015; Lindau & Topolinski, 2018; Topolinski & Boecker, 2016a; Topolinski et al., 2014, for a review, see Topolinski, 2017). A recent article by Topolinski and Boecker (2016a) also tested the potential impact of vowel sequences in the in-out preference effect and found that vowels did not have any influence on the effect. In fact, a preference for inward over outward consonantal sequences could be shown for mere consonant pairs (e.g. KM) which did not contain any vowels. Overall, the in-out preference effect has proven to be a replicable effect that also extends to other dependent variables, such as palatability ratings of food (Topolinski & Boecker, 2016b), willingness-to-pay for products (Topolinski, Zürn, & Schneider, 2015), and trustworthiness of online sellers (Silva & Topolinski, 2018). The original assumption of approach versus avoidance motivation (due to associations with actions of oral ingestion versus excretion) as the underlying mechanism of the effect has recently been challenged by Bakhtiari et al. (2016), however, who proposed that fluency might be responsible for the general preference of inward over outward consonantal patterns.

1.2. Fluency as an alternative explanation of the in-out preference effect

Apart from findings on perceptual and conceptual fluency, a growing body of research has established effects of motor fluency, which is the ease with which a motor movement can be executed. A typical example of motor (dis)fluency would be executing tasks with the (non)dominant hand (e.g., Casasanto, 2009; Casasanto & Chrysikou, 2011; Susser & Mulligan, 2015). Similar effects have been shown for other movements, such as (dis)fluent typing (e.g., Brouillet, Milhau, Brouillet, & Servajean, 2016; Jasmin & Casasanto, 2012). It is important to note that the actual execution of a movement is not a necessary prerequisite of motor fluency effects; the mere perception of an object with certain action affordances can be sufficient to excite mental simulations of those actions which can involve easy (fluent) or more complex (less fluent) movements (e.g., graspable objects, Brouillet, Ferrier, Gosselin, & Brouillet, 2011; Regenber, Häfner, & Semin, 2012; or easy vs. difficult to type letter pairs, Yang, Gallo, & Beilock, 2009). Fluent motor simulations lead to enhanced positive affect compared to less fluent simulations (Cannon, Hayes, & Tipper, 2010).

Based on these findings on motor fluency, Bakhtiari et al. (2016) assumed that a similar effect might be the driving mechanism of the in-out preference effect: They proposed that words with inward consonantal patterns might be easier to pronounce than words with outward consonantal patterns. Overt verbalization of a word is not necessary for an effect of articulation fluency on attitudes because pronunciation is covertly simulated during silent reading (Silva, Chrobot, Newman, Schwarz, & Topolinski, 2017; Song & Schwarz, 2009; Topolinski, Bakhtiari, & Erle, 2016; Zürn & Topolinski, 2017). That such a covert simulation of articulation takes place in silent reading is a well-established phenomenon (e.g., Edfeldt, 1960; Hardyck, Petrino, & Ellsworth, 1966; see also Stroop, 1935). Some studies suggest that these subvocalizations are the underlying mechanism of certain fluency effects: For example, the false fame effect (Jacoby, Kelley, Brown, & Jasechko, 1989) disappeared when participants ate popcorn while judging the names (Topolinski & Strack, 2010), and chewing gum throughout an evaluation task eliminated the verbal mere exposure effect in one study (Topolinski & Strack, 2009), though not in another replication study (Westerman, Klin, & Lanska, 2015).

Bakhtiari et al. (2016) showed that reading latencies were indeed shorter for the inward pseudo-words than for the outward pseudo-words from Topolinski et al. (2014). Subjective ratings confirmed that inward words were also perceived as being easier to pronounce than outward words. The results suggest that inward words are indeed more fluently processed than outward words. The subjective articulation fluency of the pseudo-words also significantly mediated the effect of consonantal direction (inward versus outward) on liking (Bakhtiari et al., 2016), showing that as predicted, fluency seems to be a driving mechanism of the in-out preference effect. This mediation was only partial, however, a significant effect remained after controlling for the influence of fluency. Nevertheless, there is more evidence supporting a fluency explanation of the effect than there is with regard to the approach/avoidance assumption. First of all, approach or avoidance motivation as a potential mediator has not been directly tested yet. Secondly, there are findings on the in-out preference effect that speak against such an explanation: The effect could be modulated by objects' oral affordances, for example, (Topolinski, Boecker, Erle, Bakhtiari, & Pecher, 2017), meaning that inward names are not preferred over outward names anymore when the denoted object involves an oral outward movement (i.e. bubble gum, where air is blown out to produce the bubble). This finding would be more in line with a motor fluency account. Also, if approach and avoidance motivation induced by associations with movements of ingestion versus excretion was the underlying factor of the in-out preference effect, one would assume that the effect should be greater for food stimuli than other stimuli. However, effect sizes are very comparable across studies, no matter whether food, other objects, or people are denoted by the inward and outward

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