Current Psychology (2023) 42:26187–26199
https://doi.org/10.1007/s12144-022-03632-8

Promoting a hand sanitizer by persuasive messages: moving bottle and background color as approach and avoidance cues

Thierry Meyer[1] · Pauline de Pechpeyrou[2] · Magdalena Kolanska-Stronka[3] · Vincent Dru[1]

Accepted: 9 August 2022 / Published online: 15 September 2022

Abstract

In message-based health interventions, peripheral cues such as motion and color capture exogenous attention. These cues may elicit approach and avoidance motivation and the core ingredients of persuasion (argument framing, source of the message, and persuasion knowledge). In two studies, we presented participants with persuasive messages about a hand sanitizer. Messages varied by the framing of the arguments (gain vs. loss) and by the source of the message (healthcare industry vs. public health agency). In Study 1 (N = 137), the forward apparent motion of the hand sanitizer bottle compared to a backward apparent motion increased a positive attitude toward the hand sanitizer, the intention to buy it, and ease of judgment. In Study 2 (N = 280), a small main positive effect of a green background was observed for attractiveness of the hand sanitizer, but only when a green background followed a red one. Green (vs. red) background increased willingness to buy the hand sanitizer. We observed no main effects of argument framing or source of the message. The discussion emphasizes approach and avoidance motivation as a common framework for understanding the respective contribution of peripheral cues and core ingredients of messages to the persuasion process.

Keywords Persuasion · Motion · Color · Cue · Approach and avoidance motivation · Health messages · Commercial advertisements · Hand sanitizer · Hand hygiene

Color and motion are used as persuasive features of messages. Today, colors and contrasts between colors are applied to Internet advertising banners to increase purchase intent. (White et al., 2021). Drivers on highways can be dangerously distracted by animated images on a dynamic electronic billboard by the side of the road (Decker et al., 2015). Color and motion are ranked as "undoubtful" features that guide attention (Wolfe & Horowitz, 2017). With low cognitive effort, perceptual processes distinguish between colors and between motionless and moving. In message-based persuasion (i.e., commercial advertisement or health message), peripheral cues such as motion and color capture exogenous attention early after exposure to a message. A salient background color or the sudden movement of an object in the message contribute to the persuasion process in addition to their attention-grabbing property. Our hypothesis is that color and motion cues contribute to a unique persuasion process based on approach and avoidance motivation. On the one hand, the approach and avoidance motivation model (Elliot, 2006) provides predictions about the effect of motion and color cues on attitudes. On the other hand, persuasion processes involve persuasive tactics that rely on approach and avoidance motivation (Knowles & Riner, 2011; Sherman et al., 2006). To date, no systematic research has explored the interplay of color and motion cues within a message with the core ingredients of persuasion (arguments, source of the message, and persuasion knowledge; Albarracin & Shavitt, 2018). Focusing on health messages and commercial advertisements about hand hygiene, we will address two cues within persuasive messages about a hand sanitizer: forward motion or green background as approach cues, and backward motion or red background as avoidance cues.

✉ Thierry Meyer
thierry.meyer@parisnanterre.fr

[1] University Paris Nanterre, 200 avenue de la Republique, 92000 Nanterre, France

[2] Paris Est Creteil University, Créteil, France

[3] Univeristy of Zielona Gora, Gora, Poland

Exploring the core ingredients of persuasion through the approach-avoidance lens

Approach and avoidance behaviors have received considerable attention as one of the fundamental human motivations (Elliot, 1999; Koch et al., 2008). 'Approach motivation refers to the energization of behavior by, or the direction of behavior toward, positive stimuli (objects, events, possibilities), whereas avoidance motivation refers to the energization of behavior by, or the direction of behavior away from, negative stimuli (objects, events, possibilities)' (Elliot, 2006, p. 112). Social influence can be grounded on such motivations. As quoted by Knowles and Linn (2004), persuasion strategies may be categorized as Alpha strategies which "attempt to persuade by increasing the approach forces and Omega strategies "by decreasing the avoidance force" (p. 117). Resistance to persuasion is largely grounded on Omega strategies (Knowles & Riner, 2011). Fransen et al., (2015) suggest that avoidance strategies may be triggered by multiple motivations (threat to freedom, reluctance to change, and concerns of deception). Approach and avoidance goals may be supported by the arguments of the message, the source of the message and the expectations about the persuader's communication strategy (knowledge of persuasion).

Framing of arguments. Arguments gives a logical reason to support a conclusion (Govier, 2010). Persuasive Arguments are verbal statements that incite a person to change their own attitudes or behaviors. Arguments of a health message may enhance the possibility of gains by outlining the positive consequences that occur with the adoption of the prevention behavior (the goal is to approach future gains). Arguments may enhance the possibility of losses by outlining the negative consequences that occur without the adoption of the prevention behavior (the goal is to avoid future losses) (Rothman et al., 2006; Rothman & Salovey, 1997). During the 2009–2010 H1N1 flu pandemic, Updegraff et al., (2011) found that among other semantic cues (e.g., perceived susceptibility), gain-framed messages led to greater sanitizer usage. However, a meta-analysis of the message framing literature (Gallagher & Updegraff, 2012; O'Keefe & Jensen, 2007; Van't Riet et al., 2014) yielded small size effects. Globally, gain-framed messages are not better when the message promotes a detection behavior (e.g., breast cancer screening) rather than a prevention behavior (sunscreen against solar risk). They are better than loss-framed messages in prevention messages, especially in some health domains (i.e., oral health).

The relationship between the framing of arguments and approach-avoidance motivation has been a topic of interest. Approach motivation may result from dispositional traits or a transient context. From a dispositional point of view (e.g., Behavior Inhibition vs. Activation Scale; Carver & White, 1994), gain-based messages are more persuasive when people follow approach motivation, and loss-framed messages are more persuasive when people follow avoidance motivation (i.e., congruency effect). The framing effect is stronger when the framing and dispositional approach/avoidance motivation are congruent (Hevey & Dolan, 2014; Mann et al., 2004; Sherman et al., 2006; Updegraff & Rothman, 2013). Recently, the congruency effect between traits and statement ratings was demonstrated in the context of physical activity promotion messages (Wilson & Estabrooks, 2020).

Source of the message. Source refers to the communicator (person or organization) who delivers the message to the receivers (Wilson & Sherrell, 1993). People ascribe "epistemic authority" to the source of information (Kruglanski et al., 2005). Using appealing or expert sources that motivate approach goals remains a common persuasion tactic. When people have a low motivation and low level of cognitive resources to process the message (including strong prior attitudes), they rely more on source heuristics (such as the trustworthiness of the source) rather than on a costly effort to scrutinize the quality of the arguments (e.g., the content of recommendations about a risk; Chaiken & Trope, 1999; Petty & Wegener, 1998). The sources of behavioral interventions have more effects in attitude formation (i.e., people lack prior attitudes) than in attitude change and their impact decreases when people have prior attitudes (Kumkale et al., 2010). In a prevention context, the credibility of the source and message framing both influenced intentions to screen for sexually transmitted infections. However, the interaction between source credibility and message framing was not significant (McCullock & Perrault, 2020).

Persuasion knowledge. People are commonly aware of being exposed to a message to change their attitude or behavior. The *Persuasion Knowledge Model* (Friestad & Wright, 1995; Kirmani & Campbell, 2009) postulates that people hold lay knowledge about persuasion. Over their lifespan, recipients of messages recognize the persuader's intent and strategies. For instance, people may learn that, on the one hand, commercial advertisements are mainly grounded on positive arguments and approach goals (expected economic gain, positive social identity, social affiliation, models attractiveness, etc.). On the other hand, governmental public health messages remain mainly focused on the risk and hazards associated with negative consequences and avoidance goals (Gold et al., 2020). Public health messages convey goals to control one's own behavior (i.e., an avoidance goal) contrary to commercial messages that use arguments that increase interest in products (i.e., an approach goal). The labeling of the same video message about physical activity

as a "health message" (vs. a "commercial advertisement") is sufficient to reduce snacking behavior (Kergoat et al., 2019).

Exploring motion and color cues through the approach-avoidance lens

Approach and avoidance motivations may be elicited by peripheral cues that attract attention such as an unexpected motion of an object or color itself.

Motion. Moving objects capture attention more than background or stationary objects do (Carretié, 2014). They signal behaviorally urgent events which need action to gain control over the environment (Franconeri & Simons, 2003). From an information processing point of view, the motion of an object may change an observer's attitude toward this object. When oneself is the reference point, avoidance increases distance between the stimulus and the self while approach decreases distance between a stimulus and the self (Seibt et al., 2008). These distance changes are respectively associated with negative and positive feelings and assessments (Cacioppo et al., 1993; Cretenet & Dru, 2004). One's own motion, as a peripheral cue, is enough to change the valence of various stimuli (Aubé et al., 2019), in the same way as higher cognitive processes (Mennella et al., 2020; Verselder et al., 2017). When consumers imagined pulling a food product toward themselves, they were more prone to positively evaluate the product and pay a sizable amount. This effect occurs even when the food is not especially palatable for Western taste (i.e., a tin can containing grasshoppers; Labroo and Nielsen 2010).

Few researchers have explored the respective contribution of motion cues and core ingredients of persuasion together in health persuasive messages and the potential interplay between both. Cian et al. (2015) found that warning sign icons that evoke more (vs. less) apparent movement led to a quicker propensity to act because they suggest greater risk to oneself or others and increase attentional vigilance.

Color. Color is another peripheral cue that may elicit approach and avoidance motivation. Color is a widely explored feature of emotional labeling that has both universal and culture-specific properties (Jonauskaite et al., 2019). Red and green colors as basic hues are processed in the early stage of information processing (Forder et al., 2017). According to Elliot et al. (2007), the frequent use of red in warnings (Wogalter et al., 2015), and the biological link between red, blood, threat and contamination, elicits avoidance motivation in performance domains. Compared to blue, red leads to attentional narrowing (Friedman & Förster, 2005). More generally, arousal increases from blue and green to red (with interactions with other components of color). In the same vein, red triggers a motivation to avoid a poor decision (Williams & Noyes, 2007). Such a reverse effect was observed in a stock market context in China where red represents an expected gain and green an expected loss (Zhang & Han, 2014). Notably, red and green are used as a signal of avoidance and approach respectively in the health domain. Green food labels are associated with healthy products, especially for those who are more involved with health problems (Schuldt, 2013). Green is associated with a signal of growing safety and health care. In summary, red is associated with avoidance motivation. Red may impair an analytic task (such as problem solving, natural decision-making) and green is associated with an approach motivation and may sometimes increase openness to alternative decision paths, in the same way as high-level cognitive processes. Nevertheless, the intrinsic effect of color on attitudes and performances remains small and influenced by context (Elliot & Maier, 2007, 2012; Meier et al., 2012).

Many researchers have explored the contribution of color cues and the core ingredients of persuasion together in persuasive health messages. Metha and Zhu (2009; Study 5) observed that participants preferred an advertisement with a red background that enhanced details of a commercial product compared to the same advertisement focused on remote associations with the product. The abstract-congruent commercial banner advertisements (i.e., red negative, green positive, and blue positive) were attended to more and evaluated more positively than the abstract-incongruent commercial banner advertisements (Zhang et al., 2019). With persuasive messages, color was mainly used to make the arguments of the message salient (color of text or color of text background.). Gerend and Sias (2009) manipulated a red (vs. gray) background of the title of a binder and a loss (vs. gain) message framing the risk associated with Human Papillomavirus (HPV). No main effect was observed, but interaction between the color red and message framing was significant. The color red which stressed messages with a loss argument had the greatest impact on the intention to vaccinate but only among male participants. They speculated that peripheral cues may contribute to message processing by enhancing approach or avoidance motivation. Chittaro (2016) used a red background that enhanced a textual message on a Web page about the issue of fire in the home that included a recommendation for prevention. He found that the color red (compared to gray) increased the framing effect of the message. For women, the color red boosted the gain-framed message (compared to the loss-framed). For men, the color red boosted the loss-framed message. Yu and Zhou (2018) found an interaction between approach and avoidance framing respectively and a congruent background color (blue and red) for the perceived value of products. In summary, color as approach and avoidance

cue seems a suitable candidate for moderating a framing effect in persuasion.

Fluency. The interplay of the core ingredients of persuasion and motion or color cues can help to trigger a metacognitive experience. The subjective ease or difficulty of processing a message or processing fluency fosters an impression of familiarity (Lee & Aaker, 2004; Schwarz, 2004). According to a meta-analysis of health messages (Okuhara et al., 2017), fluently processed stimuli increase positive assessments. A feeling of fluency or having trouble in processing a message mediates the direct effects of persuasion as a cue of agreement or disagreement with the message (Petty et al., 2007). Visual fluency might be responsible for the contribution of peripheral cues to persuasion. It is plausible that peripheral cues of approach and avoidance may increase the global fluency of message processing in accordance with their congruency with the message approach or avoidance orientation.

The Present Study

Overview

Given our goal of incorporating peripheral cues that trigger approach and avoidance motivation into a persuasive message, we are interested in two cues: motion (a moving object) and background color. In dynamic images, the forward apparent motion of a positive object may trigger an approach motivation, and backward motion an avoidance motivation. Background color may be focused on approach (green) or avoidance (red). We sought to provide evidence that approach, relative to an avoidance motivation, may be elicited by these cues and increases the persuasive impact of the message. At an initial level, motion and color attract visual attention as exogenous cues that are processed at an early stage of visual processing. At a second level, the semantic/symbolic part of the message is processed. At this level, approach and avoidance goals are provided by the framing of the argument, the source, and the congruency between source and arguments in accordance with lay knowledge of persuasion. The brain's "persuasion network" (Huskey et al., 2020) acknowledges the distribution of motor control, visual information processing and language through separate but interrelated brain areas. Beyond surface and deep message processing, we expect both levels of processing (cues and symbolic message content) to contribute to the same approach and avoidance motivation. An additive model is expected. From a metacognitive point of view, the alignment of the cue and message as they trigger the same approach or avoidance motivation may be congruent. Messages where cue and message lead to the same approach or avoidance motivation may be processed more easily than messages where cue and message are at odds. Therefore, people will be more confident about their attitudes. In summary, our prediction is that motion and color cues would contribute additively with the core ingredients of the message (framing of arguments, source, knowledge of persuasion) as they contribute to a common approach and avoidance motivation.

Two experimental studies were focused on messages about alcohol-based hand sanitizers that are available in gel bottles. There is a large evidence-based consensus about their efficacy to reduce the spread and transmission of infectious disease (Pittet, 2016). People often use hand rub in a suboptimal way at home and even in high-risk professional contexts (Ford et al., 2014; Gould et al., 2008; Jenner et al., 2005; Judah et al., 2009). We explored how motion (Study1) and background color (Study 2), as approach and avoidance cues, change attitudes toward a hand sanitizer. The framing of arguments was either approach oriented (gain) or gain oriented (loss). The source of the message or messages was manipulated. Like other health products, hand sanitizers are advertised both by public health agencies (health messages aimed at protecting the population's health – i.e., an avoidance goal-) and by the healthcare industry (commercial advertisements are designed in order to increase the sales of particular brands of hand sanitizers – i.e., an approach goal-). The arguments of health messages are more focused on risks (avoidance) and messages which are advertised by the healthcare industry are more focused on the benefits of protective behavior (approach). This pattern is conceivably known by participants as a component of their knowledge of persuasion.

We simulated a situation where people were exposed to variants of a message from the same source. Considering that both motion and color are expected to be medium to small as between subject effects, we used a within-subjects design that enhanced the attention-grabbing properties of motion and color cues. Importantly, the research program was designed and recorded just before the 2020 COVID-19 pandemic. At this time, the usefulness of hand sanitizers was not prominent. The studies were conducted in compliance with the ethical standards of the French Society of Psychology and were systematically monitored for compliance with the ethical guidelines of the Ethical Committee of the Department of Psychology of Paris Nanterre University. All experimental conditions included in each study are reported.

Study 1. Object motion as a cue of approach and avoidance

The objective was to evaluate the effect of a moving object (a hand rub pump bottle) as an approach and avoidance cue based on interaction with the basic ingredients of persuasion. Our interest was in the intrinsic persuasive effect of the cue in the context of a persuasive communication about hand hygiene. A hand rub bottle was at the center of the message (see Appendix 1). We explored how an illusory forward vs. backward motion of the hand sanitizer bottle (within-subjects variable) changed the persuasive impact of the message. The messages varied in accordance with the arguments (gain vs. loss-framing as within-subjects variable). The source of the message (public health agency vs. healthcare industry) was manipulated as a between-subjects variable to maintain coherence of the communication area. To benefit from controlled video and computer facilities (e.g., screen size) for presenting a movement, we recruited undergraduates as participants. Hand hygiene remains a health topic among the young educated population even when sanitary facilities are available (Anderson et al., 2008). Low-to-moderate knowledge and poor compliance with hand hygiene were found in a meta-analysis even among medical and nursing students (Labrague et al., 2018). Teaching methods to improve hand hygiene must be improved even among healthcare students (Purssell & Gould, 2021).

In line with previous reasoning, we tested the following hypotheses:

H1: Compared to backward motion, forward motion of the bottle will increase a positive attitude toward hand sanitizers and purchase intention.

H2: Motion contributes additively to the effect of the source and arguments of the message.

H3: At metacognitive level, forward (vs. backward) motion positively influences the perceived ease of processing.

Participants

One hundred and thirty-seven university students (113 women) who were enrolled and taking part in course credits at a French University. The mean age was 19.1 (SD = 1.58; range 17 to 29 years). All tasks in the study were computerized, and participants completed them on a computer in a cubicle.

A power analysis (conducted via G*Power Software, Faul et al., 2007, with Cohen's recommendations, 1988), which assumed a medium effect size of 0.25 for the ANOVA with 2 within-subjects factors (bottle motion and framing of arguments) and one between-subjects factor (source of the message), indicated that 36 participants were required to have a 95% power of detecting a significant effect at p value of 0.05. These independent variables are presented below.

Method and procedure

The persuasive message combined three parts: a picture of a hand sanitizer bottle, a written brand and a text which highlighted the source of the message and the argument. A typical bottle of antibacterial gel was at the center of the picture. The brand of the hand sanitizer ("*Biactol*") was chosen from lesser-known brands. The source and the arguments of the message were located randomly either at the left or right side of the image to control for a left bias (Simmonds et al., 2018).

Independent variables. As a within-subjects variable, two types of arguments were contrasted. The gain argument was focused on the benefits of using the antibacterial gel ("Hands that are always clean and healthy"). The loss argument was focused on the risk of contamination ("To prevent bacteriological infections"). As a within-subjects variable, the bottle at the center of the picture seemed to move forward or backward (i.e., distance from the actor/perceiver seems to increase or decrease). During the forward motion, the bottle became bigger as it moved from the back to the front. The bottle image occupied a quarter of the page height at the beginning of the motion and up to three quarters of the page at the end of the motion. During the backward motion, the bottle became smaller as it moved from the front to the back. The apparent motion was implemented via a Microsoft PowerPoint © Grow/Shrink option that changes the size of objects (from 3.2 in height to 9.7 in, or inversely). The motion duration was 3s. The bottle moved across a white background and light blue perspective lines created a tunnel perspective effect to increase an illusion of motion. Qualtrics software (Version 3.0, Experience Management, Provo, UT, USA) was used to display the pictures to participants who were positioned 0.5m away from a monitor (20 in, 60Hz.Samsung; di Fronso et al., 2020). In order to fulfill face validity, the source of the message was manipulated as a between-subjects variable. The message was presented either as a public health message delivered by a health agency ("The National Agency for the Prevention of Bacteriological Risks"), or a commercial message delivered by the healthcare industry ("The French Federation of Hygiene-Beauty Companies"). Both sources were fictitious to avoid any familiarity or preference effect.

Participants were informed that they were involved in the development of an advertising campaign for a hand hygiene product. In summary, participants assessed four versions (within-subjects variable) of the same message based on a combination of argument framing and motion of the bottle

(gain/forward vs. gain/backward vs. loss/forward vs. loss/backward). The order of the four messages was randomized.

Dependent variables. Just after each message exposure, respondents filled out a questionnaire. Two direct questions (product attractiveness and purchase intention) were followed by metacognitive judgments (difficulty of and confidence in the judgment of attractiveness and purchase intention). Product attractiveness was measured using one question, which directly concerned the assessment of attractiveness ("How attractive do you find this lotion"). The rating was made on an 11-point Likert scale with the endpoints labeled "0 = not at all" and "10 = extremely." This 11-point interval mimicked the national school marking system ranges from 0 to 10 and was suitable according to the Preston and Colman (2000) review of the optimal number of response categories in rating scales; these authors found that an 11-point Likert scale was the best solution for simultaneously increasing the reliability of the measure and its internal consistency (Cronbach Alpha). Purchase intention was measured by one question, directly related to the assessment of purchase intentions ("To what extent would you intend to buy this lotion"). For attractiveness and purchase intention, two questions addressed the difficulty of producing a judgment and confidence in the judgment (e.g., "How difficult was it for you to form an intention to buy this lotion?"; "How confident was your intention to buy this lotion?"). Ratings were made on an 11-point Likert scale.

Finally, after exposure of the four messages, the participants were asked to give their expected reference market price for the hand rub bottle (open-ended response in €). They reported their willingness to pay (maximum price they would pay for the hand rub; open-ended response in €). Risk assessment for microbiological contamination was measured with the 15 items *Perceived vulnerability to disease* scale (two factors: *perceived infectability* and *germ aversion*; Duncan et al., 2009). The rating was made on a 7-point Likert scale. Attitude toward the source was measured with three attributes (sincere, honest, benevolent) which were aggregated in a single index (Cronbach's $\alpha = 0.84$). Finally, subjective health was measured with an 11-point Likert scale (poor vs. excellent health).

Results

Gender attitudes toward health, risks and cosmetic products may contribute to the variability of results (Ertel et al., 2009). Gender was first explored for exploratory purposes. We did not find any significant effect of gender. Afterwards, a 2×2×2 mixed Anova was employed with object motion and framing of arguments as within-subjects factors and source of the message as a between-subjects factor.

Attractiveness. Considering the attractiveness of the hand sanitizer, a main effect of motion was observed. The hand rub displayed in a message with the forward motion was judged more attractive compared to the message with a backward motion, respectively $M = 3.38$; $SD = 1.8$ and $M = 2.5$; $SD = 1.7$; $F\ (1,135) = 36,88$, $p < .001$, $\eta_p^2 = 0.215$. No main effect was observed for the source of the message $F\ (1,135) < 1$, nor for the framing of arguments $F\ (1,135) = 1,99$, $p = .17$. No interactions were observed between independent variables ($F < 1$).

Purchase Intention. In the same way, participants displayed a higher intention to buy the hand rub when the bottle moved forward rather than backward, respectively $M = 3.07$, $SD = 2$ and $M = 2.34$, $SD = 1.8$; $F\ (1, 135) = 28.8$, $p < .001$, $\eta_p^2 = 0.18$. No effect was observed for the source of the message or the framing of message arguments. No significant interaction was observed between the three main independent variables, $F\ (1,135) = 2.45$, $p = .12$. Simple effects analyses (*Scheffé's* post hoc test) revealed that the main difference of object motion was significant only in the two health messages. The public health agency message with a forward motion and a gain argument yielded a higher intention to buy the product ($M = 3.28$, $SD = 2.6$) compared to the same message with a backward motion ($M = 2.19$; $SD = 2.2$; $p = .0019$), and the health agency message with the backward motion and the loss argument ($M = 2.33$, $SD = 2.6$; $p = .016$).

Difficulty and Confidence in Judgments. Concerning metacognitive judgments, participants considered attractiveness to be easier to assess when the bottle moved forward rather than backward, $M = 3.26$, $SD = 2.6$ and $M = 3.62$, $SD = 2.3$; $F\ (1, 135) = 6.13$, $p = .015$, $\eta_p^2 = 0.044$. In the same vein, they considered that they were more confident in their attractiveness judgments with a forward motion of the bottle ($M = 4.37$, $SD = 2.1$) than with a backward motion, $M = 3.71$, $SD = 2.2$; $F\ (1,134) = 32,38$, $p < .001$, $\eta_p^2 = 0.193$. No difference was observed in the difficulty in assessing the purchase of a hand rub product. Participants were more confident in their intention to buy the hand rub product with a forward motion ($M = 4.15$, $SD = 2.4$) than with a backward motion ($M = 3.6$; $SD = 2.4$), $F\ (1, 134) = 18.12$, $p < .001$, $\eta_p^2 = 0.118$.

Measures of Expected Reference Price, Willingness to Pay, Risk, and Attitudes to the Source. After exposure of the four messages, participants labeled the messages more as commercial advertisements than as public health messages ($M = 5.7$; $SD = 2.9$). Attitude toward the two sources was slightly positive ($M = 5.6$, $SD = 1.8$). After exposure to the healthcare industry source, participants judged their own health level better ($M = 7.7$, $SD = 1.7$) than after exposure to a public health source, $M = 6.9$, $SD = 1.9$; $F\ (1,135) = 6,26$, $p = .014$, $\eta_p^2 = 0.044$. Concerning the *Perceived Vulnerability to Disease* scale, no difference was found concerning

perceived infectability (factor 1); $M = 3.5$, $SD = 1.1$; $F(1,135) = 2.8$, $p = .13$. Participants yielded greater scores of *germ aversion* (factor 2) with a health agency source ($M = 4.3$, $SD = 0.9$) compared to a healthcare industry source ($M = 3.9$, $SD = 1.1$; $F(1,135) = 4.5$, $p = .035$, $\eta_p^2 = 0.033$). Finally, participants expected to find the product for a reference market price of €5.8 ($SD = 2.9$). The willingness to pay was greater when the message came from the healthcare industry (M = €6.3, $SD = 3$) rather than a health agency; M = €4.7, $SD = 2.8$; $F(1,121) = 6{,}36$, $p = .013$, $\eta_p^2 = 0.05$.

Discussion

After exposure of the four messages (within-subjects exposure) from the same source (between-subjects variable), participants were aware of the source of the message as revealed by health assessment and willingness to pay for the hand sanitizer. But the source of the message did not contribute to the attitude toward the product. No effect of the loss vs. gain framing of arguments was observed. So, our additivity hypothesis (H2) was not supported. Participants mainly used apparent motion as a heuristic to assess the hand sanitizer and to assess their intention to buy the hand sanitizer. The direction of movement led their judgment. The forward motion of the hand sanitizer bottle induced a greater attractiveness, confidence in one's own judgment and a greater intention to buy. As expected, metacognitive judgments of confidence and ease of judgment were influenced positively by forward or negatively by backward motion. The effect of the movement was significant only for the public health agency source. Plausibly such a source is more associated with a sense of one's own vulnerability (participants assessed to be less healthy and more germ averse compared to a healthcare industry source). Noticeably, the manipulation of arguments (gain or loss framing as within-subjects variable) was too weak in a context where the motion of the main object of the message (the hand rub bottle) engulfed the field (Kergoat et al., 2017).

Study 2: Red vs. Green color background

The purpose was to test the effect of background color as a cue of approach and avoidance motivation on persuasion along with the core ingredients of persuasion.

Pilot study. The same picture of an antibacterial hand sanitizer bottle was exposed to the participants. We will focus here on color as a background. In all studies color was used to highlight the textual message itself (color of the text, background of the text) rather than the whole background. So, it was difficult to disentangle the message processing itself from color as a cue. To our knowledge, no research has focused on the effect of color as a whole background independently of the textual arguments. This focus on the entire background is important because people don't meet one color but a sample of many colors in their environment (Chetverikov et al., 2017). So, we focus here on the main dominant color as a global cue. The full background of the picture was either red (avoidance), green (approach) or gray (achromatic baseline) as a within-subjects variable (random order). To increase the ecological design of the messages, the source and framing of the message were integrated within two messages. The first one (health message) was a loss-framed message produced by a public health agency. The second one (commercial message) was a message produced by the healthcare industry with a gain argument. In this case, the brand ("*Mr. Propre*") was familiar to the participants but unknown as a brand extension of a hygiene product. An online Facebook convenience sample was recruited in France ($N = 492$). No gender effect was found. The main result yielded a hierarchy of preferences in accordance with background color. Participants judged a hand rub exposed with the red background as less attractive compared to the green and the gray background (on an 11-point Likert scale), respectively $M = 2.72$, $M = 3.15$, and $M = 3.04$; $F(2, 938) = 7.5$, $p < .001$, $\eta_p^2 = 0.016$. A main effect of the source was observed, as a hand sanitizer was more attractive with a health agency source compared to a healthcare industry source ($\eta_p^2 = 0.01$). This effect was observed mainly with the health agency source compared to a commercial source ($\eta_p^2 = 0.01$).

Main study. After this pilot study, we used the same design with the same two messages but with only two background colors (red and green). We used a lesser-known brand ("Baccide") to avoid the anchoring effect of previous brand knowledge.

Method and procedure

Participants were exposed to two messages: one with a red background and the other with a green background (within-subjects variable). The order of presentation of the two messages was randomly balanced (red first and green second vs. green first and red second, a between-subjects variable). The type of messages separated a gain-framed commercial advertisement vs. a loss-framed public health message as a between-subjects variable. The corresponding position of the bottle and text (right or left of the picture) was randomized to control for a left bias (Simmonds et al., 2018). (See Appendix 2a and 2b).

All participants were informed that they would evaluate a trial advertising campaign for a hand rub product. First, participants saw a slide with the hand sanitizer bottle (the source was either the healthcare industry or a public health

agency) against the red/green background—depending on the group, followed by a questionnaire. After one message exposure, another message with a different background (green or red) was displayed and the participants responded to the same questions. At the end of the message exposure, participants completed the evaluation questionnaire on the advertising campaign and their expectation about the price of the product.

Participants

Participants from a web survey pool ($N=280$) voluntarily took part here in a survey organized by a research survey company in France. Participants used their own device and clicked on a web link to complete the questionnaire. Participants were aged from 18 to 65 years ($M=38.13$, $SD=11.97$) and were mostly women (63%). The majority of participants were employees ($N=120$) and the others came from all social categories. A power analysis (conducted via G*Power Software, Faul et al., 2009, with Cohen's recommendations, 1988), which assumed a medium effect size of 0.25 for the ANOVA with one within-subjects (Color) and two between-subjects factors (type of message), indicated that 76 participants were required to have a 95% power of detecting a significant effect at p value of 0.05.

Stimuli and measures

The hand sanitizer was presented with two distinct backgrounds (red vs. green color as a within- subjects variable; see Appendix 2c for color calibration). Order of colors was controlled as a between-subjects variable. The bottle was presented with two orders of background presentation: red then green background vs. green then red background. Two types of messages were presented as a between-subjects variable. On the one hand, the commercial message combined a gain argument ("for an immediate feeling of cleanliness and hygiene") provided by an unfamiliar brand ("*Baccide*") from the healthcare industry. On the other hand, the public health message combined a loss argument ("to prevent bacterial infections") provided by the National Ministry of Health (text and logo). The same dependent variables were used as in Study 1: product attractiveness, purchase intention, difficulty to judge and confidence in one's own judgment. At the end of the message presentation, the reference price and willingness to pay were measured. Persuasion knowledge was measured by items about source credibility, communication tone (health message vs. commercial advertisement) and expected impact of the campaign. Finally, participants filled in the Approach-Avoidance Temperament Questionnaire (Elliot & Thrash, 2010) for control purposes only.

The followed hypotheses were tested.

H1: Compared to the green background, a red background will decrease a positive attitude toward hand sanitizers and purchase intention.

H2: Color contributes additively to the effect of core ingredients of persuasion.

H3: At metacognitive level, red color (vs. green) will decrease the perceived ease of message processing.

Results

A $2\times2\times2$ mixed Anova was used with color (red vs. green) as a within-subjects factor, type of message (positively framed commercial advertisement vs. negatively framed public health message) as a between-subjects factor and the order of background colors (red first/green second vs. green first/red second) as a between-subjects factor. For exploratory purposes, we added gender as main effect in the model.

Manipulation Check. The campaign was evaluated as more "commercially tuned" than "public health tuned" when the source of the message was a brand from the healthcare industry, $M=5.2$, $SD=1.9$ compared to a public health agency, $M=4.53$, $SD=1.9$; $F(1, 272)=8.1$, $p<.005$, $\eta_p^2=0.029$. The attributes of the source (Cronbach's $\alpha=0.90$) showed a moderately positive attitude toward the two sources ($M=5.1$, $SD=1.38$). Participants expected the same impact of the campaign on health ($M=4.23$, $SD=1.65$) and on sales ($M=4.45$, $SD=1.5$), whatever the type of the message.

Attractiveness and Purchase Intention. No main effect of between-subjects variables was observed (order of colors, type of message, and gender). Globally, as a main effect, images with a green background received a better evaluation than images with a red background, $F(1, 272)=4.5$, $p=.034$, $\eta_p^2=0.016$. Interaction between type of messages and order of color exposure showed that this effect was observed only when the order of presentation was firstly red then secondly green. $F(1, 272)=8.5$, $p<.001$, $\eta_p^2=0.03$. Only in this order did the image with a green background receive a better evaluation than the image with a red one ($M=4.81$, $SD=0.14$ and $M=4.46$, $SD=0.14$, $p=.008$, post hoc *Scheffé*). No background color effect was observed when the order was green then red between green ($M=4.35$, $SD=0.13$) and a red ($M=4.4$, $SD=0.14$.

The mean intention to purchase the hand sanitizer was greater with a green background $M=4.58$, $SD=0.1$ compared to a red background, $M=4.17$, $SD=0.11$, $F(1, 272)=4.3$, $p=.039$, $\eta_p^2=0.015$. No main effect of between-subjects variables was observed (order of colors, type of message and gender).

Difficulty and Confidence in Judgments. No effect was observed for the difficulty of ($M=3.23$, $SD=1.73$) or

confidence ($M = 4.93$, $SD = 1.32$) in judging attractiveness. No effect of independent variables was observed for confidence ($M = 4.89$, $SD = 1.48$) or difficulty ($M = 3.05$, $SD = 1.71$) in assessing purchase intention.

Measures of Expected Reference Price, Willingness to Pay, and Self-Reported Health. Participants guessed that the mean reference price of the hand sanitizer was €5.4 ($SD = 3.73$) and the mean willingness to pay for the hand sanitizer was €5.6 ($SD = 4.1$), with no significant main effect of between-subjects variables.

Self-reported health (one item) did not vary depending on the type of message ($M = 5.29$; $SD = 1.27$). Women reported a slightly higher frequency of use of hand sanitizers than men ($M = 2.92$, $SD = 1.5$ and $M = 2.49$, $SD = 1.2$; F (1, 272) = 6.48; $p = .012$, $\eta_p^2 = 0.023$). No effect of color background or type of message was observed when considering the approach avoidance temperament scale as a dependent variable. Women and men showed the same level of approach score ($M = 5$, $SD = 1$), but women showed a higher level of avoidance score, $M = 4.5$, $SD = 1.3$ vs. $M = 3.7$, $SD = 1.3$; $p < .001$, F (1, 272) = 24, $p < .001$, $\eta_p^2 = 0.08$.

Discussion

As in the pilot study, the background color of the message yielded a small main effect that related the red background to a decrease of attractiveness of the hand sanitizer compared to green. But interaction with the order of color exposure showed that only the shift of background from red to green contributed significantly to a color effect especially among health messages. The green background was correlated with more attractiveness of the hand rub, but only when a green background followed a red background. The red/green sequence is typically a signal that allows action, such as for instance, traffic lights in the driving environment. Compared to the color red, a green background increased purchase intention. No effect was found on metacognitive judgments (difficulty and confidence about one's own judgment). Contrary to our hypotheses, we did not find an additive effect in accordance with the type of message (a negatively framed health message vs. a positively framed commercial advertisement). It is possible that the use of an unfamiliar brand decreases the contrast between a public health message and a commercial advertisement.

Conclusion and perspectives

The approach and avoidance framework posits that peripheral cues (motion and color) may trigger approach or avoidance motivation in persuasive messages. As expected (H1), both bottle motion and background color changed attitudes toward the hand sanitizer (attractiveness and purchase intention) within the limits of small effect sizes. Globally, attitudes about the hand sanitizer changed in accordance with the apparent motion of the hand sanitizer within the message (attractiveness and purchase intention), color (purchase intention) or color change (attractiveness). Importantly, a forward movement of the bottle increased the feeling of ease in processing the message, and confidence in one's own judgment. We observed no effect on such metacognitive judgments with background color. Thus, our hypothesis regarding the metacognitive impact of approach and avoidance cues (H3) seems partially supported. Considering approach and avoidance motivation as a common framework between the peripheral cue and the core ingredients of the messages (framing of arguments, source, persuasion knowledge), our hypothesis about an additive combination was not validated. In the two experiments, there was direct and indirect evidence that participants had acknowledged that the messages were associated with a given source or epistemic authority (public health agency vs. healthcare industry). But the source of the message did not contribute to changing attitude by itself, even if a motion cue only appeared in relation to a message from a public health agency. The strength of the manipulation of sources and framing of arguments was probably too weak (H2). The small effect of source may have happened because the two sources (public health agency vs. healthcare industry) are both trustworthy in relation to the focal product. Compared to experts, lay persons pay less attention to the source when confronting a health issue (Gottschling et al., 2019). Prior to the COVID-19 pandemic, the use of hand sanitizer was not a prescribed health protective behavior. Participants shared a low level of interest in a message about a hand sanitizer and therefore the motivation to scrutinize the framed arguments of the messages was low.

Our two studies suffer from several limitations. Our convenience samples and settings were contrasted. On the one hand, a college student sample with a large female majority who completed questionnaires in a cubicle. On the other hand, an online sample of the general population. Obviously, students are not representative of the population, but they remain a vulnerable population regarding hand hygiene. To our knowledge, the attention-grabbing effect of motion and color (Wolfe & Horowitz, 2017) are not related to age (except acute cognitive deficits). We did not measure participants' motor and vision abilities (colorblindness) or vulnerability toward microbiological risk (e.g., immunosuppression). Concerning demand effects, participants may have been aware that experimenters had an interest in changes in the messages. Still, participants were plausibly not fully aware of the intensity nor the direction of cues' effects and therefore the direction of the desirable

judgment (Wilson & Brekke, 1994). Considering purchase intention, a part of unknown variability came from the fact that some people already possess a lot of hand sanitizers at home (Haddock & Maio, 2019). Considering generalization to other health domains, we must have in mind two features of hand sanitizers. Firstly, protecting microbiological risk is a fundamental motive shaped by evolution to avoid disease and contamination (Griskevicius & Kenrick, 2013) that differs from other modern risk domains (e.g., car accidents). A "public health" message seems to focus more on germ aversion than a commercial advertisement from the healthcare industry. Secondly, the protection means itself (a hand sanitizer bottle) reflects the concrete day-to-day use of a material product which is available in colored packaging both in public health facilities and in retail outlets. People must grasp a bottle (approach motion) and execute cleaning actions to avoid future disease. This means that motion and color change are relevant in such an action context as they trigger approach and avoidance motivation. Other means of protection are less directly controllable and do not need an action to be repeated daily (e.g., vaccination). Cues such as motion and color may be associated with subtle or blatant cultural symbolic meaning in specific cultural and task contexts. The evidence that cues trigger avoidance and approach motivation remains indirect.

The within-subjects design lacks ecological validity regarding how people receive health messages in everyday contexts. Nevertheless, exposure to multiple versions of a message remains a current communication strategy. In addition, the development of communication campaigns requires lay people and health professionals to choose one preferred message among a set of messages (Kim & Cappella, 2019; Witte et al., 2001). During the COVID-19 pandemic, many health messages were posted around the world about hand hygiene compliance (Liddelow et al., 2021). In such a context, a forward movement of a hand sanitizer bottle may be ambivalent as a reminder of the risk of exposure to disease. Clearly, a larger research program is needed to generalize to other operationalizations of motion and color cues, and other message domains, and to close the gap between attitudes and behaviors (Pellegrino et al., 2016).

In summary, approach and avoidance motivation can provide a useful framework for integrating all the components of a message including peripheral cues such as motion and color. With caution, these cues can help improve the efficacy of risk mitigation interventions. As such, they can be added to a *Typology of Interventions in Proximal Physical Microenvironments* (–TIPPME-; Hollands et al., 2017) as a part of a strategy which "*Add, remove or change words, symbols, numbers or pictures that convey information about the product or object or its use*". In practice, motion and color cues are easy to implement in modern media such e-health communication or dynamic billboards. Besides, our results regarding attitude certainty associated with forward move are promising, as attitude certainty is a predictor of attitude change and stability (Tormala & Rucker, 2018).

Appendix 1

Study 1. Message with a public health source ("*National*

Appendix 2c

Colorimetric coordinates (HSB) of the red and green backgrounds (Study 2).

	Hue	Saturation	Brightness
Red	137	80	69
Green	357	88	92

Data Availability The datasets generated during and/or analyzed during

the current study are available in the OSF (Open Science Framework) repository, https://osf.io/zykn5/.

Declarations

Informed consent On behalf of all authors, the corresponding author states that there is no conflict of interest.

Informed consent Study 1 (University student sample): Informed consent was obtained from all participants included in the study according to the *Société Française de Psychologie* Ethical Guidelines. Study 2 (online sample): Informed consent was obtained from all participants included in the study according to the ICC/ESOMAR International Code on Market, Opinion and Social Research and Data Analytics.

References

Albarracin, D., & Shavitt, S. (2018). Attitudes and attitude change. *Annual Review of Psychology*, *69*, 299–327. https://doi.org/10.1146/annurev-psych-122216-011911

Anderson, J. L., Warren, C. A., Perez, E., Louis, R. I., Phillips, S., Wheeler, J., Cole, M., & Misra, R. (2008). Gender and ethnic differences in hand hygiene practices among college students. *American Journal of Infection Control*, *36*(5), 361–368. https://doi.org/10.1016/j.ajic.2007.09.007

Aubé, B., Rougié, M., Muller, D., Ric, F., & Yzerbyt, V. (2019). The online VAAST: A short and online tool to measure spontaneous approach and avoidance tendencies. *Acta Psychologica*, *201*, 1–10. https://doi.org/10.1016/j.actpsy.2019.102942

Cacioppo, J. T., Priester, J. R., & Berntson, G. G. (1993). Rudimentary determinants of attitudes: Arm flexion and extension have differential effects on attitudes. *Journal of Personality and Social Psychology*, *65*, 5–17. https://doi.org/10.1037/0022-3514.65.1.5

Carretié, L. (2014). Exogenous (automatic) attention to emotional stimuli: a review. *Cognitive, Affective & Behavioral Neuroscience, 14*, 1228-58. https://doi.org/10.3758/s13415-014-0270-2

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: the BIS/BAS scales. *Journal of Personality and Social Psychology*, *67*, 319–333. https://doi.org/10.1037/0022-3514.67.2.319

Chaiken, S., & Trope, Y. (Eds.). (1999). *Dual-process theories in social psychology*. Guilford Press.

Chetverikov, A., Campana, G., & Kristjánsson, Á. (2017). Representing color ensembles. *Psychological Science*, *28*(10), 1510–1517. https://doi.org/10.1177/0956797617713787

Chittaro, L. (2016). Tailoring Web pages for persuasion on prevention topics: message framing, color priming, and gender. *International Conference on Persuasive Technology*, *9638*, 3–14. https://doi.org/10.1007/978-3-319-31510-2_1

Cian, L., Krishna, A., & Elder, R. S. (2015). A sign of things to come behavioral change through dynamic iconography. *Journal of Consumer Research*, *41*, 1426–1446. https://doi.org/10.1086/680,673

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Cretenet, J., & Dru, V. (2004). The influence of unilateral and bilateral arm flexion versus extension on judgments: an exploratory case of motor congruence. *Emotion*, *4*, 282. https://doi.org/10.1037/1528-3542.4.3.282

Decker, J. S., Stannard, S. J., McManus, B., Wittig, S. M., Sisiopiku, V. P., & Stavrinos, D. (2015). The impact of billboards on driver visual behavior: A systematic literature review. *Traffic Injury Prevention, 16*(3), 234–239. https://doi.org/10.1080/15389588.2014.936407

di Fronso, S., Aquino, A., Bondár, R. Z., Montesano, C., Robazza, C., & Bertollo, M. (2020). The influence of core affect on cyclo-ergometer endurance performance: Effects on performance outcomes and perceived exertion. *Journal of Sport and Health Science*, *9*(6), 578–586. https://doi.org/10.1016/j.jshs.2019.12.004

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. *Personality and Individual Differences*, *47*, 541–546. https://doi.org/10.1016/j.paid.2009.05.001

Elliot, A. J. (1999). Approach and avoidance motivation and achievement motivation. *Educational Psychologist*, *34*, 169–189. https://doi.org/10.1207/s15326985ep3403_3

Elliot, A. J. (2006). The hierarchical model of approach-avoidance motivation. *Motivation and Emotion*, *30*, 111–116. https://doi.org/10.1007/s11031-006-9028-7

Elliot, A. J., & Maier, M. A. (2007). Color and psychological functioning. *Current Directions in Psychological Science*, *16*, 250–254. https://doi.org/10.1111/j.1467-8721.2007.00514.x

Elliot, A. J., & Maier, M. A. (2012). Color-in-context theory. In P. Devine & A. Plant (Eds.), *Advances in Experimental Social Psychology, Vol.45*, pp.61–125). Academic Press. https://doi.org/10.1016/B978-0-12-394286-9.00002-0

Elliot, A. J., & Thrash, T. M. (2010). Approach and avoidance temperament as basic dimensions of personality. *Journal of Personality*, *78*, 865–906. https://doi.org/10.1111/j.1467-6494.2010.00636.x

Elliot, A. J., Maier, M. A., Moller, A. C., Friedman, R., & Meinhardt, J. (2007). Color and psychological functioning: the effect of red on performance attainment. *Journal of Experimental Psychology: General*, *136*, 154–168. https://doi.org/10.1037/0096-3445.136.1,154

Ertel, K., Dooley, C., Focht, H., & Moak, J. (2009). Gender Differences in Attitudes and Practices Towards Body Skin Care. *Journal of the American Academy of Dermatologists*, *60*, AB85. https://doi.org/10.1016/j.jaad.2008.11.383

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Ford, E. W., Boyer, B. T., Menachemi, N., & Huerta, T. R. (2014). Increasing hand washing compliance with a simple visual cue. *American Journal of Public Health*, *104*, 1851–1856. https://doi.org/10.2105/ajph.2013.301477

Forder, L., Bosten, J., He, X., & Franklin, A. (2017). A neural signature of the unique hues. *Scientific reports*, *7*, 42364. https://doi.org/10.1038/srep42364

Franconeri, S. L., & Simons, D. J. (2003). Moving and looming stimuli capture attention. *Perception & Psychophysics*, *65*, 999–1010. https://doi.org/10.3758/BF03194829

Fransen, M. L., Smit, E. G., & Verlegh, P. W. J. (2015). Strategies and motives for resistance to persuasion: an integrative framework. *Frontiers in Psychology*, *6*, 1201. https://doi.org/10.3389/fpsyg.2015.01201

Friedman, R. S., & Förster, J. (2005). The influence of approach and avoidance cues on attentional flexibility. *Motivation and Emotion*, *29*(2), 69–81. https://doi.org/10.1007/s11031-005-7954-4

Friestad, M., & Wright, P. (1995). Persuasion knowledge: Lay people's and researchers' beliefs about the psychology of advertising. *Journal of Consumer Research*, *22*, 62–74. https://doi.org/10.1086/209,435

Gallagher, K. M., & Updegraff, J. A. (2012). Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. *Annals of Behavioral Medicine*, *43*, 101–116. https://doi.org/10.1007/s12160-011-9308-7

Gerend, M. A., & Sias, T. (2009). Message framing and color priming: How subtle threat cues affect persuasion. *Journal of Experimental Social Psychology*, *45*, 999–1002. https://doi.org/10.1016/j.jesp.2009.04.002

Gold, N., Lin, Y., Ashcroft, R., & Osman, M. (2020). Better off, as judged by themselves': do people support nudges as a method to change their own behavior? *Behavioural Public Policy*, 1–30. https://doi.org/10.1017/bpp.2020.6

Gottschling, S., Kammerer, Y., & Gerjets, P. (2019). Readers' processing and use of source information as a function of its usefulness to explain conflicting scientific claims. *Discourse Processes*, *56*(5–6), 429–446. https://doi.org/10.1080/0163853X.2019.1610305

Gould, D. J., Drey, N. S., Moralejo, D., Grimshaw, J., & Chudleigh, J. (2008). Interventions to improve hand hygiene compliance in patient care. *Journal of Hospital Infection*, *68*(3), 193–202. https://doi.org/10.1016/j.jhin.2007.11.013

Govier, T. (2010). *A Practical Study of Argument*. Belmont, CA: Wadsworth.

Griskevicius, V., & Kenrick, D. T. (2013). Fundamental motives: How evolutionary needs influence consumer behavior. *Journal of Consumer Psychology*, *23*, 372–386. https://doi.org/10.1016/j.jcps.2013.03.003

Haddock, G., & Maio, G. R. (2019). Inter-individual differences in attitude content: Cognition, affect, and attitudes. *Advances in Experimental Social Psychology*, *59*, 53–102. https://doi.org/10.1016/bs.aesp.2018.10.002

Hevey, D., & Dolan, M. (2014). Approach/avoidance motivation, message framing and skin cancer prevention: A test of the congruency hypothesis. *Journal of Health Psychology*, *19*(8), 1003–1012. https://doi.org/10.1177/1359105313483154

Hollands, G. J., Bignardi, G., Johnston, M., Kelly, M. P., Ogilvie, D., Petticrew, M., & Marteau, T. M. (2017). The TIPPME intervention typology for changing environments to change behaviour. *Nature Human Behaviour*, *1*, 1–9. https://doi.org/10.1038/s41562-017-0140

Huskey, R., Turner, B. O., & Weber, R. (2020). Individual Differences in Brain Responses: New Opportunities for Tailoring Health Communication Campaigns. *Frontiers in Human Neuroscience*, *14*, https://doi.org/10.3389/fnhum.2020.565973

Jenner, E. A., Jones, F., Fletcher, B. C., Miller, L., & Scott, G. M. (2005). Hand hygiene posters: motivators or mixed messages. *Journal of Hospital Infection*, *60*, 218–225. https://doi.org/10.1016/j.jhin.2004.12.014

Jonauskaite, D., Wicker, J., Mohr, C., Dael, N., Havelka, J., Papadatou-Pastou, M., Zhang, M., & Oberfeld, D. (2019). A machine learning approach to quantify the specificity of colour—emotion associations and their cultural differences. *Royal Society Open Science*, *6*, 190741. https://doi.org/10.1098/rsos.190741

Judah, G., Aunger, R., Schmidt, W. P., Michie, S., Granger, S., & Curtis, V. (2009). Experimental pretesting of hand-washing interventions in a natural setting. *American Journal of Public Health*, *99*(Suppl 2), S405–S411. https://doi.org/10.2105/AJPH.2009.164160

Kergoat, M., Meyer, T., & Legal, J. B. (2019). Influence of "health" versus "commercial" physical activity message on snacking behavior. *Journal of Consumer Marketing*, *37*, 170–179. https://doi.org/10.1108/JCM-07-2018-2765

Kergoat, M., Meyer, T., & Merot, A. (2017). Picture-based persuasion in advertising: the impact of attractive pictures on verbal commercial ad's content. *Journal of Consumer Marketing*, *34*, 624–635. https://doi.org/10.1108/JCM-01-2016-1691

Kim, M., & Cappella, J. N. (2019). Reliable, valid and efficient evaluation of media messages: Developing a message testing protocol. *Journal of Communication Management*, *23*, 179–197. https://doi.org/10.1108/JCOM-12-2018-0132

Kirmani, A., & Campbell, M. C. (2009). Taking the target's perspective: The persuasion knowledge model, In M. Wänke (Ed.) *Social psychology of consumer behavior* (pp297–316). London: Psychology Press. https://doi.org/10.4324/9781441605283

Knowles, E. S., & Linn, J. A. (2004). Alpha and Omega strategies for change. In E. S. Knowles, & J. A. Linn (Eds.), *Resistance and persuasion* (pp. 117–148). New York: Psychology Press.

Knowles, E. S., & Riner, D. D. (2011). Omega approaches to persuasion: Overcoming resistance. In A. R. Praktanis (Ed.), *The science of social influence: Advances and future progress* (pp. 83–114). New York: Psychology Press.

Koch, S., Holland, R. W., & van Knippenberg, A. (2008). Regulating cognitive control through approach-avoidance motor actions. *Cognition*, *109*, 133–142. https://doi.org/10.1016/j.cognition.2008.07.014

Kruglanski, A. W., Raviv, A., Bar-Tal, D., Raviv, A., Sharvit, K., Ellis, S., Bar, R., Pierro, A., & Mannetti, L. (2005). Says who?: epistemic authority effects in social judgment. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology, Vol.37*, (pp.345–392). Elsevier Academic Press. https://doi.org/10.1016/S0065-2601(05)37006-7

Kumkale, G. T., Albarracín, D., & Seignourel, P. J. (2010). The effects of source credibility in the presence or absence of prior attitudes: Implications for the design of persuasive communication campaigns. *Journal of Applied Social Psychology*, *40*(6), 1325–1356. https://doi.org/10.1111/j.1559-1816.2010.00620.x

Labrague, L. J., McEnroe-Petitte, D. M., Van de Mortel, T., & Nasirudeen, A. M. A. (2018). A systematic review on hand hygiene knowledge and compliance in student nurses. *International nursing review*, *65*(3), 336–348. https://doi.org/10.1111/inr.12410

Labroo, A. A., & Nielsen, J. (2010). Half the thrill is in the chase: Twisted inferences from embodied cognitions and brand evaluation. *Journal of Consumer Research*, *37*, 143–157. https://doi.org/10.1086/649908

Lee, A. Y., & Aaker, J. L. (2004). Bringing the frame into focus: the influence of regulatory fit on processing fluency and persuasion. *Journal of Personality and Social Psychology*, *86*, 205–218. https://doi.org/10.1037/0022-3514.86.2.205

Liddelow, C., Ferrier, A., & Mullan, B. (2021). Understanding the predictors of hand hygiene using aspects of the theory of planned behaviour and temporal self-regulation theory. *Psychology & Health*, 1–18. https://doi.org/10.1080/08870446.2021.1974862

Mann, T., Sherman, D., & Updegraff, J. (2004). Dispositional motivations and message framing: a test of the congruency hypothesis in college students. *Health Psychology*, *23*, 330–334. https://doi.org/10.1037/0278-6133.23.3.330

McCullock, S. P., & Perrault, E. K. (2020). Exploring the effects of source credibility and message framing on STI screening intentions: An application of prospect and protection motivation theory. *Journal of Health Communication*, *25*(1), 1–11. https://doi.org/10.1080/10810730.2019.1692262

Meier, B. P., D'Agostino, P. R., Elliot, A. J., Maier, M. A., & Wilkowski, B. M. (2012). Color in context: Psychological context moderates the influence of red on approach-and avoidance-motivated behavior. *PloS one*, *7*, e40333. https://doi.org/10.1371/journal.pone.0040333

Mennella, R., Vilarem, E., & Grèzes (2020). Rapid approach-avoidance responses to emotional displays reflect value-based decisions: Neural evidence form EEG study. *Neuroimage*, *222*, 117253. https://doi.org/10.1016/j.neuroimage.2020.117253

Metha, R., & Zhu, R. J. (2009). Blue or red? Exploring the effect of color on cognitive task performance. *Science*, *323*(5918), 1226–1229. https://doi.org/10.1126/science.1169144

O'Keefe, D. J., & Jensen, J. D. (2007). The relative persuasiveness of gain-framed loss-framed messages for encouraging disease prevention behaviors: A meta-analytic review. *Journal of Health Communication*, *12*, 623–644. https://doi.org/10.1080/10810730701615198

Okuhara, T., Ishikawa, H., Okada, M., Kato, M., & Kiuchi, T. (2017). Designing persuasive health materials using processing fluency: a literature review. *BMC Research Notes 10*, 198 (2017). https://doi.org/10.1186/s13104-017-2524-x

Pellegrino, R., Crandall, P., & Seo, H. S. (2016). Using olfaction and unpleasant reminders to reduce the intention-behavior gap in hand washing. *Scientific Reports*, *6*, 18890. https://doi.org/10.1038/srep18890

Petty, R. E., Briñol, P., Tormala, Z. L., & Wegener, D. T. (2007). The role of meta-cognition in social judgment. In A. W. Kruglanski, & E. T. Higgings (Eds.), *Social Psychology: Handbook of basic principles* (2nd ed., pp. 254–284). New York: Cambridge.

Petty, R. E., & Wegener, D. T. (1998). Attitude change: Multiple roles for persuasion variables. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (pp. 323–390). McGraw-Hill.

Pittet, D. (2016). Clean care is safer care. *World Health Organization.* Geneva: WHO; [2016-01-10]. http://www.who.int/gpsc/pittet_message/en/webcite

Preston, C. C., & Colman, A. M. (2000). Optimal number of response categories in rating scales: reliability, validity, discriminating power, and respondent preferences. *Acta Psychologica*, *104*, 1–15. https://doi.org/10.1016/s0001-6918(99)00050-5

Purssell, E., & Gould, D. (2021). Teaching health care students hand hygiene theory and skills: a systematic review. *International Journal of Environmental Health Research*. https://doi.org/10.1080/09603123.2021.1937580

Rothman, A. J., & Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: The role of message framing. *Psychological Bulletin*, *121*, 3–19. https://doi.org/10.1037/0033-2909.121.1.3

Rothman, A. J., Bartels, R. D., Wlaschin, J., & Salovey, P. (2006). The strategic use of gain-and loss-framed messages to promote healthy behavior: How theory can inform practice. *Journal of Communication*, *56*, 202–220. https://doi.org/10.1111/j.1460-2466.2006.00290.x

Schuldt, J. P. (2013). Does green mean healthy? Nutrition label color affects perceptions of healthfulness. *Health Communication*, *28*, 814–821. https://doi.org/10.1080/10410236.2012.725270

Schwarz, N. (2004). Metacognitive experiences in consumer judgment and decision-making. *Journal of Consumer Psychology*, *14*, 332–348. https://doi.org/10.1207/s15327663jcp1404_2

Seibt, B., Neumann, R., Nussinson, R., & Strack, F. (2008). Movement direction or change in distance? Self-and object-related approach–avoidance motions. *Journal of Experimental Social Psychology*, *44*(3), 713–720. https://doi.org/10.1016/j.jesp.2007.04.013

Sherman, D. K., Mann, T., & Updegraff, J. A. (2006). Approach/avoidance motivation, message framing, and health behavior: Understanding the congruency effect. *Motivation and Emotion*, *30*, 164–168. https://doi.org/10.1007/s11031-006-9001-5

Simmonds, G., Woods, A., & Spence, C. (2018). "Seeing What's Left": The effect of position of transparent windows on product evaluation. *Foods*, *7*, 151. https://doi.org/10.3390/foods7090151

Tormala, Z. L., & Rucker, D. D. (2018). Attitude certainty: Antecedents, consequences, and new directions. *Consumer Psychology Review*, *1*(1), 72–89. https://doi.org/10.1002/arcp.1004. https://doi-org.faraway.parisnanterre.fr/

Updegraff, J. A., & Rothman, A. J. (2013). Health message framing: Moderators, mediators, and mysteries. *Social and Personality Psychology Compass*, *7*, 668–679. https://doi.org/10.1111/spc3.12056

Updegraff, J. A., Emanuel, A. S., Gallagher, K. M., & Steinman, C. T. (2011). Framing flu prevention—An experimental field test of signs promoting hand hygiene during the 2009–2010 H1N1 pandemic. *Health Psychology*, *30*, 295–299. https://doi.org/10.1037/a0023125

Van't Riet, J., Cox, A. D., Cox, D., Zimet, G. D., De Bruijn, G. J., Van den Putte, B., & Ruiter, R. A. (2014). Does perceived risk influence the effects of message framing? A new investigation of a widely held notion. *Psychology & Health*, *29*, 933–949. https://doi.org/10.1080/08870446.2014.896916

Verselder, H., Freddi, S., & Dru, V. (2017). Effect of combined motor and spatial cues on mathematical reasoning: A polarity correspondence account. *Psychological Research Psychologische Forschung*, *81*, 910–924. https://doi.org/10.1007/s00426-016-0799-5

Williams, D. J., & Noyes, J. M. (2007). How does our perception of risk influence decision-making? Implications for the design of risk information. *Theoretical Issues in Ergonomics Science*, *8*, 1–35. https://doi.org/10.1080/14639220500484419

White, A. R., Martinez, L. M., Martinez, L. F., & Rando, B. (2021). Color in web banner advertising: The influence of analogous and complementary colors on attitude and purchase intention. *Electronic Commerce Research and Applications*, *50*, https://doi.org/10.1016/j.elerap.2021.101100

Wilson, T. D., & Brekke, N. (1994). Mental contamination and mental correction: unwanted influences on judgments and evaluations. *Psychological Bulletin*, *116*(1), 117–142. https://doi.org/10.1037/0033-2909.116.1.117

Wilson, K. E., & Estabrooks, P. A. (2020). Physical activity promotion message perceptions biased by motivational dispositions. *Applied Psychology Health & WellBeing*, *12*, 610–635. https://doi.org/10.1111/aphw.12199. https://doi.org-org.ezproxy.u-pec.fr/

Wilson, E. J., & Sherrell, D. L. (1993). Source effects in communication and persuasion research: A meta-analysis of effect size. *Journal of the Academy of Marketing Science*, *21*(2), 101–112. https://doi.org/10.1007/BF02894421

Witte, K., Meyer, G., & Martell, D. (2001). *Effective health risk messages*: *A step-by-step guide.* Sage: Thousand Oaks (CA). https://doi.org/10.4135/9781452233239

Wogalter, M., Mayhorn, C., & Zielinska, O. (2015). Use of color in warnings. In A. Elliot, M. Fairchild, & A. Franklin (Eds.), *Handbook of color psychology* (pp.377–400). Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9781107337930.019

Wolfe, J. M., & Horowitz, T. S. (2017). Five factors that guide attention in visual search. *Nature Human Behaviour*, *1*(3), 1–8. https://doi.org/10.1038/s41562-017-0058

Yu, Y. X., & Zhou, H. (2018). Red or Blue? The influence of background color on promotion value perception. *American Journal of Industrial and Business Management*, *8*, 619–637. https://doi.org/10.4236/ajibm.2018.83041

Zhang, T., & Han, B. (2014). Experience reverses the red effect among Chinese stockbrokers. *PloS one*, *9*, e89193. https://doi.org/10.1371/journal.pone.0089193

Zhang, T., Bao, C., & Xiao, C. (2019). Promoting effects of color-text congruence in banner advertising. *Color Research & Application*, *44*(1), 125–131. https://doi.org/10.1002/col.22260. https://doi.org/.org-org.ezproxy.u-pec.fr/