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Approach-avoidance action tendencies: A replicable approach/avoidance compatibility effect can be found when valence is task irrelevant☆

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ABSTRACT

Attitude objects (e.g., social groups) are assumed to elicit behavioral responses without thoughtful processing of their valence. Despite a theoretical consensus on this assumption, empirical evidence is mixed. To address this question, we provide evidence that approach-avoidance action tendencies are triggered by attitude objects when participants do not need to process objects' valence to perform the task. We did so with a version of the Visual Approach-Avoidance by the Self Task (VAAST, Rougier et al., 2018) in which participants were primed with a positive or negative word and then had to approach/avoid a neutral target. Across seven experiments we consistently found approach-avoidance compatibility effects (i.e., faster response times to approach a neutral target preceded by a positive [vs. negative] prime and to avoid a neutral target preceded by a negative [vs. positive] prime), even when introducing challenging manipulations. These effects yielded evidential *p*-values, they were robust across data-analytic decisions, and experiments were highly powered. This work corroborates theories predicting action triggering without thoughtful processing and could be the basis for studying action tendencies associated with various social stimuli (e.g., ingroup and outgroup individuals).

Would it be adaptive to thoughtfully decide what to do every time you encounter an object? Probably not. Consistent with this view, many social psychologists indeed assume that objects are evaluated for valence without individuals' intention to do so (e.g., Bargh et al., 1992; Chen & Bargh, 1999; Fazio et al., 1986; Greenwald et al., 1998; Payne et al., 2005; Zajonc, 1980). A remaining question is whether this unintended evaluation leads to the enactment of behavioral tendencies. This question is of particular importance because behavioral tendencies are at the core of the concept of "attitude", one of the most central concepts in social psychology (Allport, 1935; Campbell, 1963; Eagly & Chaiken, 1993). In this work, we aim to provide robust (i.e., highly replicable) evidence that attitude objects can influence approach-avoidance action tendencies even when performing the task does not require valence processing.

1. Approach/avoidance action tendencies in a task where valence is irrelevant

A common idea in social psychology is that human must process large amounts of information, making it adaptive to launch behavioral responses without thoughtful processing (Bargh, 2017; Wilson, 2002). As an illustration, Chen and Bargh (1999) argued that approach/avoidance behavioral tendencies should be activated automatically when individuals are presented with positive and negative stimuli. Their participants had to move a lever either with arm flexion (considered by these authors as an approach action) or extension (considered as an avoidance action) as soon as words appeared on a screen (Chen & Bargh, 1999, Exp. 2). Importantly, although the words were either positive or negative, valence was irrelevant for performing the task. This study revealed an approach/avoidance compatibility effect such that participants were faster to approach positive words and avoid negative words—'compatible' trials—than to approach negative words and avoid

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positive words—'incompatible' trials. According to Chen and Bargh, simply seeing valenced words was enough to automatically trigger approach/avoidance action tendencies—that is, without the need to evaluate words as positive or negative.

"Automaticity" can, of course, imply different things (Bargh, 1994; Moors & De Houwer, 2006). In the approach/avoidance literature, automaticity often points to intentionality (e.g., Chen & Bargh, 1999; Krieglmeyer et al., 2013; Laham et al., 2015; Phaf et al., 2014). This is often translated into 'valence-irrelevant tasks', namely, tasks where participants are required to respond on a dimension (e.g., color, shape, grammatical category, or the mere onset of the target stimulus) other than the dimension under investigation (in the present case, valence; for a discussion of such tasks, see De Houwer, 2009). The level of evidence in support for an approach/avoidance compatibility effect with such tasks is, however, debated. Therefore, it remains unknown whether a replicable approach/avoidance compatibility effect can be found when participants are not required to evaluate the valence of the stimuli to perform the task—or even to process the stimuli at all. We now present theoretical accounts of approach/avoidance compatibility effects that predict a compatibility effect in valence-irrelevant tasks.

One of the most influential theoretical accounts of approach/avoidance compatibility effects is the "distance change hypothesis" (Krieglmeyer et al., 2013; Krieglmeyer & Deutsch, 2010). It suggests that positive stimuli trigger a motivation to reduce the distance between the self and the object (i.e., to approach), whereas negative stimuli trigger a motivation to increase this distance (i.e., to avoid). Importantly, this motivation should be activated without a thoughtful processing of the stimuli.

A second account is the evaluative coding hypothesis (Eder & Rothermund, 2008). It argues that the approach/avoidance compatibility effect is driven by the compatibility between the valence of the stimulus and the affective connotation of the response, because approach is positive whereas avoidance is negative in most contexts. Here again, approach-avoidance responses should be activated by positive stimuli in the case of approach and by negative stimuli in the case of avoidance without the intention to process their shared evaluative codes.

A third account is the grounded cognition framework, which argues that perception of valenced stimuli pre-activates the sensorimotor components of action tendencies—the motor component involved in arm movements (Chen & Bargh, 1999) or the visual component of the approach/avoidance visual flow (Rougier et al., 2018). Importantly, this should not require intending to evaluate the valence of the stimuli (Barsalou, 2008; Niedenthal et al., 2005). Although explanations relying on arm movements have been challenged in the literature (Krieglmeyer et al., 2013), it is important to note that the grounded cognition framework is not inherently limited to motor aspects (Barsalou, 2020; Rougier et al., 2018).

In sum, several theoretical accounts predict approach/avoidance compatibility effects even when the task does not require participants to evaluate the valence of the stimuli. However, empirical evidence on this issue remains inconclusive.

Chen and Bargh (1999; Exp. 2) provided the first experimental demonstration of this effect, but later replications failed to provide clear-cut results (Rotteveel et al., 2015; see also Krieglmeyer & Deutsch, 2010). Moreover, two meta-analyses (Laham et al., 2015; Phaf et al., 2014) reported conflicting conclusions. Whereas Laham et al. concluded that this effect is small but significant, Phaf et al. concluded that this effect was not reliable. This reinforces the need for an empirical investigation of an effect predicted both by general theoretical frameworks (Bargh, 2017; Wilson, 2002) and by hypotheses specific to attitudes and the approach/avoidance domain. As we explain below, one possible explanation for previous inconclusive findings is the use of suboptimal approach/avoidance measures.

2. Selecting the appropriate approach/avoidance measure

There are at least two orthogonal dimensions to consider when selecting the most appropriate task for our purpose. The first dimension relates to stimuli and what participants are required to process about them. The second dimension concerns how approach/avoidance is operationalized.

2.1. Dimension 1: What the stimuli are and what is required to be processed about them

Stimuli displayed to participants can be of a single kind—that is, targets (that participants need to respond to)—or of two kinds—that is, primes (that participants can ignore) and targets. When only (positive or negative) targets are presented, participants can be asked to intentionally process and respond to their valence—making it a valence-relevant task—or to intentionally process and respond to another dimension (e.g., adjectives vs. nouns; De Houwer et al., 2001)—making it a valence-irrelevant task. When primes and targets are presented, participants are required to intentionally process and respond only to a characteristic of the targets (e.g., their geometric shapes; Pillaud et al., 2024), also making it a valence-irrelevant task. Still, in this configuration primes are expected to influence participants' response times on the targets. In addition, those primes can be presented either suboptimally (sometimes referred to as subliminally) or supraliminally.

Selecting the optimal valence-irrelevant task requires finding the right balance between a task sufficiently robust to produce the effect and sufficiently stringent as a test of a compatibility effect when valence is task-irrelevant. There are at least three main kinds of tasks.

Again, when only targets are presented, participants need to respond along a dimension other than valence, such as whether the targets are nouns or adjectives (De Houwer et al., 2001; Krieglmeyer & Deutsch, 2010). In that kind of work, although participants do not need to process the valence of the targets to perform the task, they still must process the target stimuli (because they must, for instance, determine their grammatical category). Therefore, such a paradigm would be less stringent because it does not demonstrate that approach/avoidance behaviors can be triggered when participants are not asked to process the stimuli at all to perform the task.

The second and third kinds of paradigms use primes and targets, and participants do not need to process the primes to perform the task because responses are made only to the targets. In the second kind of paradigm, these primes are presented suboptimally (some would say subliminally; Alexopoulos & Ric, 2007; Arnaudova et al., 2017; Pillaud & Ric, 2022; Rougier et al., 2018). For instance, in one experiment participants were briefly (30 ms) exposed to valenced word primes and then saw a string of letters (e.g., "nlkjdsOaq") that either contained or did not contain an uppercase letter (Rougier et al., 2018; Exp. 5). Participants needed, for example, to approach when an uppercase letter was present and to avoid when it was not. Such a task, by making the primes difficult to perceive consciously, obviously renders the influence of the prime (and thus valence processing) unintentional. The literature on subliminal priming, however, shows that these effects are difficult to replicate (Newell & Shanks, 2014). Because our goal is to provide replicable findings that other teams could easily reproduce, such a paradigm is not the best option.

The third kind of paradigm is a middle ground between the other two paradigms, because the primes are now presented supraliminally, but participants still do not need to process them. For instance, in Pillaud et al. (2024), participants were presented with a prime (i.e., a positive or a negative word) for 300 ms, followed by a geometric shape (i.e., a square or a diamond), and participants had to approach one shape (e.g., the square) and avoid the other (e.g., the diamond). In our experiments, we used a similar task with a few modifications. Notably, in most of our experiments, we explicitly asked participants to ignore the primes to discourage intentional processing of the primes.

2.2. Dimension 2: Selecting the approach/avoidance operationalization

We present three of the most common operationalizations of approach/avoidance and discuss their relative effect sizes. This point is important because effect sizes often shrink when using valence-irrelevant tasks (Phaf et al., 2014), thereby reducing the likelihood of finding a replicable approach/avoidance compatibility effect.

The first approach/avoidance operationalization, inspired by Chen and Bargh (1999), relies on arm movements using joysticks (Krieglmeyer & Deutsch, 2010; Seibt et al., 2008) or using modified keyboards (Alexopoulos & Ric, 2007; Paladino & Castelli, 2008). This operationalization is often combined with a visual simulation of the stimulus approaching or moving away (e.g., Krieglmeyer & Deutsch, 2010; Rinck & Becker, 2007).

The second type of operationalization has been introduced by De Houwer et al. (2001). In the manikin task (Krieglmeyer & Deutsch, 2010), participants see, for instance, in the upper or lower part of the screen, a small character and must move this character, intended to represent them, closer or farther away from the critical stimuli (e.g., valenced words presented in the center of the screen).

In the third type of operationalization, participants need to approach or avoid stimuli in a virtual computerized environment (Rougier et al., 2018). Pressing, for instance, the approach key provides a visual simulation of what happens when someone moves toward a stimulus, namely, the stimulus moves toward the participant and the background changes as it does when one takes a step forward in an environment (what can be referred to as a visual flow). Since the task focuses on visual simulations and simulates movements of the whole self, Rougier et al. coined it the Visual Approach/Avoidance by the Self Task (VAAST).

Prior work has shown that the joystick task led to smaller compatibility effects than the manikin task (Krieglmeyer & Deutsch, 2010). In addition, a previous experiment showed that the VAAST leads to a larger compatibility effect than the manikin task (Rougier et al., 2018). Because larger effect sizes are more easily replicated, in this contribution we therefore relied on the VAAST.

3. Overview

As we mentioned earlier, at least three theoretical accounts of approach/avoidance predict an approach/avoidance compatibility effect even with valence-irrelevant tasks. The existence of this effect, however, remains a matter of debate. The goal of the present research is to gather convincing evidence that such a compatibility effect can be found (and readily replicated). Because the robustness of our findings regarding the compatibility effect (namely the movement-by-valence interaction) was central, all experiments except the first were preregistered and all of them were well-powered to test this effect. To enhance generalizability, we also relied on both lab (with student participants) and online experiments (with more diverse participants; Paolacci et al., 2010), as well as on French and UK participants.

In Experiments 1a, 1b, and 1c, we tested whether we could find a robust approach-avoidance compatibility effect with a valence-irrelevant task. In Experiments 2a and 2b, we aimed to decrease the salience of valence using neutral primes in addition to valenced primes (50% and 75% neutral primes in Experiments 2a and 2b, respectively). In Experiments 3a and 3b, we tested the approach/avoidance compatibility effect again, this time either without instructing participants to ignore the words (i.e., contrary to what we did before) or orienting the secondary task toward a dimension other than the semantic one.

4. Transparency and openness

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study, and we follow the JARS (Appelbaum et al., 2018). All data, materials, and analysis codes are available as components on the OSF page of each individual experiment. For all experiments except Experiment 1a, the hypothesis, sample size, design, and analysis plans were preregistered on OSF. We report deviations from preregistrations in Table S11. Note that Experiment 1a was replicated twice (i.e., in Exp. 1b and 1c). In terms of analytical strategy, we used linear mixed models, notably because they allow to reduce Type 1 errors (Judd et al., 2012). Links to individual OSF pages and preregistrations are provided in Table 1.

5. Participants, designs, and power analyses

To facilitate reading, we provide descriptive information about participants for each experiment in Table 2. In all our experiments, we relied on a 2 (prime: positive word vs. negative word) × 2 (movement: approach vs. avoidance) within-subjects design. Response times for approach and avoidance decisions (measured from target onset) was our dependent variable. In all experiments except Experiment 1b, we relied on a priori sensitivity analyses to detect small-to-moderate effect sizes with 80%–90% power. Because Experiment 1b was a direct replication, we relied on an a priori power analysis based on the observed effect size of Experiment 1a. Details about a priori power analyses are provided in the preregistrations for each experiment available on OSF. Furthermore, for each experiment, we report sensitivity power analyses given the final (analyzed) sample size.

6. Data analytic procedure

All our experiments followed the same data-analytic procedure. Participants were excluded if they (a) failed an attentional check, (b) did not report at least a very good level of French or English, (c) had less than 70% accuracy, or (d) had a mean response time more than three standard deviations above or below the sample mean. Our conclusions remained unchanged when the exclusion criteria were not applied. Trials were excluded if they met any of the following criteria: (a) incorrect responses, (b) response times faster than 250 ms, or (c) response times slower than 1500 ms. We provide details about the exclusions for each experiment in Table 3. In addition, we report the approach/avoidance compatibility effect *p*-values across variations in data-analytic decisions (sometimes referred to as a multiverse analysis; Steegen et al., 2016) in the supplementary material (cf. Table S1).

We analyzed participants' log-transformed response times using a linear mixed-effects model in R (version 4.3.2; R Core Team, 2023) and the lme4 package (version 1.1–35.1; Bates et al., 2015). As fixed effects we specified movement (approach vs. avoidance), word valence

Table 1
OSF pages and preregistrations links.

Experiment	OSF Page	Preregistration
Exp. 1a	https://osf.io/sj2y6/?view_only=91d94ffa7c9049f3a656764e88beb6d7	No preregistration
Exp. 1b	https://osf.io/9qxhs/?view_only=17d8350cba66490f9618686669e08b34	https://osf.io/rzm2g/?view_only=e081d1e4323d42c9b6514cf37e0461e3
Exp. 1c	https://osf.io/3vd7n/?view_only=00888ae966d847a8b1dcb8c4a0a38c74	https://osf.io/e7cfb/?view_only=08a79feb880f485a8514a1c4599d844a
Exp. 2a	https://osf.io/y7px3/?view_only=d975b3d36ec0461fb484b00d0941a165	https://osf.io/jxtes/?view_only=1c6634de83d242bb932f29640f64b14f
Exp. 2b	https://osf.io/67sy8/?view_only=ca9fb28cfe4f4eae8ebd8a7017d6230e	https://osf.io/ebamf/?view_only=779fba193cc446fa95be078a17b7609a
Exp. 3a	https://osf.io/79uvd/?view_only=1427cf10ed964dcca23587600b30f0ea	https://osf.io/5mwej/?view_only=f03828a30ed2490bbb29112d6341eccb
Exp. 3b	https://osf.io/3jwkb/?view_only=61ce073726ec48d7801818f18af8cf0f	https://osf.io/acxz6/?view_only=cf0a397982c2449d9a89b4ebf7b67ef5

Table 2
Descriptive table of participants' demographic information.

Experiment	*N* (women, men, other)	Mean age (*SD*)	Settings	Participants (retribution)	Country of residence	Year
Exp. 1a	122 (110,12,0)	21 (3)	Lab	Psych students (course credit)	France	2019
Exp. 1b	100 (92, 8, 0)	20 (2)	Lab	Psych students (course credit)	France	2020
Exp. 1c	198 (100, 97, 1)	35 (13)	Online	Prolific (1.50£)	UK	2021
Exp. 2a	297 (189, 107, 1)	35 (12)	Online	Prolific (3.00£)	UK	2021
Exp. 2b	346 (195, 147, 4)	35 (14)	Online	Prolific (3.80£)	UK	2021
Exp. 3a	112 (70, 40, 2)	32 (11)	Online	Prolific (1.90£)	UK	2021
Exp. 3b	110 (55, 54, 1)	38 (12)	Online	Prolific (2.00£)	UK	2021

Note. Sample sizes (*N*) are reported before exclusion (see Table 3 for a reporting of these exclusions).

Table 3
Descriptive table of participants and trials exclusions.

Experiment	Number of participants exclusions					% of trials excluded		
	AC[a]	Language	< 70% ACC[b]	RT > 3SD	MT[c]	Incorrect	<250 ms	>1500 ms
Exp. 1a		5		1		4.23%	0.71%	0.53%
Exp. 1b		5	1	2		4.54%	0.51%	0.52%
Exp. 1c	1		1	4		2.11%	0.04%	1.14%
Exp. 2a	2	2	1	1		2.04%	0.04%	1.95%
Exp. 2b	4			1		2.06%	0.05%	2.09%
Exp. 3a	2					2.73%	0.08%	1.33%
Exp. 3b	1			1	7	1.78%	0.10%	2.17%

Note. [a]Attentional Check criterion. [b]Participants having less than 70% of accuracy. [c]Mental Tally exclusions (only relevant in Exp. 3b).

(positive vs. negative), and their interaction. Fundamentally, testing either the compatibility effect (difference between compatible and incompatible trials) or the Movement × Valence interaction amounts to the same effect (see Brauer & Judd, 2000). We report the interaction to provide readers more information about the main effects of movement and word valence. As random effects, we specified random intercepts for participants and stimuli, as well as by-participants random slopes for movement, valence, and their interaction, and by-stimuli random slopes for movement. We obtained p-values using the Satterthwhaite approximation implemented in lmerTest (version 3.1–3; Kuznetsova et al., 2017). When encountering convergence or singularity issues, we simplified the model following the recommendations of Barr et al. (2013).[1] Our data-analytic procedure was preregistered for all experiments, with the exception of Experiment 1a. Deviations from the preregistered procedure are reported in Table S11. We report the significance of the random terms relevant to the compatibility effect in supplementary material (cf. Table S3). Effect sizes estimates (i.e., *dz*) were based on a 2 × 2 (by-participants) within-subjects ANOVA. We also analyzed participants' accuracies (rather than response times) using a logistic mixed-effects model with the same fixed- and random-effects structure (see Table S9). Overall, we observed significant compatibility effects on accuracy as well, except in Experiment 3b, and found no evidence of speed-accuracy trade-offs.

7. Experiments 1a, 1b, and 1c

The goal of these experiments was to provide a first test of our valence-irrelevant version of the VAAST. This version of the task was modeled after Fazio et al.'s (1986) classic evaluative priming paradigm. We presented participants with a word prime (positive vs negative) for 200 ms, followed by a blank screen for 100 ms, and then the target stimulus (a square or a diamond), which they were instructed to approach or to avoid as quickly as possible. We explicitly instructed participants to ignore the word prime. Experiments 1a and 1b were conducted in the lab (on French participants), whereas Experiment 1c was conducted online (with UK participants recruited via Prolific). Given the final analyzed sample sizes, Experiments 1a, 1b, and 1c had 80% power (with $\alpha = 0.05$) to detect effect sizes of $dz = 0.26$, $dz = 0.30$, and $dz = 0.20$, respectively.

8. Method

8.1. Procedure and material

The procedure we used was a version of the VAAST (Rougier et al., 2018). Throughout the procedure, the same visual environment was presented as a background, creating an impression of depth (i.e., a street alley). We instructed participants to use only their index finger when pressing keys to perform the task. After pressing the start button (i.e., the middle button of a button box in the lab or the G key on the keyboard online), each trial began with a white circle, which was replaced by a fixation cross presented for a random duration (i.e., 650 ms to 2000 ms). Once the fixation cross disappeared, a word (i.e., the positive or negative prime) was displayed for 200 ms. Then, 100 ms after the word disappeared, a geometric shape (i.e., a square or a diamond) was displayed. Participants were instructed to ignore the word (except in Exp. 3a and 3b) and half were assigned to approach the square and to avoid the diamond, whereas the other half were assigned to the opposite mapping. When participants pressed the approach (i.e., a button above the middle button in the lab or the T key online) or the avoidance button (i.e., a button below the middle button in the lab or the B key online), the entire visual environment (including the geometric shape) changed, visually

[1] Because we followed this data modelling procedure, the final statistical models random-effect structure varied across experiments (see Table S2). This explains that there are sometimes wide variations in the estimated degrees of freedom.

simulating a whole-body movement of approach or avoidance (see Fig. 1). Specifically, the geometric shape became larger or smaller, and the environment changed as it would when one moves through a space (e.g., objects previously hidden by obstacles became visible when moving forward).

The task began with a training phase of 10 trials, after which participants proceeded to the test phase consisting of 160 trials presented in random order (40 positive–approach, 40 positive–avoidance, 40 negative–approach, and 40 negative–avoidance trials). The 20 positive words (e.g., beach, joy, smile) and 20 negative words (e.g., cancer, death, poison) of the test phase were selected to be clearly positive or negative. Each word was repeated four times in the test phase (twice before a square shape and twice before a diamond shape). In Experiment 1c, we replaced some words to better equate average frequencies between positive and negative words (see Tables S4-S7 in the supplementary material). The prime words of the training phase were also clearly positive or negative, but different from those of the test phase, except in Experiment 1a (see Table S8). Critically, the valence of the prime words was irrelevant for performing the task, which required responses only to the geometric shapes. The procedure was programmed using *E*-Prime 3 (Psychology Software Tools, Inc., 2016) for in-lab settings and using jsPsych (version 6.3; De Leeuw, 2015) for online settings.

9. Results

In Experiment 1a, the mixed-effects model analysis revealed a significant movement main effect, $t(114.05) = 3.26$, $p = .001$, $dz = 0.31$, 95% CI [0.13, 0.50] with participants being faster to approach ($M = 518.82$, $SD = 170.36$) than to avoid ($M = 532.80$, $SD = 165.40$). It also revealed a significant valence main effect, $t(111.67) = 3.17$, $p = .002$, $dz = 0.29$, 95% CI [0.10, 0.48] with participants being faster for positive ($M = 522.27$, $SD = 164.87$) than for negative ($M = 529.45$, $SD = 171.06$) words. Critically, the interaction between movement and valence (i.e., the approach/avoidance compatibility effect) was significant, $t(98.27) = 9.20$, $p < .001$, $dz = 0.90$, 95% CI [0.68, 1.12]. That means that participants were faster for the average of the compatible conditions ($M = 511.06$, $SD = 167.15$) than for the average of the incompatible conditions ($M = 541.03$, $SD = 167.57$; see Fig. 2A).

In Experiment 1b, the analysis revealed non-significant main effects for movement, $t(91.01) = 1.11$, $p = .270$, $dz = 0.11$, 95% CI [−0.09, 0.32] and valence, $t(38.05) = 0.82$, $p = .416$, $dz = 0.09$, 95% CI [−0.12, 0.29]. Critically, the interaction between movement and valence was significant, $t(88.98) = 7.42$, $p < .001$, $dz = 0.77$, 95% CI [0.53, 1.00] with participants being faster, on average, in the compatible conditions ($M = 527.80$, $SD = 175.73$) than in the incompatible conditions ($M = 550.21$, $SD = 170.45$; see Fig. 2B).

In Experiment 1c, the analysis revealed a significant movement main effect, $t(192.69) = 2.49$, $p = .014$, $dz = 0.19$, 95% CI [0.05, 0.33] with participants being faster to approach ($M = 617.76$, $SD = 180.83$) than to avoid ($M = 628.78$, $SD = 178.94$). The valence main effect was not significant, $t(29{,}116.62) = 1.50$, $p = .133$, $dz = 0.11$, 95% CI [−0.04, 0.25]. Critically, the interaction between movement and valence was significant, $t(41.22) = 4.79$, $p < .001$, $dz = 0.48$, 95% CI [0.33, 0.62] with participants being faster, on average, in the compatible conditions ($M = 617.91$, $SD = 178.80$) than in the incompatible conditions ($M = 628.69$, $SD = 180.99$; see Fig. 2C).

10. Experiments 2a and 2b

In our previous experiments, participants saw only positive or negative word primes. Although the task did not require processing valence, merely seeing valenced words could make this dimension salient and thus more likely to be processed. Indeed, prior work on the Simon effect and affective priming has shown that these effects were reduced to non-significance when valence was made less salient by reducing the proportion of valenced words (Duscherer et al., 2008; Everaert et al., 2011). We tested a similar idea by including only 50% and 25% valenced primes, respectively in Experiments 2a and 2b. Because we aimed to gather evidence that attitude objects can influence approach/avoidance action tendencies even when there is no reason to process valence, we expected the compatibility effect to remain significant. Given the final analyzed sample sizes, Experiments 2a and 2b had 80% power (with $\alpha = 0.05$) to detect effect sizes of $dz = 0.17$ and $dz = 0.15$, respectively.

11. Method

11.1. Procedure

The procedure in Experiments 2a and 2b was similar to that of the previous experiments, with the only exception that the prime was neutral in valence (e.g., "average", "clue", "demonstration") in 50% (Exp. 2a) and 75% (Exp. 2b) of the trials. In Experiment 2a, we doubled the number of trials (i.e., 320 trials) compared to Experiments 1a and 1b to allow for the inclusion of 50% of filler trials with 40 neutral words. We replaced some valenced words to better equate the average

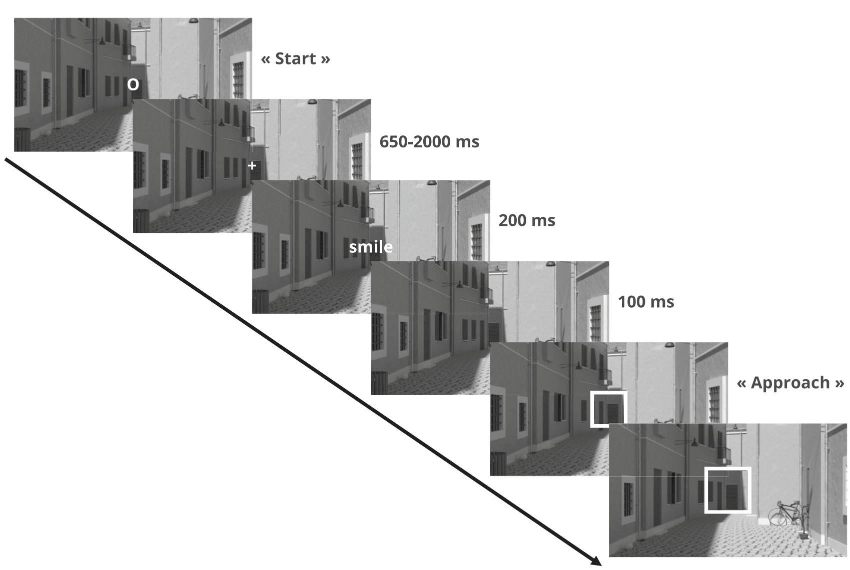

Fig. 1. Schema of an approach trial in the valence-irrelevant VAAST with a positive prime.

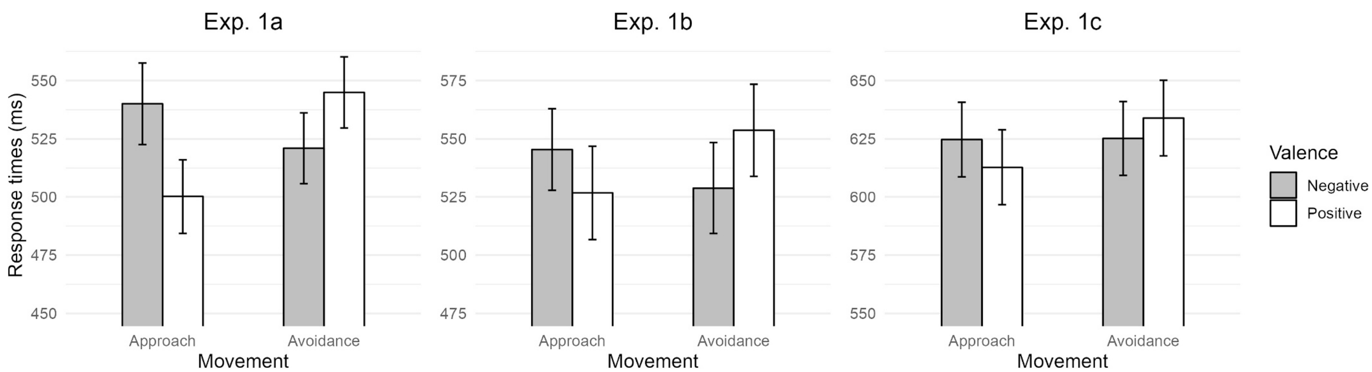

Fig. 2. Mean response times (in ms) as a function of movement and valence in Experiments 1a, 1b, and 1c.
Note. Error bars represent the 95% confidence intervals. The y-axes were cropped to ease the visualization. Additionally, the response time ranges differ across experiments while remaining within a 100 ms range to facilitate visual comparison.

frequency of positive and negative words with that of neutral words (see Table S6). Thus, participants performed 160 trials with valenced primes (i.e., positive and negative words) and 160 trials with neutral primes (i. e., valence-neutral words). The 320 trials were presented in random order. In Experiment 2b, participants completed 480 trials, 75% of which included neutral primes (i.e., 360 trials with a neutral prime, 60 with a positive prime, and 60 with a negative prime). Consequently, we added 50 new neutral words (see Table S7). Furthermore, because the number of trials with positive or negative primes was reduced from 160 to 120, each participant was exposed to 15 positive and 15 negative prime words. Prime words were randomly drawn for each participant from the valenced word set of Experiment 2a.

11.2. Results

In Experiment 2a, the mixed-effects model analysis revealed a significant movement main effect, $t(290.17) = 4.54$, $p < .001$, $dz = 0.27$, 95% CI [0.15, 0.38] with participants being faster to approach ($M = 634.17$, $SD = 195.02$) than to avoid ($M = 648.80$, $SD = 193.80$). The valence main effect was also significant, $t(283.89) = 4.12$, $p < .001$, $dz = 0.24$, 95% CI [0.12, 0.35], participants being faster for positive ($M = 638.99$, $SD = 194.26$) than negative ($M = 643.98$, $SD = 194.80$) words. Critically, the interaction between movement and valence (i.e., the approach/avoidance compatibility effect) was significant, $t(284.09) = 9.08$, $p < .001$, $dz = 0.52$, 95% CI [0.40, 0.65]. On average, participants were faster in the compatible conditions ($M = 635.60$, $SD = 193.30$) than in the incompatible conditions ($M = 647.41$, $SD = 195.61$; see Fig. S1).

In Experiment 2b, the analysis revealed non-significant main effects for movement, $t(228.43) = 1.71$, $p = .089$, $dz = 0.10$, 95% CI [−0.01, 0.20] and valence, $t(37.70) = 0.49$, $p = .63$, $dz = 0.03$, 95% CI [−0.08, 0.14]. Critically, the interaction between movement and valence was significant, $t(38.29) = 3.84$, $p < .001$, $dz = 0.23$, 95% CI [0.13, 0.34] with participants being, on average, faster in the compatible conditions ($M = 621.88$, $SD = 193.00$) than in the incompatible conditions ($M = 628.30$, $SD = 194.14$; see Fig. S2).

12. Experiments 3a and 3b

In our previous experiments, not only was the valence of the words task-irrelevant, but participants were also instructed to ignore them. Duscherer et al. (2008) suggested, however, that such an instruction can paradoxically increase attention to the primes. In Experiments 3a and 3b, we addressed this possible limitation in two opposite ways. In Experiment 3a, we simply did not ask participants to ignore the primes, whereas in Experiment 3b, we instructed participants to process primes' ink color (see Gawronski et al., 2010 for a similar rational and procedure). Except for these changes, Experiments 3a and 3b were otherwise identical to Experiments 1a-1c. Again, we predicted a significant compatibility effect. Given the final analyzed sample sizes, Experiments 3a and 3b had 80% power (with $\alpha = 0.05$) to detect effect sizes of $dz = 0.27$ and $dz = 0.28$, respectively.

13. Method

13.1. Procedure

In our previous experiments, we told participants that a word would appear before the target stimulus (i.e., the square or diamond) and that their task would be "to ignore this word and to approach or to avoid depending on the geometric shape." In Experiment 3a, we again told participants that a word would appear before the target stimulus, but mentioned only that their task was to approach or to avoid depending on the geometric shape. Therefore, we did not ask participants to ignore the word. In Experiment 3b, participants were instead asked to keep a mental tally of how many words were presented in gray ink as a secondary task. Accordingly, we added 10% supplementary trials (i.e., 16 trials) in which the color of the prime was gray instead of white. For these trials, we used new words (i.e., crisis, tumors, joke, and affection). Participants were instructed to count the number of gray(−colored) words. At the end of the task, we asked participants how many gray words had been presented. We excluded seven participants who failed to keep an accurate count.

13.2. Results

In Experiment 3a, the mixed-effects model analysis revealed a significant movement main effect, $t(108.17) = 2.99$, $p = .003$, $dz = 0.28$, 95% CI [0.09, 0.47] with participants being faster to approach ($M = 617.80$, $SD = 185.05$) than to avoid ($M = 629.30$, $SD = 180.60$). The valence main effect was not significant, $t(39.83) = 1.23$, $p = .227$, $dz = 0.13$, 95% CI [−0.05, 0.32]. Critically, the interaction between movement and valence (i.e., the approach/avoidance compatibility effect) was significant, $t(107.82) = 3.78$, $p < .001$, $dz = 0.35$, 95% CI [0.16, 0.55]. On average, participants were faster in the compatible conditions ($M = 619.20$, $SD = 182.63$) than in the incompatible conditions ($M = 627.96$, $SD = 183.12$; see Fig. S3).

In Experiment 3b, the analysis revealed non-significant main effects for movement, $t(100.05) = 1.98$, $p = .050$, $dz = 0.20$, 95% CI [0.00, 0.39] and valence, $t(15{,}152.10) = 0.31$, $p = .753$, $dz = 0.04$, 95% CI [−0.15, 0.24]. Critically, the interaction between movement and valence was significant, $t(15{,}151.98) = 3.67$, $p < .001$, $dz = 0.39$, 95% CI [0.18, 0.59], participants being faster in the compatible condition ($M = 684.65$, $SD = 207.90$) than in the incompatible condition ($M = 692.03$, $SD = 207.06$; see Fig. S4).

14. General discussion

Although this has long been a claim in the attitudes and approach/avoidance action tendencies literature, empirical evidence supporting compatibility effects in valence-irrelevant tasks has remained debated. We tested this effect across seven experiments using a valence-irrelevant version of the VAAST (Rougier et al., 2018). We consistently found evidence supporting this effect, while combining several methodological strengths. We preregistered all experiments (except Exp. 1a). We used 90% statistical power or more (therefore providing stable results; Lakens & Evers, 2014; Schönbrodt & Perugini, 2013). Our *p*-values were always below 0.001 and thus met the more stringent alpha level of 0.005 recommended by Benjamin et al. (2017). This also implies that a p curve analysis would conclude in favor of evidential value (Simonsohn et al., 2014). Our analyses reached the same conclusions when no participants were excluded and across various data-analytic decisions (Steegen et al., 2016). Finally, we used mixed-effects models, further reducing the risk of Type I error (Judd et al., 2012).

At a methodological level, many previous studies relied on valence-irrelevant tasks where participants were only presented valenced words but were required to make decisions based on a non-valence dimension (e.g., adjectives vs. nouns; Krieglmeyer & Deutsch, 2010). Participants, however, still needed to process these words to complete the task. In contrast, the task we used made the (valenced) words irrelevant in the sense that participants did not need to process them at all to perform the task (as was also the case in Chen & Bargh, 1999). Additionally, in some experiments we still observed a compatibility effect while modifying the task in ways uncommon in the approach/avoidance literature, such as adding neutral words, asking participants to ignore the words, or focusing them on another dimension (i.e., font color). This arguably reduced the likelihood of intentionally using valence. In sum, we obtained strong evidence even under more stringent conditions than those used in most of this literature (except for so-called subliminal display of the valence words). Overall, we conclude that, at least when using this version of the VAAST, a replicable compatibility effect can be found with a valence-irrelevant task. This finding fits the idea that behavioral tendencies can be triggered by the unintentional evaluation of attitude objects.

Interestingly, this conclusion contrasts with Phaf et al.'s (2014) meta-analysis, which concluded that there was no effect. One possible explanation for this discrepancy is that, at the time, many studies were using arm movements (e.g., Krieglmeyer & Deutsch, 2010; Rotteveel et al., 2015). Yet, as we mentioned in the introduction, Rougier et al. (2018) showed that the (valence-relevant version of the) VAAST produces larger effects than the manikin task, which itself is known to produce larger effects than an arm movement task (i.e., the joystick task; Krieglmeyer & Deutsch, 2010). This difference in the operationalization of approach/avoidance could be a reasonable explanation and could be explored in future research.

In addition to observing replicable compatibility effects, our task—in its basic version (Exp. 1a-1c)—allowed us to observe quite large effect sizes (ranging from $dz = 0.48$ to $dz = 0.90$) compared to traditionally reported compatibility effects in valence-irrelevant tasks. This contrasts with Laham et al.'s (2015) approach-avoidance meta-analysis that yielded an effect size of $d = 0.099$ in valence-irrelevant conditions. In the domain of evaluative priming, Herring et al.'s (2013) meta-analysis yielded effect sizes of $d = 0.20$, $d = 0.29$, and $d = 0.06$ in semantic, pronunciation, and lexical decision tasks. Multiple explanations may account for these (descriptive) differences in effect sizes between what we found here and those reported in these two literatures, but one lies in the theoretical framework that supported the development of the VAAST (see Rougier et al., 2018), namely grounded cognition (Barsalou, 2020). This framework motivated the reliance on the visual simulation of whole-body self-movement in approach-avoidance. It suggests that (a) focusing on approach-avoidance, which is closely tied to the sensorimotor system (Barsalou, 2020), and (b) choosing a task that simulates the visual experience of whole-body movement (i.e., the VAAST) may have contributed to the observed compatibility effects.

Our results represent a theoretical contribution, because, as we previously explained, the literature was inconclusive with regard to compatibility effects when using valence-irrelevant tasks. This was an issue because both meta-theories (Bargh, 2017; Wilson, 2002) and specific theoretical models and hypotheses of approach/avoidance (Chen & Bargh, 1999; Eder & Rothermund, 2008; Krieglmeyer et al., 2013) predict such an effect. This work provides stronger evidence that participants do not need to be asked to explicitly process the valence of the critical stimuli (i.e., primes) for approach/avoidance compatibility effect to occur. This result is consistent with the idea that the cognitive system is adaptive: it can represent situations in which an organism reacts to a potential threat even when it is pursuing a task that does not require processing of the stimuli representing that threat (Bargh, 2017; Wilson, 2002). Moreover, this work also constrains future models of approach/avoidance effects, because such models need to account for the fact that compatibility effects can emerge without explicit instructions to process the valence of the critical stimuli.

Our work could also be useful for the indirect measure literature. Here, we used positive or negative words as primes in a valence-irrelevant VAAST and produced replicable approach/avoidance compatibility effects. In principle, researchers could use other target categories (e.g., black vs. white, male vs. female) as primes in a target category-irrelevant VAAST. As a first step, we would advise starting with target categories in a population for which it is clear that an approach/avoidance bias is expected. That would be a necessary step because what was observed here with valence may not generalize to other categories. Once established, one could start testing how a target category-irrelevant VAAST performs as an indirect measure. Clearly, it would be premature at this stage to consider this task a valid indirect measure, as it was not the goal of this work to validate it. Still, our results could stimulate research tackling this important issue.

Making these target categories task-irrelevant would place the VAAST among paradigms (the affective priming paradigm and the Affective Misattribution Procedure being other examples; Fazio et al., 1986; Payne et al., 2005) for which processing the target category (valence in our experiments) is not helpful for performing well in the task. Therefore, researchers who wish to study, for example, approach/avoidance toward Black and White targets would not necessarily need their participants to explicitly categorize stimuli along these dimensions to perform the task. In addition to reducing strategic processes (which might be amplified when participants are constrained to use the categories of interest to perform the task; De Houwer, 2009), this approach offers at least two advantages. First, many social targets can be categorized along multiple dimensions (e.g., race and gender) and explicitly requiring participants to use a specific category (i.e., race) that is supposed to be processed implicitly has been criticized. This criticism has been raised, for instance, when using the Implicit Association Test as an indirect measure, because in this task participants are required to categorize targets along the target categories (Fiedler et al., 2006; Yamaguchi & Beattie, 2020). Second, tasks that require participants to use a specific category to perform well in the task also make it difficult to study intersectional intergroup biases (i.e., biases involving several categories such as race and gender; Connor et al., 2023).

Nevertheless, tasks that do not explicitly impose the use of the categories of interest also have their drawbacks. For instance, when researchers observe no bias, they can be left wondering whether participants were not biased or whether the task itself (by being a target category-irrelevant task) did not allow them to observe such a bias (for a discussion of this issue with the Affective Misattribution Procedure, see Teige-Mocigemba et al., 2017). Establishing that valence can produce replicable effects even with such a version of the VAAST is a first necessary step to alleviate this issue. However, this would be only a first step because it could be that what we found to be true with valence does not generalize to other target categories.

Finally, as shown in our online experiments, the VAAST, contrary to other approach/avoidance tasks (e.g., those using modified keyboards or joysticks), allows researchers to conduct studies without the need for specialized equipment or software, enabling online studies and accessing participants from around the world. As shown by Project Implicit (Ratliff & Smith, 2021), having such easy-to-use online measures can be particularly insightful for studying implicit social cognition.

One limitation of our work is that we cannot definitively assert that participants did not intentionally process valence. Our strategy to prevent intentional processing was to use a valence-irrelevant task, which is a common strategy in the literature assessing approach/avoidance tendencies without intentional valence processing (see Krieglmeyer et al., 2013 for a review). Additionally, we took extra measures with the instructions and the proportion of valence-related words to minimize intentional processing. It remains possible, however, that participants chose to process valence despite its irrelevance to the task and our explicit instructions. Nevertheless, we can still conclude that under task conditions at least as demanding, and in some cases even more demanding than those in the meta-analyses referenced earlier (Laham et al., 2015; Phaf et al., 2014), we observed a replicable effect with the VAAST. Finally, it is worth noting that our goal was not to investigate the precise mechanisms underlying approach-avoidance tendencies but rather to provide a robust (in the sense of highly replicable) methodological and empirical basis for pursuing investigations into these mechanisms. As a result, our work leaves open important questions that future work should address, such as the construct validity of the task.

14.1. Constraints on generality

Our research aimed to provide robust evidence that approach-avoidance action tendencies can be triggered in a task that can be completed without an explicit instruction to process valence. In our work, we focused only on approach-avoidance tendencies, which are a fundamental behavioral distinction, but we did not study more fine-grained action tendencies (e.g., different kinds of approach such as peaceful approach and aggressive approach; Rougier et al., 2025). We believe that our results and conclusions are robust since we combine multiple strengths (e.g., preregistration, high power, replication, multiverse analysis, evidential *p* values). However, results should be considered definitely reliable only when replicated by independent labs. Therefore, a clear limitation is the absence of such replications, which we call for. In terms of generalizability, even though our samples encompass some diversity in terms of age and gender, we only recruited French and UK participants and did not include non-WEIRD participants. Another limitation of this work is that we only probed action tendencies associated with highly valenced stimuli; therefore our conclusions might not extend to less strongly valenced attitude objects. Our results are not to be generalized to other approach/avoidance tasks. Research could focus on these limitations in the future. For a more thorough assessment of the limitations, see Table S10.

15. Conclusion

Although many theoretical frameworks predict the effect we tested in this research—a compatibility effect in a valence-irrelevant task—, evidence for its existence has remained a matter of debate. Using the tools available to provide stronger and more transparent evidence (e.g., large sample sizes, preregistration, multiverse analysis), we demonstrated that a replicable approach/avoidance compatibility effect can be found at least when using the VAAST.

Open practices

All data, materials, and analysis codes are available at https://osf.io/n9zqv/?view_only=4950fc65ac3945f28a644752992abf15. All experiments (except Exp. 1a, which was then replicated twice with preregistrations) hypothesis, sample size, design, and analysis plans were preregistered on OSF.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the authors used ChatGPT (version 5.2, OpenAI) to assist with language editing and minor wording suggestions. Each time this service was used, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Author note

Preregistrations, materials, data, and analysis codes are available on the Open Science Framework at https://osf.io/n9zqv/?view_only=4950fc65ac3945f28a644752992abf15.

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YJ, DM, CB, FR, and MR conceptualized and designed the experiments; YJ and MT worked on the stimuli; CB and MB performed Exp. 1a and Exp. 1b; YJ performed the other experiments; YJ analyzed the data; YJ and DM wrote the paper; MR, FR, MT, and CB provided critical revisions. DM played a lead role in supervision and funding acquisition.

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CRediT authorship contribution statement

Yoann Julliard: Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Cédric Batailler:** Writing – review & editing, Validation, Software, Resources, Methodology, Investigation, Data curation, Conceptualization. **François Ric:** Writing – review & editing, Methodology, Conceptualization. **Marine Rougier:** Writing – review & editing, Software, Resources, Methodology, Conceptualization. **Maude Tagand:** Writing – review & editing, Resources. **Mae Braud:** Investigation. **Dominique Muller:** Writing – original draft, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Consent to participate

Before the beginning of the experiment, participants were informed that by starting the experiment they gave their free and informed consent to participate. Participants were also informed that they could leave the experiment at any moment.

Ethical considerations

All reported experiments were conducted in accordance with ethical standards as specified by the American Psychological Association. For this project, we did not gather the approval from the Ethics committee because in France such committees are mostly restricted to more complex studies. Because such approvals are not required for such simple studies, those committees do not have the workforce to handle the increase that it would represent.

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Declaration of competing interest

None of the authors have any conflict of interest to declare. All authors agreed upon the content of the manuscript and on author order. They moreover confirm that this article is in line with the APA Code of Conduct ethical guidelines, as well as the national ethics guidelines of France.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jesp.2026.104916.

Data availability

Data, as well as preregistrations, materials, and analysis codes are available on the Open Science Framework at https://osf.io/n9zqv/?view_only=4950fc65ac3945f28a644752992abf15

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