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The online-VAAST: A short and online tool to measure spontaneous approach and avoidance tendencies

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ABSTRACT

Among the great variety of approach/avoidance tasks, the Visual Approach/Avoidance by the Self Task (VAAST, Rougier et al., 2018) appears to be a promising tool. Previous work showed that the VAAST leads to large and replicable compatibility effects (e.g., faster response time to approach positive stimuli and avoid negative stimuli than the reverse). In the present contribution, we provide an online and easy-to-use version of the VAAST (namely, the online-VAAST). Across four experiments, we show that the online-VAAST produces effects that are of similar magnitude to those of the lab version of this task. Specifically, we obtained compatibility effects when using positive/negative words (Experiment 1), positive/negative images (Experiment 2), French/North-African first names (Experiment 3), and European American/African American first names (Experiment 4). Moreover, these effects emerged with culturally different populations (i.e., Americans in Experiments 1, 2, and 4, French in Experiment 3). Overall, the online-VAAST could be of great interest for all researchers interested in measuring approach/avoidance tendencies: Its specificities allow reaching large samples both offline and online with no accessibility constraints regarding programming abilities or program copyright.

1. Introduction

Approach and avoidance are crucial responses to the environment. For survival, organisms need to approach positive stimuli (e.g., food) because of their potential reward and to avoid negative ones (e.g., predators) to preserve their security (Frijda, 1986; Lang, 1995). Given their importance for survival, it has been proposed that positive and negative stimuli would spontaneously trigger approach and avoidance responses, respectively. Consistent with these proposals, studies have shown that individuals responded faster by an approach movement to positive than to negative stimuli, whereas they responded faster by an avoidance movement to negative than to positive stimuli (i.e., a "compatibility effect"; Chen & Bargh, 1999; Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010; Solarz, 1960). However, researchers have challenged the link between valence and approach/avoidance based on failures to replicate these effects (Rotteveel et al., 2015). In response, Rougier et al. (2018) argued that the tasks commonly used to measure approach/avoidance tendencies might not be the best suited to capture approach/avoidance tendencies. Relying on a grounded cognition framework, they developed a new task, namely the Visual Approach and Avoidance by the Self Task (VAAST), and showed that this task produces large and replicable compatibility effects. Specifically, respondents produce faster response times to approach positive stimuli and to avoid negative ones than to approach negative stimuli and to avoid positive ones.

The aim of the present work was to make this efficient task available for any researcher or professional interested in the measure of approach/avoidance tendencies in the lab but also online. The so-called replication crisis in psychological sciences has made clear that researchers often need to target larger sample sizes, but also to engage in large, multisite, collaborative studies (for examples, see the Psychological Science Accelerator initiative, Moshontz et al., 2018, or the Many Labs papers, e.g., Klein et al., 2014). With such a feature, the online-VAAST offers the possibility to reach larger and more specific

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samples. We thus propose to give access to a user-friendly, free, and online, version of the VAAST that enables users to conduct both lab and online studies. With this version, the VAAST will not only be easily accessible to everyone (e.g., researchers who are not able to access and program software such as Eprime or Inquisit) but it will also take very little time to administer. We provide a user manual and the code allowing all potential users to create a version of the task that would serve their specific needs. We also make available a systematic R script for data cleaning and analysis. Finally, because a response time study imposes specific constraints, such as ensuring that the software is sufficiently accurate in collecting response time or that the task is easy enough so that participants do not need any monitoring by an experimenter, we tested this new version of the VAAST through four experiments with different kinds of stimuli and participants' samples. In all these experiments, our goal was to ascertain these various assets characterized the online version of the VAAST while checking that the obtained results remained consistent with those found in the laboratory.

1.1. A brief taxonomy of approach/avoidance measures

Close inspection of the literature reveals that researchers measure approach and avoidance tendencies with three main categories of computerized tasks. In the first category, the authors relied (exclusively) on the meaning supposedly associated with arm flexion and arm extension, often approach and avoidance, respectively. Typically, researchers used the joystick task or the modified keyboard task to measure how positive stimuli facilitate arm flexion (i.e., bringing closer) and how negative stimuli facilitate extension (i.e., pushing away; e.g., Alexopoulos & Ric, 2007; Chen & Bargh, 1999; Rinck & Becker, 2007). However, one major limitation with this kind of task is that it is possible to interpret arm movements in two alternatives, and indeed opposite, ways (Markman & Brendl, 2005; Paladino & Castelli, 2008; Seibt, Neumann, Nussinson, & Strack, 2008). In addition to the above interpretation, arm flexion can also mean moving away from an object (e.g., avoiding a hot cup) and arm extension can mean moving toward something to grab it (e.g., grabbing a piece of cake). In line with this version, several studies found the compatibility effect with avoidance as arm flexion and approach as arm extension (e.g., Lavender & Hommel, 2007; Paladino & Castelli, 2008). The ambiguity in the interpretation of arm movements may readily explain various failures to replicate the compatibility effect with such tasks (Krieglmeyer & Deutsch, 2010; Rotteveel et al., 2015).

The second category of tasks comprises tasks that entail symbolic approach and avoidance movements. Rather than performing a movement, approach and avoidance are then symbolized through the movements of some characters on the screen. This is typically the case in the manikin task, in which participants move a character toward or away from a stimulus (e.g., De Houwer, Crombez, Baeyens, & Hermans, 2001). Although such a task better captures the compatibility effect than the joystick task (Krieglmeyer & Deutsch, 2010), the manikin task has two main limitations. First, participants have to imagine being the character. By asking people to project themselves in a character, the task requires some degree of cognitive effort. One may therefore wonder whether this constitutes the most direct way to capture spontaneous behaviors such as approach and avoidance tendencies. Second, and in spite of their projection efforts, participants are bound to observe the character moving much as if they were an external observer of the scene. Such a configuration not only hardly corresponds to people's everyday experience of approach and avoidance behaviors, but also neglects the major role of sensorimotor aspects in the production of approach and avoidance compatibility effects (Rougier et al., 2018). Therefore, although this category of tasks appears to produce compatibility effects, the general method seems less than optimal, with some room for improvement if one wishes to secure large effect sizes.

Finally, the third category of tasks more directly builds on the principle of simulating visual aspects of approach and avoidance. In such tasks, a visual feedback (e.g., a zoom in/out or a sequence of screenshots taken in a virtual environment) makes it seem like, depending on the task, the stimulus is moving toward or away from the participant or the participant is moving toward or away the stimuli (Rinck & Becker, 2007; Rougier et al., 2018). The first task of this kind was the 'feedback joystick task.' The task combines arm flexion and arm extension with a visual feedback such that participants have the impression that the stimulus is moving toward or away from them (Rinck & Becker, 2007). The visual feedback is supposed to help participants to interpret their arm movements and, therefore, to address the abovementioned limitation stemming from the ambiguity of arm movements. The fact that the feedback joystick task offers a direct way to simulate approach and avoidance behavior suggests that this would be a more reliable measure of compatibility effects than the manikin task. However, this is not the case, as evidence shows the feedback joystick task to be a less efficient measure of compatibility effects than the manikin task (Krieglmeyer & Deutsch, 2010). Upon closer analysis, the key role of the self in everyday approach and avoidance behavior may well account for this state of affairs. Indeed, as pointed out by Rougier et al., although arm movements reflect movements of grabbing or pushing objects away, it is also clear that all objects cannot be grabbed or pushed away (e.g., a car, a house). In sharp contrast to what happens in the feedback joystick task, the manikin task simulates approach and avoidance by means of movements of the whole body toward or away from the stimulus.

1.2. The Visual Approach/Avoidance by the Self Task (VAAST)

Building on the above analysis, Rougier et al. (2018) recently developed the VAAST. The VAAST simulates approach and avoidance movements of the whole self by manipulating the visual information provided to the participants. A stimulus first appears in the center of the screen in a simulated street background. Participants have to press the "move toward" or the "move away" key as a function of the stimulus category and the instructions. When pressing one or the other key, a visual feedback operates on both stimulus and street background (i.e., a zoom in/out on the stimulus associated with a sequence of screenshots in the street environment). This visual feedback gives participants the impression that they are moving toward or away from the stimulus in the street, pretty much as in real life. With this configuration, the VAAST avoids the limitations mentioned earlier.

First, by simulating approach and avoidance of the whole self, the VAAST excludes the ambiguity issue of arm movements. Indeed, people commonly use arm flexion and extension in a bidirectional way in that arm flexion is associated to approach *and* to avoidance just as arm extension is. Conversely, this ambiguity issue does not apply on movements of the whole self because, with only a few exceptions, moving forward/backward always means approach/avoidance, respectively. Accordingly, movements of the whole self do not create any conflict of interpretation and thus maximize the chances to capture compatibility effects.

Second, by capitalizing on the visual simulation of approach and avoidance movements, the VAAST measures approach and avoidance tendencies in a more direct way than the manikin task that requires cognitive effort to project the self in the character. By combining both a movement of the whole self and the visual information of approach and avoidance movements, the VAAST indeed delivers larger effect sizes than the manikin task (Rougier et al., 2018). This is noteworthy because previous work showed that until then the manikin task seemed to be the most efficient task when it comes to measuring compatibility effects (Krieglmeyer & Deutsch, 2010).

1.3. An online version of the VAAST

For all these reasons, it would be useful to provide the VAAST to any researcher or professional who wishes to use a reliable measure of approach and avoidance tendencies. Still, aspects of the task may make it difficult to implement for any kind of users and for large-scale online studies. For example, the current version of the VAAST imposes having participants come to the laboratory and being able to access and program a paid software. In order to circumvent these limitations and to secure a wider access to the task, we developed a short online version of the VAAST. The key ambition was to make the VAAST freely available and without major technical obstacles. Accordingly, we programmed this task on PsyToolkit, a website offering programmable online experiments (https://www.psytoolkit.org/; Stoet, 2017). Users only need to create a free account on PsyToolkit to have access to the VAAST. We also made sure that every prospective users, and not only researchers who know how to use a software like Eprime or Inquisit, should be able to use this task. Concretely, we facilitate the task use by providing the PsyToolkit script with instructions for running the online version of the VAAST with users' own selection of words (see https://www.psytoolkit.org/experiment-library/vaast_words.html) or images (see https://www.psytoolkit.org/experiment-library/vaast_images.html). We also provide a step-by-step R script to analyze the data from the PsyToolkit output, so that users can easily filter the data, compute descriptive statistics (e.g., a mean value corresponding to each condition, as approach positive, avoid negative, avoid positive, and approach negative), and conduct the data analyses of their choice (ordinary least square regression or mixed-models). Moreover, users can combine the online-VAAST with a questionnaire programmed on their own or directly taken from the PsyToolkit library. This can be particularly useful to measure additional characteristics of participants (e.g., intergroup attitudes, social anxiety, drug use). Finally, the online-VAAST does not require anything installed on the users' computer. Users only need a browser that can be exploited online but also offline (e.g., Google Chrome, Mozilla Firefox). This could be an asset in specific contexts where internet access is not always available or allowed (e.g., a school context in France).

Although we provide a user-friendly environment for researchers or professional who would like to use the online-VAAST, the question remains whether it is able to produce the kind of results produced by the VAAST in the laboratory, and also when using less trials than before (Rougier et al., 2018). Indeed, not using a dedicated software always raises the question of accuracy in response time (Keller, Gunasekharan, Mayo, & Corley, 2009; Reimers & Stewart, 2015). It also raises concerns regarding the ability for participants to understand all the instructions without an experimenter and to work sufficiently seriously on the task to produce the same effect as in the laboratory. For all these reasons, we ran four experiments in which we tested the reliability of the online-VAAST by varying the type and the categories of stimuli as well as the cultural background of participants. In line with current practices promoting transparency, we provide all the data, R scripts and stimuli pertaining to the experiments at https://osf.io/ywzm9/.

1.4. Overview

In Experiment 1, we measured approach and avoidance tendencies toward positive vs. negative words in Americans participants. We predicted a compatibility effect, meaning that participants should be faster to approach positive stimuli and to avoid negative ones than to approach negative stimuli and to avoid positive ones. In Experiment 2, we aimed to replicate the effect with positive vs. negative pictures, again with Americans participants. Experiments 3 and 4 extended the test of the online-VAAST to approach and avoidance toward social groups. In Experiment 3, we chose the group of North-African origin (vs. French-origin) persons, as the former represents a minority that is a prime target of prejudice in Europe in general, and in France in particular (e.g., Dambrun & Guimond, 2004; Echebarria-Echabe & Guede, 2007). Specifically, we used North-African-origin versus French-origin first names to measure approach and avoidance tendencies among French-origin participants. We predicted our participants to show faster approach responses to French-origin first names and avoidance responses to North-African-origin first names than approach responses to North-African origin first names and avoidance responses to French-origin first names. In Experiment 4, we followed the same method as for Experiment 3, but turned to European American participants and used European American versus African American first names, as the latter are known to be the target of racism in the USA (e.g., Devine, 1989; Fiske, Cuddy, Glick, & Xu, 2002; Pearson, Dovidio, & Gaertner, 2009). We hypothesized that participants should be faster to approach European American first names and to avoid African American first names than to approach African American first names and to avoid European American first names.

2. Experiment 1

In Experiment 1, we aimed to replicate the compatibility effect previously observed with the VAAST (Rougier et al., 2018) but with a shorter and online version of the VAAST. To this end, we followed the procedure of Experiment 4 by Rougier et al. (2018). We made several changes to adapt the new version to a large-scale use (see Method section for details). Among them, the major change concerned the time to complete the VAAST (i.e., about 20 min in Rougier et al., 2018). Because we wanted to maximize participant's attention and facilitate online recruitment for a computerized task, we shortened this version of the VAAST from 80 to 40 trials per block (resulting in a 10-min duration). This is also critical for researchers because oftentimes reducing the time that participants spend on the task also decreases the amount of money that one has to pay participants. As such, this should allow researchers to increase their sample size and, by way of consequence, their statistical power, as well as the stability and the reliability of their findings (Schönbrodt & Perugini, 2013).

2.1. Method

2.1.1. Participants and design

In order to determine our sample size, we turned to earlier work by Rougier et al. (2018) and, specifically, the experiment that most closely resembles the online-VAAST, namely Experiment 4. These authors observed a $dz = 1.01$. To achieve a power of 80% to detect an equivalent compatibility effect with a .05 alpha two-tailed criterion, the minimum required number of participants was 35 (calculated with the R pwr package). Because we wanted to maximize our chances and prevent possible data loss, we decided to collect at least 50 participants.

Fifty-one American participants recruited via Prolific Academic took part in this experiment in exchange for USD 1.40. We used prescreening filters offered by the platform to select only American participants whose first language was English. Three participants were excluded because their screen resolution fell below the minimum required for the full-screen mode (i.e., 1200 × 675 px) and three others because their accuracy rate was suboptimal, that means under 60% (i.e., 60% of the trials were accurate on combined compatible and incompatible blocks), leaving 45 participants in the sample (21 females; M_{age} = 35.98 yrs, SD_{age} = 13.71 yrs).

We used a 2 (movement: approach vs. avoidance) x 2 (valence: positive vs. negative) x 2 (block order: compatible first vs. incompatible first) mixed design with the last variable varying between participants. Participants went through the compatible block (i.e., approaching positive words and avoiding negative words) and the incompatible block (i.e., avoiding positive words and approaching negative words). Block order was counter-balanced between participants. Each block comprised 40 words, i.e., 20 positive and 20 negative words taken from Warriner, Kuperman, and Brysbaert's (2013) database, presented randomly, once within each block. Database's participants evaluated positive words as making them more happy ($M = 8.12$, $SD = 0.25$) than negative words ($M = 1.86$, $SD = 0.26$), $t(38) = 77.71$, $p < .001$, on a

9-point scale (from 1 = unhappy to 9 = happy). Moreover, positive words did not differ significantly from negative words on valence extremity (M_{pos} = 8.12, SD_{pos} = 0.25; M_{neg} = 8.14, SD_{neg} = 0.26), t(38) = 0.17, p = .87, arousal (M_{pos} = 5.45, SD_{pos} = 1.03; M_{neg} = 5.51, SD_{neg} = 1.05), t(38) = 0.20, p = .84, frequency (M_{pos} = 2495.45, SD_{pos} = 3142.37 ; M_{neg} = 1406.45, SD_{neg} = 2027.31), t(38) = 1.30, p = .20, and number of letters (M_{pos} = 7.45, SD_{pos} = 2.82; M_{neg} = 6.80, SD_{neg} = 1.73), t(38) = 0.88, p = .38. Before each block, participants underwent a training phase consisting of 10 trials using 10 words (5 positive and 5 negative) not presented in the main experiment.

2.1.2. Procedure

We programmed the online-VAAST in PsyToolkit (Stoet, 2010, 2017), a platform allowing to conduct off/online surveys and experiments. Because of constraints relative to our experimental setting and PsyToolkit, we had to exclude Safari users as well as mobile phone or tablet users. Note that participants of the four experiments signed an informed consent before starting.

The online-VAAST was as similar as possible to the VAAST previously used in the lab (Rougier et al., 2018). Apart from the number of trials, the differences derived from the fact that this version ran on participants' personal computer instead of a lab setting. Indeed, participants communicated their approach/avoidance responses via their keyboard instead of a button box. The screen resolution was that of participants' screen (rather than a 1600 × 900 fixed resolution), with the requirement that the minimum resolution was of 1200 × 675. At the beginning of each trial of the lab version of the VAAST, participants have to press a start button and keep the button pressed until the target word appears on the screen. To simplify the procedure of the online-VAAST, participants only have to press the start button (with the possibility to release it), after what the fixation cross appears. Finally, the time between the fixation cross and the presentation of the target word randomly ranged between 800 and 2000 with 100 ms intervals.

The instructions informed participants that they would find themselves in a virtual environment allowing them to move forward or backward by pressing the Y or the N key of their keyboard, respectively. For each trial, a street background with a centered white circle indicated to participants that they had to press the start key (i.e., H key).[2] After pressing the start key, a fixation cross replaced the white circle after a delay ranging between 800 and 2000 ms. This fixation cross was then followed by the target word. Depending on the word valence and instructions, participants had to move forward or backward by pressing the Y or the N key. When participants pressed the Y key (move forward) or the N key (move backward), a visual feedback applied to the entire visual environment (i.e., the background image and the word). The word was zoomed in/out (by approximately 13%) and the visual image background was replaced by another one (i.e., another screenshot taken further ahead or behind of the initial position in the 3D virtual street), giving the visual impression to participants that they were moving toward or away from the word. After responding to the trial, the word disappeared and, after a 500 ms delay, a new trial started (with the white circle). At the end of the task, participants had to indicate their sex, age, and native language (English or other).

2.2. Results and discussion

We excluded incorrect responses (i.e., 2.36% of the trials). Before conducting the main analyses, we selected filters out of a series of a priori filters and transformations leading to the more normal response times (RTs) distribution (for RTs distributions as a function of filters and transformations in all experiments, see https://osf.io/ywzm9/). Specifically, we excluded RTs below 450 ms and above 2500 ms (i.e., 1.79% of the trials) and we used an inverse function (Ratcliff, 1993). We analyzed our data by means of mixed model analyses, as this maximizes the robustness and the generalizability of the findings compared to traditional analyses of variance (Judd, Westfall, & Kenny, 2012; Westfall, Kenny, & Judd, 2014). Accordingly, we estimated a mixed model using movement, valence, block order, and their interactions as fixed effects. Because block order did not significantly interact with the crucial movement by valence interaction, t(42.41) = 0.99, p = .33, we removed this variable from the analyses. We also estimated the relevant random intercepts and slopes for participants (i.e., the random slopes of movement, valence, and their interaction) and stimuli (i.e., the random slope of movement). We do not present the random effects in the main text because these are not central for the present work but we provide all the results relative to these random effects for all the experiments as supplementary materials (see Table S1). Moreover, for the ease of comparison with previous work on the VAAST (e.g., Rougier et al., 2018), we present effect sizes for by-participant analyses in the core text.[3]

The main effect for valence was significant, t(43.49) = 2.17, p = .03, dz = 0.79, such that participants responded faster for positive words (M = 833 ms, SE = 24 ms) than for negative ones (M = 873 ms, SE = 25 ms). The main effect of movement was not significant, t(50.27) = 0.92, p = .36, dz = 0.45. More important, and as predicted, the compatibility effect emerged as evidenced by a significant movement by valence interaction, t(45.81) = 6.78, p < .001, dz = 1.06 (see Fig. 1). Participants were faster to approach positive words (M = 754 ms, SE = 23 ms) and to avoid negative ones (M = 806 ms, SE = 21 ms) than to approach negative words (M = 940 ms, SE = 34 ms) and to avoid positive ones (M = 912 ms, SE = 29 ms).[4]

As expected, the online-VAAST produced a large compatibility effect. Interestingly, this online version even produced a descriptively larger effect size than the one observed with the most similar lab version of the VAAST (i.e., the "short movement" VAAST, Experiment 4, Rougier et al., 2018). Although our aim was not to compare the two versions of the task, this result is remarkable in itself. Indeed, a common criticism of online experiments is that participant's environment is more variable than in the lab context (e.g., noise, material, light; Dandurand, Shultz, & Onishi, 2008). This feature would lead us to observe a smaller effect size with the online version of the VAAST, which is clearly not the case for the current experiment.

3. Experiment 2

The aim of Experiment 2 was to replicate the compatibility effect with another kind of stimuli. In this experiment, we used positive versus negative images originating from two different databases, namely the IAPS database (Lang, Bradley, & Cuthbert, 1997) and the OASIS database (Kurdi, Lozano, & Banaji, 2017). The IAPS is a well-known database developed to provide a reliable set of affective stimuli. However, because most of the pictures may appear outdated to participants, we used an additional recently published database of affective images looking more contemporary.

[2] Readers interested in applying the VAAST to English speaking participants might consider using T, G, and B, instead of Y, H, and N, because Y and N could be associated with Yes and No. It is worth mentioning, however, this is not a concern for the validity of the current studies because the compatibility effect was found for French-native speakers. Rougier et al. (2018) also showed that the effect still emerges even though participants responded with a button box with no reference to Y and N keys.

[3] We also provide the mixed model effect sizes as supplementary materials (see Table S2).

[4] For all experiments, we provide the simple effects as supplementary material (see Table S3).

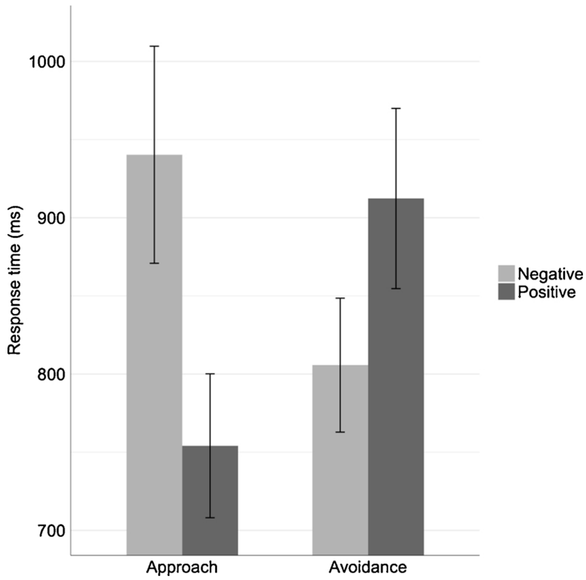

Fig. 1. Experiment 1: response time (in ms) as a function of movement (approach vs. avoidance) and word valence (positive vs. negative). Errors bars represent 95% confidence intervals.

3.1. Method

3.1.1. Participants and design

In order to determine our sample size, we relied on the effect size obtained for the interaction in Experiment 1, namely $dz = 1.06$. Using this estimate, the minimum required number of participants was 33. Because Experiment 1 relied on words whereas Experiment 2 turned to images, we may have overestimated the actual effect size. Therefore, and given that we had an easy access to respondents, we decided to collect at least 100 participants.

One hundred and one American participants took part in this experiment. We recruited participants via Prolific Academic filtering them a priori according to their nationality (American) and their first language (English). They received USD 1.40 for their participation.

We excluded 8 participants because of their low screen resolution, another 4 because of very long response times (i.e., RTs means = 4103 ms, 5721 ms, 6054 ms, 8405 ms), and 3 because their accuracy rate was too low (i.e., under 60%). The final sample included 86 participants (39 females and 2 others; $M_{age} = 33.64$ yrs, $SD_{age} = 11.70$ yrs). Each participant randomly performed either the VAAST with positive and negative images from the OASIS database (46 participants; Kurdi et al., 2017) or from the IAPS database (40 participants; Lang et al., 1997). Otherwise, the design was the same as in Experiment 1. Participants performed a compatible and an incompatible block and the order of blocks was counterbalanced across participants. Each block started with 10 practice trials (with 5 negative and 5 positive images not used in the test trials), followed by 40 test trials (for a total of 100 trials). We selected 20 positive and 20 negative images from each database. For the IAPS images, the positive images ($M = 5.99$, $SD = 0.20$) were evaluated as more positive than the negative ones ($M = 3.12$, $SD = 0.63$), $t(38) = 19.46$, $p < .001$, on a 9-points scale. Moreover, there were no differences in terms of valence extremity ($M_{pos} = 5.99$, $SD_{pos} = 0.20$; $M_{neg} = 5.88$, $SD_{neg} = 0.63$), $t(38) = 0.79$, $p = .43$ and arousal ($M_{pos} = 4.38$, $SD_{pos} = 1.02$; $M_{neg} = 4.72$, $SD_{neg} = 0.69$), $t(38) = 1.23$, $p = .22$. For the OASIS images, the positive images ($M = 6.18$, $SD = 0.14$) were also evaluated as more positive than the negative ones ($M = 1.82$, $SD = 0.27$), $t(38) = 64.03$, $p < .001$, on a 7-points scale. Valence extremity ($M_{pos} = 6.18$, $SD_{pos} = 0.14$; $M_{neg} = 6.18$, $SD_{neg} = 0.27$), $t(38) = 0.005$, $p = 1$, and arousal ($M_{pos} = 4.21$, $SD_{pos} = 0.53$; $M_{neg} = 4.39$, $SD_{neg} = 0.69$), $t(38) = 0.88$, $p = .38$, did not differ between categories of images.

3.1.2. Procedure

After agreement of the consent form, participants randomly saw the IAPS or the OASIS version of the VAAST. In both versions, the procedure was the same as in Experiment 1, except that instructions informed participants that they would have to approach or avoid images, rather than words.

3.2. Results and discussion

We excluded incorrect responses (i.e., 6.28% of the trials) and relied on the same filters and transformations as in Experiment 1 (i.e., 450–2500 ms; 2.50% of the trials excluded). Fixed effects and random intercepts and slopes were the same as in Experiment 1, except that we added the type of database (IAPS vs. OASIS) as a fixed effect. Because neither block order nor type of database significantly moderated the critical valence by movement interaction, $t(83.45) = 0.89$, $p = .38$, and, $t(83.62) = 1.09$, $p = .28$, respectively, we excluded these control factors from all analyses.

The main effects of valence, $t(55.04) = 1.24$, $p = .22$, $dz = 0.26$, and movement, $t(56.39) = 0.38$, $p = .70$, $dz = 0.03$, were not significant. In contrast, and in line with our compatibility hypothesis, the movement by valence interaction was significant, $t(79.99) = 4.97$, $p < .001$, $dz = 0.53$ (see Fig. 2). Participants were faster to approach positive images ($M = 893$ ms, $SE = 27$ ms) and to avoid negative ones ($M = 906$ ms, $SE = 24$ ms) than to approach negative images ($M = 973$ ms, $SE = 27$ ms) and to avoid positive ones ($M = 956$ ms, $SE = 29$ ms).

As in Experiment 1, we replicated the compatibility effect with affective images as stimuli. Although the effect size turned out to be somewhat smaller than in Experiment 1, this finding is important because it extends the use of the online-VAAST to images. This can prove very useful, for instance, when measuring phobic reactions for which the visual presentation of stimuli is particularly well suited.

4. Experiment 3

Experiment 3 aimed at extending the test of this online version of the VAAST to a different category of stimuli and participants sample.

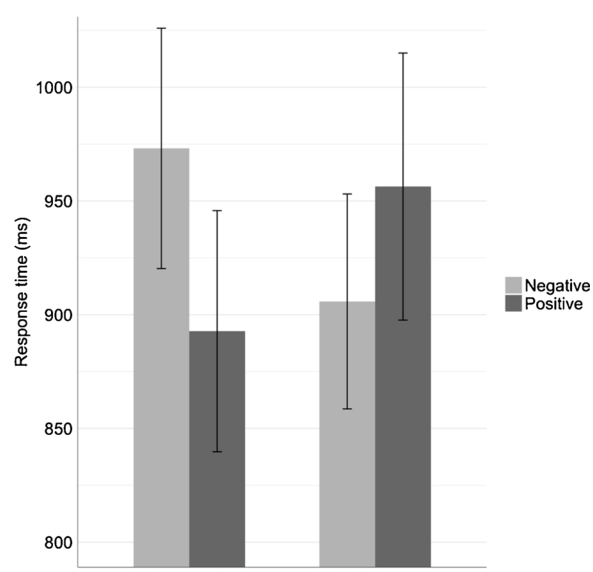

Fig. 2. Experiment 2: response time (in ms) as a function of movement (approach vs. avoidance) and images valence (positive vs. negative). Errors bars represent 95% confidence intervals.

Because North-Africans in France represent a minority that is a prime target of prejudice (Dambrun & Guimond, 2004; Echebarria-Echabe & Guede, 2007), we tested the online-VAAST with North-African vs. French origin first names as stimuli on French culture participants. We know from other experiments that the lab version of the VAAST can produce compatibility effects with these first names categories (Rougier, Muller, Courset et al., 2019). We therefore hypothesized that French participants should produce a compatibility effect by being faster to approach French origin first names and to avoid North-African origin first names than to approach North-African origin first names and to avoid French origin first names.

4.1. Method

4.1.1. Participants and design

To determine the sample size of Experiment 3, we estimated the effect size by relying on the lowest effect size of Experiments 1 and 2, that is $dz = 0.53$. The minimum number of participants needed to achieve a power of 80% to detect an equivalent compatibility effect with a .05 alpha two-tailed criterion was 116. Because we had an easy access to participants but were unsure as to how many we would have to discard given our specific requirements (i.e., only participants of French origin), we decided to collect at least 200 participants more.

Three hundred and forty-one participants took part in the experiment in exchange for USD 1.14. We recruited participants via Foule Factory, a French crowdsourcing platform. Thirty-nine participants were excluded because they reported being of North-African origin. We also excluded participants who declared having already participated to a VAAST experiment (68 participants).[5] The final sample comprised 234 participants, all French native speakers (188 females; $M_{age} = 39.98$ yrs, $SD_{age} = 12.04$ yrs). All had an accuracy score above 60%.

The design was the same as in the previous experiments. We relied on a 2 (movement: approach vs. avoidance) x 2 (first name origin: French vs. North-African) x 2 (block order: approach French first vs. approach North-African first) mixed design with the last variable varying between participants. Because block order moderated our focal interaction (i.e., movement x first name origin), $t(225.88) = 6.21$, $p < .001$, $dz = 0.39$, we kept this factor in all the analyses. We characterized North-African origin and French origin groups by means of their typical first names, selected from Lexique 2, a French lexical database (New, Pallier, Brysbaert, & Ferrand, 2004). We selected 20 French first names and 20 North-Africans first names, randomly presented once within each block, making for 40 trials in each block. We selected the first names based on their frequency in the French population. Because North Africans first names are less frequent in the French population than French first names, and in order to avoid a confound between origin and frequency, we selected 9 French first names to be as frequent ($M = 2.34$, $SE = 5.61$) as North Africans first names ($M = 2.21$, $SE = 3.97$), $t(29) = 0.01$, $p = .90$. The remaining 11 French first names were more frequent ($M = 51.59$, $SE = 5.61$) than the 9 rare French first names ($M = 2.34$, $SE = 5.61$), $t(19) = 19.06$, $p < .001$, and the North African names ($M = 2.21$, $SE = 3.97$), $t(30) = 5.43$, $p < .001$.[6]

4.1.2. Procedure

The procedure was the same as in the previous experiments but for a few differences.[7] First, participants had to approach French first names and avoid North-Africans first names in the compatible block and the other way around in the incompatible block. Moreover, at the end of the task, participants had to indicate their native language (French or other), if they considered themselves of North-African origin, French origin, or another origin, as well as their sex and age. Finally, we asked participants if they already participated in an experiment with the VAAST.

4.2. Results and discussion

We first excluded incorrect responses (2.31% of the trials). For the analyses, we used the best cutoff for securing an RTs normal distribution, namely above 400 ms and below 2000 ms (leading to the exclusion of 1.59% of the trials). We also applied an inverse function on RTs and, finally, estimated fixed effects of movement, first name origin, and their interaction using a mixed-model approach.

Whereas the movement main effect was significant, $t(131.46) = 4.04$, $p < .001$, $dz = 0.29$, indicating faster approach ($M = 762$ ms, $SE = 9$ ms) than avoidance ($M = 778$ ms, $SE = 9$ ms), the main effect of first names category was not, $t(48.86) = 0.07$, $p = .95$, $dz = 0.01$. More crucially, and confirming our predictions, the compatibility effect emerged, as the critical interaction between movement and first name origin was significant, $t(171.93) = 2.68$, $p = .008$, $dz = 0.15$ (see Fig. 3). Participants were faster to approach French first names ($M = 752$ ms, $SE = 10$ ms) and to avoid North-African first names ($M = 767$ ms, $SE = 10$ ms) than to approach North-African first names ($M = 762$ ms, $SE = 10$ ms) and to avoid French first names ($M = 781$ ms, $SE = 10$ ms).

Experiment 3 successfully replicated the compatibility effect with social groups as stimuli. This finding highlights the capacity of the online-VAAST to capture approach and avoidance tendencies toward ambiguous stimuli known to generate variable (and sometimes divergent) reactions (Degner, Essien, & Reichardt, 2016; Rougier, Muller, Courset et al., 2019). Indeed, approach/avoidance effects toward this kind of stimuli strongly depend on individual-level variables (e.g., school context, Degner et al., 2016; group membership, Rougier, Muller, Courset et al., 2019). Accordingly, we expected differences between approach and avoidance tendencies to be smaller for social groups than for valenced stimuli, leading to smaller effect sizes. To establish further the reliability of our findings, we conducted a last experiment that aimed at replicating the compatibility effect with social groups, but on a culturally different sample.

5. Experiment 4

In Experiment 4, we decided to measure the compatibility effect with social groups using an American sample. As it is the case for North-Africans in France, African Americans are the target of racism in the USA (e.g., Devine, 1989; Fiske et al., 2002; Pearson et al., 2009). We thus used European versus African American first names to test the compatibility effect, even though the lab version of the VAAST never examined such stimuli. We hypothesized that participants would be faster to approach European Americans first names and to avoid African Americans first names than to approach African American first names and to avoid European American first names.

[5] Including the 68 participants does not influence the significance of the reported results.

[6] Note that the compatibility effect emerged when the analysis was conducted with only names of similar frequence (i.e., the 9 rare French first names and the 20 North Africans first names), $t(171.93) = 2.65$, $p = .009$, $dz = 0.16$.

[7] At a technical level, we improved the program by taking into account participants' screen size to secure a better fit for the background image. Specifically, depending on the size of their screen, participants were automatically redirected to the "small screen" (screen size exceeding 1200 x 675 px but lower than 1600 x 900 px) or the "large screen" (exceeding 1600 x 900 px) version of the VAAST. Note, however, that this feature was programmed with JsPsych and is not included on Psytoolkit. For more information regarding this feature, please contact the authors.

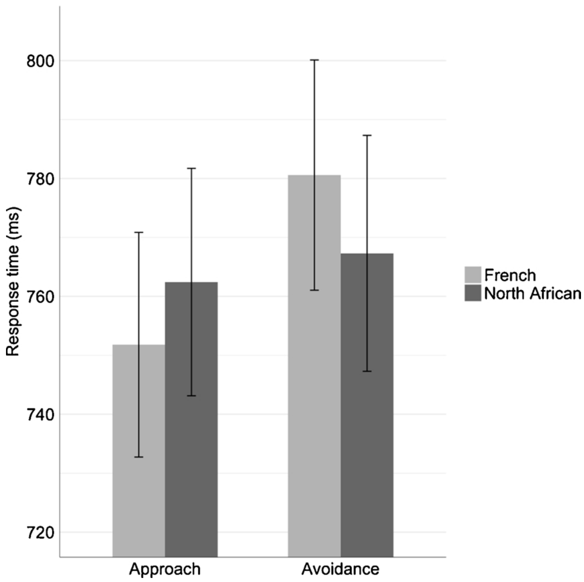

Fig. 3. Experiment 3: response time (in ms) as a function of movement (approach vs. avoidance) and first names (French vs. North-African). Errors bars represent 95% confidence intervals.

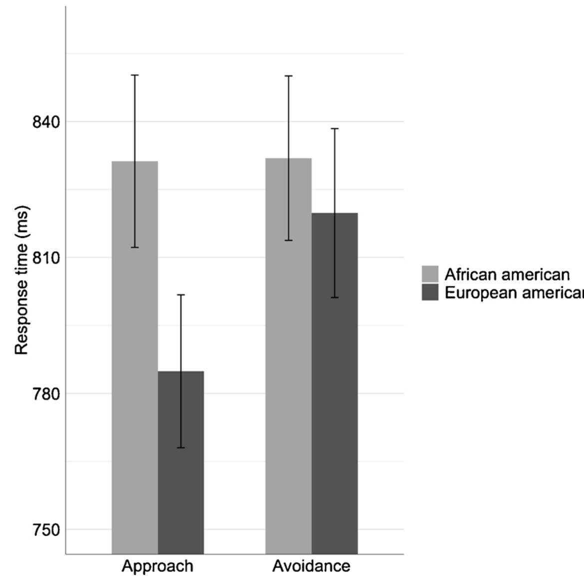

Fig. 4. Experiment 4: response time (in ms) as a function of movement (approach vs. avoidance) and first names (European American vs. African American). Errors bars represent 95% confidence intervals.

5.1. Method

5.1.1. Participants and design

To determine our sample size for Experiment 4, we used the same effect size as the one we used for Experiment 3, namely $dz = 0.53$, because both experiments were conducted simultaneously. As before, the minimum required number of participants was 116. Because we had an easy access to participants and we wanted to take into account some data loss, we decided to collect 300 participants.

Two hundred and ninety-nine participants completed the experiment in exchange for USD 1.31. As in Experiments 1 and 2, we recruited participants via Prolific Academic with filters on ethnicity (European American), nationality (American), and first language (English). After data collection, we excluded one participant who declared not being American and 9 participants because of their low accuracy rate (i.e., under 60%). The final sample of 289 participants (153 females and 3 others; $M_{age} = 37.26$ yrs, $SD_{age} = 11.97$ yrs) declared being good English speakers at minimum. The design was the same as in Experiment 3, that is, a 2 (movement: approach vs. avoidance) × 2 (first name origin: European American vs. African American) × 2 (block order: compatible first vs. incompatible first) mixed design with the last variable varying between participants. Because block order did not significantly interact with the crucial interaction, $t(285.45) = 0.94$, $p = .35$, we dropped this variable from the analyses. Regarding first names, we used 25 typical European American first names and 25 typical African American first names from Greenwald, McGhee, and Schwartz, 1998 (Exp. 3). For each group of first names, 23 were used for the test trials and 2 for the training. Consequently, participants completed two test blocks of 46 trials each (instead of 40 trials as in previous studies) and two training blocks of 8 trials (two first names per group repeated twice each).

5.1.2. Procedure

The procedure followed the same sequence as in Experiment 3 but with European American and African American first names instead of French and North-African first names.

5.2. Results and discussion

We excluded incorrect responses (4.57% of the trials), RTs exceeding the 400–2000 ms filters (1.54% of the trials)—these filters leading to RTs normal distribution—and we applied an inverse function on RTs. Our mixed model analysis mimicked the one used in Experiment 3.

Whereas the main effect of movement was significant, $t(117.82) = 4.47$, $p < .001$, $dz = 0.32$, revealing faster approach responses ($M = 808$ ms, $SE = 8$ ms) than avoidance ones ($M = 826$ ms, $SE = 9$ ms), the main effect of first name origin was marginal, $t(48.77) = 1.80$, $p = .08$, $dz = 0.44$. Participants tended to respond faster to European American names ($M = 802$ ms, $SE = 9$ ms) than to African American names ($M = 831$ ms, $SE = 9$ ms). Once again, results showed that the expected compatibility effect as the critical interaction was significant, $t(186.82) = 3.56$, $p < .001$, $dz = 0.22$ (see Fig. 4). Participants responded faster to approach European American first names ($M = 768$ ms, $SE = 9$ ms) and to avoid African American ones ($M = 832$ ms, $SE = 9$ ms) than to approach African American first names ($M = 831$ ms, $SE = 10$ ms) and to avoid European American ones ($M = 820$ ms, $SE = 9$ ms). In sum, this experiment shows that the compatibility effect replicates with social groups that are relevant for another culture than the French one. This finding lends strong support to the validity of the online version of the VAAST as a measure of approach and avoidance tendencies toward various categories of stimuli on culturally diverse samples.

6. General discussion

In four experiments varying the type (words, images) and categories (positive/negative, social groups) of stimuli as well as the cultural background of participants, the present research establishes the reliability of a short and online version of the VAAST in producing compatibility effects. Specifically, we showed that the online-VAAST replicated a series of effects previously obtained with the lab version of this task, namely, approach/avoidance compatibility effects with positive vs. negative words (Experiment 4; Rougier et al., 2018) and French vs. North-African first names (Experiment 3; Rougier, Muller, Courset et al., 2019). Importantly, the effect sizes observed in the present experiments were of similar magnitude to those obtained in the lab experiments. The present contribution also extends previous work by showing that the online VAAST produces compatibility effects with positive vs. negative images (Experiment 2) as well as with European

Americans people vs. African Americans people first names (Experiment 4). Overall, the online version of the VAAST comes as a promising tool as it allows assessing approach/avoidance tendencies both reliably and easily.

The advantages of the online version of the VAAST are numerous. First, in the context of what has been coined the replication crisis in psychological sciences, the task comes with a number of dividends. For one thing, this version allows researchers to increase drastically their sample size by capitalizing on online platforms such as Mechanical Turk, Prolific Academic, and the like. Importantly, the move to online platforms does not come at the cost of the produced effect sizes because these were of the same magnitude as those obtained with the lab version of the task (for example, see Experiment 1 above and Rougier et al., 2018, Experiment 4). For another, in line with the growing ambition to conduct large-scale studies, all laboratories around the world would be able to join in without financial difficulty because this online version relies on a free access browser.

Second, the online version of the VAAST offers new opportunities to any researcher or professional who needs to measure approach and avoidance tendencies. More specifically, the ‘easy to use’ setup opens possibilities for all users to measure approach and avoidance tendencies without requiring specific training with high-end and rather demanding software like Eprime. Even more important is the fact that the online setup of the VAAST allows bringing the measure of approach and avoidance outside the lab into a great many respondents’ day-to-day environment. This feature is key, as the online-VAAST should prove useful in various contexts that make if difficult if not impossible to rely on the existing lab version of the VAAST. For instance, the online-VAAST would benefit developmental psychologists for whom it is sometimes difficult to measure approach and avoidance tendencies among children because of school constraints. The same holds among elderly who can hardly come to the lab. Along similar lines, organizational psychologists could also capitalize on the online-VAAST to measure approach and avoidance tendencies among employees, either at work or at home. With this tool, it would be possible to assess these spontaneous reactions toward specific target groups by relying on people’s office or home equipment. In a related vein, social and cultural psychologists could access population in a variety of settings around the world (including countries at war), allowing them to compare approach and avoidance tendencies as a function of social background or culture (Payne, Vuletich, & Lundberg, 2017).

Although the advantages of a short and online version of the VAAST would benefit various areas of psychology, the task would prove especially valuable in clinical or health psychology. For instance, the measure lends itself to such environments as people’s home, which could be particularly helpful for people with special needs (e.g., people with anxiety disorders or with Autism Syndrome Disorder). As yet another illustration, one could use the online-VAAST to measure approach and avoidance responses for a wide variety of stimuli that may be of interest such as addictions (alcohol, cigarettes, etc.). For that purpose, the VAAST can also be used to contrast positive or negative stimuli to neutral ones. In the area of addiction, this can be particularly useful as addiction-associated stimuli are often contrasted with neutral stimuli. Nevertheless, one may logically expect that effect size would be smaller with this set up than with stimuli of extreme valence, as the difference of valence between the two categories of stimuli is smaller. As far as cigarette smoking is concerned, the VAAST has already been shown to be able to capture approach/avoidance tendencies toward tobacco that correlate with self-reported tobacco consumption (Rougier, Muller, Smeding, & Neyroud, 2019). One important issue here is that society deems some behaviors (illegal drugs, porn use, unsafe sex, etc.) as being undesirable. When this is the case, self-report becomes problematic and may require turning to such tools as a ‘bogus pipeline’ to increase the truthfulness of the answers (Tourangeau, Smith, & Rasinski, 1997). Efficient as these methods may be, their implementation is both complex and costly and often requires respondents to come to the laboratory. Another way to make the task even more indirect is, for instance, to ask participants to respond to content-irrelevant features such as the frame color of images or the color of words. More indirect instructions would be useful to make the goals of the task less obvious to the participants and to decrease if not suppress the switch cost of instructions between blocks. Even though the materials provided along with the manuscript do not allow relying on such a set up, they can easily be adapted to this end.

Although still a conjecture at this stage, we speculate that the online-VAAST may prove a useful ally to collect information about people’s actual tendencies at the same time that it would allow accessing much larger scale samples with rather limited costs, both financially and materially.

In addition, the online version of the VAAST readily stands as a tool for retraining, as it is often the case in health psychology for the approach bias modification (for a review, see Kakoschke, Kemps, & Tiggemann, 2017). Indeed, a growing number of researchers are testing the effectiveness of modifying approach bias for harmful consumption products such as cigarettes (e.g., Kong et al., 2015; Wittekind, Feist, Schneider, Moritz, & Fritzsche, 2015), unhealthy food (e.g., Schumacher, Kemps, & Tiggemann, 2016; Warschburger, Gmeiner, Morawietz, & Rinck, 2018) or alcohol (e.g., Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011, Wiers et al., 20152015). In these studies, researchers generally use the feedback joystick task to modify the approach bias of patients (Kakoschke, Albertella, Lee, & Wiers, 2019; Kakoschke et al., 2017). An advantage of the VAAST compared to the joystick task, however, is that this task does not require any specific material (but see Wittekind et al., 2015). This renders the online-VAAST a very handy tool indeed to modify approach/avoidance tendencies.

Although preliminary at this stage, work is accumulating that shows the VAAST to be an efficient training tool. Specifically, a set of experiments using the lab version of the VAAST showed that when women under-identified to math are trained to approach math stimuli (and to avoid art stimuli), they subsequently identify more with math (Batailler, Muller, Nurra, Trouilloud, & Rougier, 2019). This work replicated Kawakami et al. findings (Kawakami, Steele, Cifa, Phills, & Dovidio, 2008) but also showed that the VAAST performs as good as the feedback joystick task (employed in the initial procedure) in producing these training effects. Recent work by Rougier, Schmitz, and Yzerbyt (2019) also found that using the online-VAAST to train individuals to approach/avoid faces belonging to novel groups (e.g., the blue group and the yellow group) influences the visual representation of these groups, as measured with a reverse correlation paradigm (Dotsch & Todorov, 2012). To the extent that the VAAST seems to constitute a reliable way to (re-)train approach/avoidance tendencies—both in the lab and online—the online version of the VAAST could also be a practical and efficient tool for retrainings in clinical and health psychology. This is all the more true in light of the fact that retraining programs ought to be easily accessible for patients if one wishes to increase the chances of success (e.g., with several sessions of approach/avoidance training; e.g., Eberl et al., 2014). To be sure, and although the available findings regarding retraining prove promising at this stage, a great deal of research and data collection is needed to determine the exact level of effectiveness of the VAAST in clinical and health psychology.

On a somewhat different note, we hope that the present findings on the online-VAAST will encourage researchers to collect more and more data to be able to normalize population samples for purpose of comparison. As an example, by establishing normalized samples on approach and avoidance tendencies toward phobic or addictive objects, professionals would be able to compare the individual score of their patients to established standards. This could help better diagnose the intensity of a pathology or an addiction. Clearly, the flexibility and the accessibility of the online version of the VAAST allow an unprecedented number of researchers and professionals to measure approach and avoidance tendencies in various categories of participants.

Finally, we cannot help but note that the effect sizes vary quite a bit across the four studies. Turning to the first drop in effect size, between the first and the second experiment, we note that the only difference concerns the type of stimuli (i.e., words vs. image). As it turns out, this pattern is in line with a recent meta-analysis (Phaf, Mohr, Rotteveel, & Wicherts, 2014) and empirical work (Rougier, Muller, Braud, Mangione, & Courset, 2019) suggesting that the compatibility effect is larger for words than for images. The second decrease in effect size showed up between the first two studies and the two following ones. These sets of studies differ with respect to the category of stimuli (i.e., clearly valenced stimuli vs. social groups). Again, such a difference would seem quite logical in light of the fact that social groups, unlike words, do not differ explicitly in valence and that participants do not all experience bias against minorities to the same extent (see Rougier, Muller, Courset et al., 2019, for a discussion of this topic).

To conclude, the present research consistently showed that the online-VAAST was able to produce compatibility effects with different type and categories of stimuli as well as with culturally different samples. It is our hope that the free and easy-to-use features of this online-VAAST will encourage researchers and professionals alike to carry the investigation of approach and avoidance tendencies to new topics and new populations. As such, this should prove not only valuable theoretically but it should also be immensely beneficial at a practical level.

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Declaration of Competing Interest

None.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.actpsy.2019.102942.

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