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The Role of Attention in Motivated Behavior

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All too frequently, people fail to take actions that are in their best interest (e.g., not taking necessary medications). Researchers have attempted to explain such behaviors by identifying subtle motivational forces that foster an avoidance of attractive outcomes. However, in many cases, such motivational forces have been difficult to identify. We propose that failures such as these to act in valued ways are in some cases caused by insufficient levels of orienting attention. To test this hypothesis, we first created a laboratory analog of real-world failures to act in valued ways, 1 in which participants persisted in viewing lower-valenced images even though they could have, at no cost, viewed a higher-valenced image. When we experimentally increased their orienting attention toward a caption stating they had the option to switch, participants more frequently elected to view the higher valenced image (Studies 1a–c). In real-world behavioral contexts, increasing attention, without an apparent change in valuation, also led to increased levels of approach motivation in behavioral contexts involving purchasing apples (Study 2) and electing to take the stairs instead of the escalator (Studies 3a–c). In light of these findings, we consider the role of orienting attention in motivated behavior.

Keywords: motivation, attention, decision-making, valuation, affect

Human behavior sometimes appears to defy explanation. For example, patients frequently do not take medications that are crucial to their well-being (Morris & Schulz, 1992) and employees do not start retirement accounts that are important to their financial future (Beshears, Choi, Laibson, & Madrian, 2006).

Researchers have attempted to explain such puzzling behavior by analyzing their (potentially hidden) motivational drivers. This quest is founded on the assumption that all instrumental behavior is *energized* and *directed* by motivational forces (Elliot & Covington, 2001). The energization of behavior refers to its activation, and the direction of behavior refers to whether the individual approaches or avoids objects, events, or internal representations (Elliot, 2006).

The motivational forces that give rise to motivated behavior are thought to be the result of *valuation*, which involves classifying things as "good for me" or "bad for me." Ochsner and Gross (2014) suggest that multiple valuations often are computed for a given stimulus. These vary along a continuum of representational complexity, from core valuations representing relatively direct associations between a stimulus and an action (e.g., reaching for an apple) to conceptual valuations representing appraisals that are abstract and often verbalizable (e.g., I want to avoid the escalator and take the stairs because it is healthier).

If people are not taking their medications or signing up for favorable retirement accounts, then according to traditional motivational accounts, a lack-of-approach motivation, or an avoidance motivation (founded upon a "bad for me" valuation) must be present. Such motivations may sometimes be based on contextual variables that obviously affect valuations (e.g., undesirable side effects of medication or retirement forms requiring a large time commitment); other times the contextual variables may be subtle and harder to detect. In their seminal paper, Samuelson and Zeckhauser (1988) hypothesized two potential sources of such relatively subtle avoidance motivation: choice difficulty and loss aversion. Choice difficulty refers to costly mental effort required to evaluate whether or not an action should be pursued (cf. Shah & Oppenheimer, 2008). Loss aversion (Kahneman, Knetsch, & Thaler, 1991) refers to people's tendency to prefer avoiding losses to acquiring gains. It may cause (inferior) current-state preferences if the gains associated with leaving one's current state are valued to be less significant than the potential losses associated with leaving one's current state, even though objective valuations of rational decision theories would have valued the gains and losses equivalently (or even valued the gains to be higher than the losses).

Unfortunately for traditional motivational accounts, there seem to be cases in which neither obvious nor subtle contextual variables are evident—and yet the expected valuation-based behavior does not occur. For example, medical compliance rates are known to be low even when obvious contextual variables such as drug side effects or prescription costs are not a relevant factor (Joyner-Grantham et al., 2009). Subtle contextual variables also do not appear to apply in this context: the value of taking one's medicine is seldom in question and does not require costly analysis and there are few, if any, losses associated with leaving the current state of being unwell. Similarly, many company retirement plans do not entail a time-consuming application process, out of pocket costs, a high degree of choice difficulty, or potential losses upon leaving the current state (of an uncertain financial future)—and yet a large fraction of employees do not enroll in them (Madrian & Shea, 2000).

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Building on work on attention and motivation (Carver, 1979; Carver & Scheier, 1981; Pessoa, McKenna, Gutierrez, & Ungerleider, 2002), implementation intentions (Gollwitzer & Sheeran, 2006), and value-driven decision making (Rangel, Camerer, & Montague, 2008), in this article we consider the possibility that valuation processes require attention in order to be translated into motivated behavior. Because valuation is the engine for motivation, this implies that motivated behavior is predicated upon attention (see Figure 1). On this view, motivated behavior with respect to a given stimulus can only occur if that stimulus is attended to.

Attention is not a unitary construct. Well-accepted frameworks of attention have described several types of attention. Here we are specifically focused on orienting attention, which enables the ability to prioritize input by selecting a modality or location (Petersen & Posner, 2012). On our account, valuation processes cannot be completed without a minimum level of orienting attention. This means that one reason that people do not take medications or start retirement accounts might be that during the course of their day such stimuli (the medicine bottle or the retirement forms) are not adequately prioritized and attended to.

The hypothesis that valuation (and therefore motivated behavior) requires attention may initially seem puzzling. We do not usually need to try to pay attention to a piece of cake before being motivated to eat it. Nor do we need to try to pay attention to a snake before being motivated to step back. However, the lack of effortful attention in these cases does not mean that attention is not required. This is because some affectively laden states of the world are known to automatically capture attention (Carretié, Hinojosa, Martín-Loeches, Mercado, & Tapia, 2004). Such stimuli are typically evolutionarily "hard-wired" to elicit "bottom-up" attentional and perceptual prioritization (Öhman, Flykt, & Esteves, 2001). However, other stimuli—even stimuli whose effects are equally consequential—do not automatically capture attention. On our account, the valuation of such stimuli requires the implementation of "top-down" attentional processes. For example, the act of choosing a healthy snack over an unhealthy one often requires attention toward one's eating behavior.

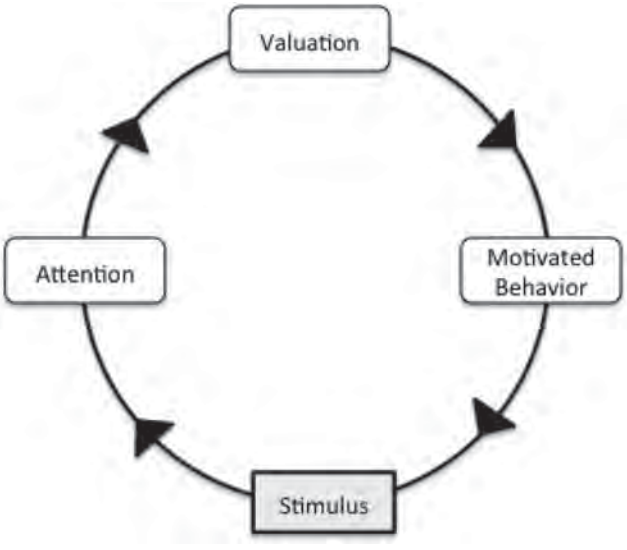

Figure 1. We propose that a stimulus must receive attention in order for it to be valued and for motivated behavior to occur (with respect to that stimulus). Motivated behavior may change the state of that stimulus which may cause the cycle to repeat.

To test whether attention is necessary for valuation in such cases (and therefore for motivated behavior), we first developed a laboratory analog of the puzzling behaviors discussed above (Studies 1a–c). We created a context in which participants, according to motivational accounts, should always proactively leave their current state to approach positive stimuli or avoid negative stimuli. We then manipulated orienting attention. We hypothesized that motivated approach or avoidance behavior should be more evident in a high attention group compared with a low attention group. In Study 2 and Studies 3a–c, we sought to demonstrate the effects of increased attention on real-world behaviors. In Study 2 we tested whether a sign that read "APPLES" could increase apple sales in company cafeterias. This sign was not designed to affect the valuation of apples (a sign that read "SWEET APPLES" may have increased valuation); rather it was designed to increase attention toward the apples. In Study 3a we tested whether signs that read "Stairs" and "Stairs or Escalator?" would increase the number of pedestrians choosing to take the stairs at the stair/escalator choice point. These signs were not designed to affect the valuation of taking the stairs (a sign that read "TAKE THE STAIRS FOR YOUR HEALTH" may have increased valuation); rather they were designed to increase attention toward the stairs. Finding an increase in stair-climbing rates, we then tested whether this effect could be attributed to routine-disruption (Study 3b) or subtle demand characteristics (Study 3c).

Study 1

Varying Levels of Attention Affects Motivated Behavior in the Laboratory

To investigate the role of attention in motivated behavior, we first sought to recreate in the laboratory the behavioral puzzles described above. In particular, we sought a context in which participants would frequently fail to act even though valuation processes implied that they would act. We then sought to test whether increasing attention levels would increase levels of proactive behavior.

These goals were best served by a behavioral context in which the valuation process is well understood. The viewing of affective images provides one such context (Lang, Bradley, & Cuthbert, 1999). According to a standard hedonic account (Higgins, 1998), the valuation associated with viewing a higher-valenced (more pleasant or less negative) image is greater than the valuation associated with viewing a lower valenced image. Thus, barring error or idiosyncratic preferences, participants should act to view higher valenced images. Our experimental results were consistent with this prediction (Study 1a). As detailed below, when participants were asked to indicate their preferences by pressing one button to view a higher valenced image and another button to view a lower valenced image, they indicated a preference for viewing the higher valenced image in nearly every trial.

However, when participants' orienting attention was no longer forcibly directed to the buttons, and when they were instead

required to *proactively* press a button to switch from viewing a lower-valenced image to a higher-valenced image in a series of trials, they did so infrequently. This provided an analog to the behavioral puzzles described above, in that participants were not acting in accord with their preferences. This then enabled us to test whether increasing attention in this image-switching context would increase proactive behavior (Study 1b). Finding this to be the case, we then tested whether subtle demand effects could account for the observed results (Study 1c).

Study 1a

When given a choice, participants prefer viewing higher valenced images. We sought to determine whether, when provided with an explicit, binary choice, participants would prefer viewing a higher valenced image over a lower valenced image.

Method. We created a series of 40 trials in each of which 40 participants (24 women; sample size based on effect sizes observed in pilot studies) were asked to indicate viewing preferences between a pair of affective images. Three types of images were used in the experiment: positive images depicted beautiful scenes from nature; neutral images depicted everyday items such as umbrellas; and negative images depicted images known to create disgust.

In each trial, a pair of images was sequentially presented for 1 s. There were an equal number (20) of two types of trials: negative-to-neutral trials and neutral-to-positive trials. In negative-to-neutral trials the negative image was designated as the default image and in neutral-to-positive trials, the neutral image was designated as the default image.

After the 1-s initial presentation of the default image, participants were presented with a 3-s binary choice screen (without the image). In negative-to-neutral trials, the choice screen read "Press 's' to switch to a neutral image or press 'c' to view default image." In neutral-to-positive trials, the choice screen read "Press 's' to switch to a positive image or press 'c' to view default image." If no response was recorded, participants were shown the default image. Else, the chosen image was displayed for 15-s. Attention to the choice was mandatory: Participants were instructed that they were required to make a choice in each trial.

To avoid perceptions of experimenter preferences in favor or against viewing the default image, participants were falsely told that experimenters were interested in measuring their autonomic responses to viewing any of the images included in the experiment (no such data were collected, although participants were hooked up to autonomic assessment devices). Postexperiment interviews suggested that 100% of participants believed this cover story and acted accordingly.

Results and discussion. Participants responded in 100% of trials and elected to view the higher valenced image in 87.5% of trials (the higher valence image was selected, on average, in 36.4 out of 40 trials, 95% CI [34.9, 37.8]).

Across all groups there were no observed differences between default-image viewing for negative-to-neutral and neutral to positive trials suggesting that preferences for higher valenced images and attention effects generalize across the two different types of trials.

Study 1b

Attention drives actions associated with positively valued outcomes. We sought to recreate the laboratory equivalent of a behavioral puzzle in which participants would continue viewing a lower-valenced image even though they had the option to view a higher valenced image with proactive action (i.e., electing to pressing a button). We tested whether increasing levels of attention would lead to increased proactive action.

Method. Fifty participants were randomly divided into two equal groups: a low-attention group (14 women, 11 men) and a high attention group (14 women, 11 men). Prior to the start of the experiment all images were sequentially displayed (500 ms/image) so that the participants knew the type of images they could expect in the positive, neutral and negative category. In the low attention group, participants were shown a default image for 1-s. In negative-to-neutral trials, this default image was negatively valenced and the instruction caption under the initial negative image read "Press 's' to switch to a neutral image." In neutral-to-positive trials, this default image was neutrally valenced and the instruction caption under the initial neutral image read "Press 's' to switch to a positive image." Each trial lasted 15 s. If a participant elected not to press "s" she would see the default image for the entire trial. Else, if a participant elected to press "s" at time t, the image would instantly switch, and the participant would view the higher valenced image for 15-t s.

An identical protocol was used for the high attention group with one important exception: if the participant had not switched in the first 5 s of viewing the default image, a red border appeared around the caption under the default image (see Figure 2). If the participant had still not switched within 10 s of watching the default image the caption flashed for 0.5 s. Both these manipulations were designed to orient participant attention toward the caption that reminded them that they could view a higher-valenced image by pressing "s."

As is Study 1a, participants were falsely told that experimenters were interested in their autonomic responses to image viewing and were indifferent to which specific images they viewed. Postexperiment interviews regarding beliefs about the purpose of the study suggested that 100% of the participants in both groups believed this cover story and acted accordingly.

Results and discussion. In the low attention group, participants switched images in only 29.4% of trials (mean number of switches 11 out of 40, 95% CI [8.0, 15.5]). This low number was noteworthy since actions based on preference alone should have led to a switch in nearly every trial. These results suggested that we had successfully recreated a laboratory equivalent of the behavioral puzzles discussed above.

We had hypothesized that increasing attention would lead to increased levels of motivated behavior more consistent with image valuations (although not to the level of Study 1a, because proactive action away from a default was required). We found this to be the case: In the high attention group participants switched images in 50.3% of trials (mean number of switches 20.1 out of 40, 95% CI [15.6, 24.5]). The difference in the rate of switching from the default between the low attention and the high conditions is significant, $t(23) = 2.80$, $p = .007$, $d = 0.79$.

Notably, the rate of switching in the first 5-s (pre-red border) of the high attention group was undistinguishable from the low at-

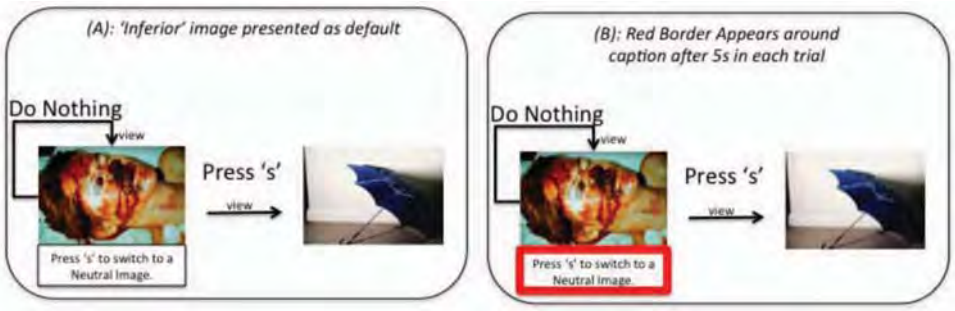

Figure 2. As depicted in Panel A, participants frequently neglected to switch to the higher valenced image. In the high attention condition (Panel B), participants more frequently switched images after their attention was oriented toward the red-bordered caption. See the online article for the color version of this figure.

tention group: High attention group participants switched images for 16.9% (6.76 out of 40) trials within the first 5 s compared with 18.5% (7.4 out of 40) switches in the low-attention group within the first 5 seconds, $t(23) = 0.39$, $p = .70$. However, a large difference was observed in the second 5-s interval: Participants in the high attention group switched images in an *additional* 26.5% of trials, whereas the low-attention group switched in an additional 8.5% of trials. The difference in the rate of switching in the second 5-s interval is significant, $t(23) = 4.18$, $p < .001$, $d = 1.18$. This (second) 5-s interval accounted for the bulk of the difference between the two groups.

Across all groups there were no observed differences between default-image viewing for negative-to-neutral and neutral to positive trials suggesting that preferences for higher valenced images and attention effects generalize across the two different types of trials.

These results are consistent with the hypothesis that orienting attention (engendered in this empirical context by the red-border) unlocks the valuation processes that lead to motivated action (i.e., a button press to switch images). However, it is also possible that the salient red border created a demand effect by making participants suspect that the experimenters *wanted* them to press a button and switch images (this could have occurred despite our attempts at creating a—reportedly credible—cover story about being interested in autonomic responses, not image-viewing behavior). We investigated this possibility in Study 1c.

Study 1c

Attention does not drive actions associated with negatively valued outcomes. The goal of this study was to determine whether the image-switching behavior in the high-attention group of Study 1b was attributable to unlocking of the valuation process by orienting attention, or to experimenter-generated demand effects. To achieve this goal, we created trials in which we expected outcomes based on valuation to be different from outcomes based on demand effects.

As in Study 1b, we used trials in which a red-border/flash highlighted the option of pressing a button to switch from one image to another. As in Studies 1a and 1b, participants had the option of moving from a worse image (lower valenced) to a better (higher valenced) image. In Study 1c, we included trials in which participants had the option to move from a better image to a worse image.

Accounts based on attention-enabled valuation would suggest that participants would not, in general, press a button to move from a better to a worse image since doing so would result in a negatively valued outcome. In contrast, accounts based on demand-effects would suggest that participants would frequently press any highlighted button since experimenters' cues (i.e., displaying a red-border/flash) were giving rise to strong demand effects.

Method. Forty participants were randomly divided into two equal groups: a low-attention group (20 participants, eight women) and a high attention group (20 participants, seven women). Participants in both groups followed precisely the same procedures as participants in corresponding groups in Study 1b: Participants in the low-attention group had the option to press a button and switch the default image to view an alternative image; participants in the high attention group additionally saw the red border and caption flash if they did not switch images early in each trial. The crucial difference from Study 1b was that in half the trials the default image was higher valence (i.e., more pleasant) than the alternative image.

There were a total of 80 trials: 40 worse-to-better trials (50% negative-to-neutral and 50% neutral-to-positive) that were identical to the 40 trials of Studies 1a and 1b, and 40 better-to-worse trials (50% neutral-to-negative and 50% positive-to-neutral). No images were repeated between trials. As in Studies 1a and 1b, participants were falsely informed that experimenters were interested in their autonomic responses to image viewing and were indifferent to which specific images they viewed.

Results and discussion. For both the low-attention group and the high-attention group, the worse-to-better trials replicated the pattern of results from Study 1b. The rate of switching for the high attention group was 61.4% (24.55 out of 40 trials) and the rate of switching for the low attention group was 40.2% (24.55 out of 40 trials). The difference in image switching between the high attention and low attention groups (for worse to better trials) was 21.2%, $t(78) = 3.08$, $p < .01$, which was virtually identical to the 20.9% difference observed in Study 1b.

Importantly, for the better to worse picture trials, as shown in Table 1, there was no statistical difference between the low atten-

Table 1
Average Rate of Image Switching % by Group

	Low attention group	High attention group
Worse-to-better trials	40.2% (95% CI [33.4, 46.9])	61.4% (95% CI [51.0, 71.6])
Better-to-worse trials	8.4% (95% CI [7.0, 9.8])	11.2% (95% CI [9.3, 13.0])

tion group and the high attention group (8.4% vs. 11.2%, $t(78) = 1.08$, $p = .39$).

Thus, participants did not appear to merely react to the cues and treat them as an indication of experimenter preferences. Rather, their behavior was more consistent with an account that featured the enabling of valuation processes via attention. When attention unlocked a valuation that was positive (e.g., switching from a worse to a better picture), the associated action was often undertaken. Conversely, when attention unlocked a valuation that was negative (e.g., switching from a better to a worse picture), the associated action was often not undertaken.

Although the results of Studies 1a–1c support the hypothesis of attention enabling valuation and motivated action, this behavioral context was contrived and laboratory based. We next sought to determine whether similar attention-related effects were observable in more natural behavioral contexts.

Study 2

Varying Levels of Attention Affects Real-World Purchasing Behavior

Can an attention-eliciting message—not designed to change valuation—increase approach motivation in a real-world behavioral setting? To answer this question, we placed a colored, attention-attracting sign reading "APPLES" on apple baskets (which themselves were manifestly visible) in company cafeterias. We hypothesized that the sign should increase orienting attention, which would enable valuation process and create increased motivation to purchase apples.

Method

We selected five company cafeterias with nearly identical layouts belonging to an enterprise located in the San Francisco Bay Area. Each cafeteria served several hundred employees every day. The main purpose of these cafeterias was to serve meals (primarily breakfast and lunch). However they also provide fruits, nutrition bars and other refreshments that were consumed either as standalone snacks or as accompaniments to meals.

An apple basket was prominently displayed near the cash register of each cafeteria. Preexperiment interviews with cafeteria employees (across all five cafeterias) suggested that many customers picked up an apple while waiting to pay for their meal. These customers were said to account for most apple sales. A small minority of customers were said to come to the cafeteria specifically to purchase an apple.

We constructed a colored sign on a folded A3 sized paper containing the word "APPLES" in upper case, 300-point Herculaneum font in bright blue ink with a red border. We placed these signs at the back of the apple baskets on alternate days over a 2-week experimental period. The signs were placed on Monday, Wednesday, and Friday of Week 1 and Tuesday and Thursday of Week 2. No signs were placed on the remaining days. Experimenters recorded the sales of apples at the end of every business day. This was accomplished by subtracting the apples remaining in the basket at the end of the business day from the total number of apples present in the basket at the start of the business day.

Results and Discussion

In the sign-present condition (across five days in five cafeterias) there were a total of 223 apples sold (8.92 apples per cafeteria per day). In the sign-absent condition (across five days in five cafeterias) a total of 99 apples were sold (3.96 apples per cafeteria per day). The difference was significant, $t(23) = 3.93$, $p < .001$, $d = 1.11$). The 5-day sign-present total sales were greater than the 5-day sign-absent total sales in each of the five cafeterias.

Notably, the effects of the sign were strongest on Day 1 and Day 2 of the experiment and the weakest on Day 9 and Day 10 of the experiment. The average difference between the sign present and the sign absent conditions on these 2 days (Monday and Tuesday of Week 1) was eight apples; the average difference on the last two days of the experiment (Thursday and Friday of Week 2) was only 2.4 apples. The average difference monotonically declined for each day-pair. One reason for this pattern of results may be that the novelty of the sign was highest on Day 1 and this novelty attracted maximum orienting attention.

The "APPLES" sign increased sales even though it did not directly seek to influence customers' valuation of the apples the way a sign reading "SWEET APPLES" might have. However, this study did not preclude the possibility that it was not attention that enabled valuation processes; rather the presence of the sign may have directly increased valuation—because, for example, customers may have reasoned that the fact that someone went to the trouble of making a sign about the apples must mean that they are good. We investigated the source of effectiveness of similar signs in a different behavioral context in Study 3.

Study 3

Attention Affects Behavior in a Real-World Health Related Behavioral Context

In Study 3, we sought to show that increased motivated behavior was due to unlocking of valuation processes by attention (and not because of direct change in the valuation). We used the context of pedestrians making the choice between taking the escalator or stairs at train stations in the San Francisco Bay Area. We tested whether attention-orienting signs could increase stair-climbing rates (Study 3a). Finding this to be the case, we tested whether these effects were induced, not by attention, but by a disruption to

routine (Study 3b). Finally, we tested if subtle demand effects could lead to increased stair-climbing (Study 3c).

Study 3a

Attention orienting sign increased rate of stair climbing. The choice of whether to take the stairs or escalator is determined by a variety of factors. Prior studies have shown that only about 6% of pedestrians proactively choose to take the stairs (Suri, Sheppes, Leslie, & Gross, 2014). Thus, taking the escalator is seen as a default and most pedestrians do not appear to view taking the stairs as an available option. We tested whether signs placed at the stair escalator choice point could increase rates of stair-climbing.

Method. Many prior studies have shown that signs highlighting the health benefits of taking the stairs, when placed at the stair-escalator point of choice are effective in increasing the number of pedestrians who elect to take the stairs (Suri, Sheppes, Leslie, & Gross, 2014). A common assumption underlying these signs is that they are effective because they highlight the benefits of taking the stairs (e.g., weight loss, heart fitness) thereby directly impacting valuation.

We sought to determine if signs that did *not* refer to benefits of stair-climbing but only drew attention to the available option of taking the stairs could impact behavior. We chose two such signs: a sign that read "Stairs?" and a second sign that read "Stairs or Escalator?" We hypothesized that these signs would induce more pedestrians to take the stairs relative to cases in which no sign was in place. We used an A/B testing methodology (A = sign present; B = no sign) and recorded the percentage of pedestrians who took the stairs. Both signs were displayed on a 22" × 28" placard that was placed on a floor-standing sign stand. The signs used black lettering printed on white poster paper.

The choices of 1,369 pedestrians approaching (ascending) stair/escalator banks outside two train stations in the San Francisco Bay Area during the commute hours of 7 a.m. and 10 a.m. and 4 p.m. to 6 p.m. were observed and recorded. Measurements were made in two different stations on two consecutive weekdays over a duration of approximately 9 hr. This ensured that pedestrians were unlikely to have seen any sign more than once (this was later confirmed via interviews). Staircases in both stations had approximately 50 steps.

Pedestrians with items larger than a computer bag or a handbag were excluded because these items would influence their choice. We excluded individuals carrying a baby for similar reasons. Additionally, we counted groups of individuals larger than two as one choice, since people in these groups typically went along with the choice of the first pedestrian in the group.

Experimenters were positioned so that they could not be observed by pedestrians at the point of choice. Each experimenter was armed with two counters—one for the stairs and one for the escalator. A pedestrian was counted when she fully ascended the stairs or escalator. Experimenters were instructed to note any instance of a choice being driven by congestion on either the stairs or the escalator. No such instances were observed. One of the two signs was "on" for a 15-min interval that was then followed by no sign being present for the next 15-min interval. A 2-min break between conditions provided experimenters time to place, or remove signs. The break also provided sufficient time to ensure that pedestrians who observed the experimenter handing the sign were not included in the study set. A stopwatch was used to mark 15-min measurement intervals. Pedestrians in the process of ascending as the 15-min measurement interval ended were not included.

We approached all pedestrians who had elected to take the stairs when there was a sign in place at the stair-escalator choice point and asked them to participate in a brief interview. People at the bottom of the stairs could not have observed pedestrians being approached after they had finished climbing the stairs. We sought to determine whether they had seen the sign below, and if so, to describe whether the sign had influenced their choice. If they indicated that the sign influenced them, they were asked to explain how (in an open ended form). They were then asked to indicate which item in a prewritten list was closest to their open-ended response. The list contained three items: (a) The sign convinced me that it is better to take the stairs or (b) The sign drew my attention toward considering what is better for me or (c) Other.

Results and discussion. Both signs increased the percentage of pedestrians electing to take the stairs. The sign reading "Stairs?" outperformed the No Sign condition (11.9% vs. 5.8%; $\chi^2 = 7.09$, $df = 1$, $N = 625$, $p = .008$, V = 0.11). The sign reading "Stairs or Escalator?" also outperformed the No Sign condition (13.2% vs. 6.4%; $\chi^2 = 9.44$, $df = 1$, $N = 744$, $p = .002$, V = 0.11).

Out of the 91 pedestrians who took the stairs when a sign was present at the stair-escalator choice point (across both signs conditions), 63 provided complete interviews of which 26 either did not see the sign or indicated that the sign played no role in their decision. When asked to explain the source of the sign's effectiveness, the remainder of the participants (37) provided open responses which were later coded by an experimenter who was blind to the hypothesis into the three items described in the Method section above (i.e., "sign increased valuation" or "sign attracted attention," or "other"). A large majority of the open responses—31 out of 37 (84%)—were coded as the "sign attracted attention" item. After their open response when participants were asked to pick an item that most closely matched their open response, 33 out of 37 (89%) respondents self-coded their response as the "sign attracted attention" item.

The increased rate of stair climbing after reading an attention-eliciting sign suggests that attention increases the impact of motivational forces on behavior. Results from participant interviews suggested that this increase is created because orienting attention enabled the valuation process to be translated into behavior.

However, there are two other possible explanations for pedestrian choices observed in Study 3a. First, choices may have been due to a disruption of typical routines due to the sign. Because the dominant majority of pedestrians routinely take the escalator, *any* disruption could have increased the rate of the stair climbing. We considered this possibility in Study 3b. Second, pedestrian choices could have been influenced by subtle demand effects that they did not (or could not) articulate in postchoice interviews. Despite the seeming neutrality of the signs used in Study 3a, they both prominently featured the word "stairs." This may have introduced a communicative intention that implied a preference for stair-taking by the creator of the sign (hence influencing valuation). We tested this possibility in Study 3c.

Study 3b

A disruption in routine does not influence stair/escalator choices. In Study 3b, we sought to determine whether any disruption in typical routines (that almost always feature escalator-taking) could increase stair-taking behavior. We therefore constructed a sign that read "Have a good day!" We reasoned that such a sign would cause a disruption in routines like the signs used in Study 3a. However, this sign would not draw attention to the stair-escalator decision and therefore would not unlock valuation processes related to stair-climbing.

A disruption-based account would predict that "Have a good day!" sign should increase the rate of stair taking. The attention-enabled valuation account proposed in this work would predict that there should be no increase in stair-climbing. We tested these contrasting predictions using methods identical to those described in Study 3a (contrasting a "sign-on" condition with a no-sign condition).

The "Have a good-day!" sign had no effect on stair-climbing rates. In the presence of the sign 5.1% of 638 pedestrians took the stairs and in its absence (a statistically equivalent) 5.3% of pedestrians took the stairs ($\chi^2 = 0.01$, $df = 1$, $N = 638$, $p = .92$). These results were consistent with the attention-valuation hypothesis, but not with the disruption hypothesis.

Study 3c

A sign not featuring stair-use increased stair climbing rates. In Study 3c, we tested whether the increased stair-climbing rates observed in Study 3a were driven by the word "stairs" that prominently featured in both signs that were tested. It is possible that the word "stairs" introduced subtle demand characteristics that participants did not/could not report on in postchoice interviews in Study 3a. We therefore constructed a sign that read "Escalator?" We reasoned that such a sign would not directly create demand characteristics favoring stair climbing, but would draw attention to the stair-escalator decision and therefore would unlock valuation processes related to stair-climbing.

A demand-characteristic account would predict that "Escalator?" sign would not implicitly prime stair use and would therefore not increase the rate of stair taking. The attention-valuation account proposed in this work would predict that there should be an increase in stair-climbing because the "Escalator?" sign would draw attention to the stair-escalator choice. We tested these contrasting predictions using methods identical to those described in Study 3a (contrasting a "sign-on" condition with a no-sign condition).

The "Escalator?" sign increased stair-climbing rates. In the presence of the sign 9.8% of 719 pedestrians took the stairs and in its absence 5.8% of pedestrians took the stairs ($\chi^2 = 4.01$, $df = 1$, $N = 719$, $p = .04$). These results are consistent with the attention-valuation hypothesis, but not with the demand-characteristics hypothesis.

General Discussion

It is difficult to understand why people often do not do what is apparently in their best interest. Examples abound, such as patients not taking medications crucial to their well-being, and employees not signing up for retirement accounts crucial to their financial well-being. In this article, we have presented evidence that one cause of such behaviors may be a lack of orienting attention, which prevents the initiation of the valuation processes that are required to enable motivated behavior.

In Studies 1a–1c, participants frequently did not press a button that would have resulted in viewing a higher-valenced image instead of a lower-valenced default image. When their attention was trained toward a caption reminding them of their option to switch images, participants did so at much higher rates. In Study 2, company employees increased apple purchases after viewing a sign reading "APPLES" (which was designed to increase attention but not valuation). In Studies 3a–3c, pedestrians took the stairs at increased rates after they viewed signs reading "Stairs" or "Stairs or Escalator?" compared with pedestrians who had not viewed these signs. They frequently attributed their behavior to increased attention.

To our knowledge, prior empirical work on motivational puzzles has not explicitly linked attention to motivated behavior. This link enables a common explanation for a broad spectrum of puzzling findings. For example, preferentially displaying healthy items over unhealthy ones in school cafeteria lines (Hanks et al., 2012) increased sales of healthier food items increased by 18% and decreased sales of less healthy food items by 28%. Presumably the students knew that they had access to the previously preferred nonhealthy food items. However these items did not, on our account, receive enough attention to be valued and acted upon.

A similar example involved displaying tax-inclusive prices for products subject to sales tax for a 3-week period. This tax-inclusive tax display reduced demand by roughly 8% relative to control products (Chetty, Looney, & Kroft, 2007). Presumably, customers knew that they would have to pay sales tax on their purchases but a lack of orienting attention on that fact allowed them to purchase items that they otherwise would not have. When taxes were included in the display, the higher price was attended to at the time of the purchasing decision and relatively fewer sales occurred.

The present work makes clear contact with recent theories of decision making that feature the crucial role of valuation in choice. These theories point to multiple drivers of valuation (Lee, 2013; Ochsner & Gross, 2014) that are integrated in the ventromedial prefrontal cortex [vmPFC)/orbitofrontal cortex (OFC)] (Levy & Glimcher, 2012; Rushworth, Kolling, Sallet, & Mars, 2012). This integration enables every-day decision making by allowing the comparison of the values of each available option and transmitting computed preferences to motor systems that give rise to action (Hare, Schultz, Camerer, O'Doherty, & Rangel, 2011). Decision theorists have recognized the important role attention plays in the comparison of values of different options (Rolls, 2007; Hare, Malmaud, & Rangel, 2011). This study series contributes to this rapidly developing literature by presenting behavioral evidence that creates a through-line from mechanistic lab-based accounts of attention and valuation to real world motivated behavior. Further, it provides a bridge connecting the (often separate) literatures featuring theories of motivation and theories of decision making.

Our findings demonstrate that orienting attention facilitates motivated behavior—both in the laboratory and in real-world behavioral contexts. However, important details of this attention-motivation link require further investigation. For ex-

ample, we compared proactively taking an action (e.g., buying an apple) with persisting with a default option (e.g., doing nothing). It is unknown whether the valuation of default states is similar to the valuation of states requiring proactive action. Gathering evidence suggests that this may not be the case because leaving a default state may involve inertial costs (Suri, Sheppes, Schwartz, & Gross, 2013) that are typically not relevant in contexts requiring a binary choice between two items, neither of which are associated with a default action. Additionally, it remains unknown whether a minimum amount of attention or a minimum duration of attention is required to enable motivated behavior. Furthermore, it is unknown whether a behavior that has been frequently performed before requires the same level of attention as a behavior that has not been performed before. Future studies are required to illuminate these issues. In clinical contexts, future studies are required to investigate whether deficits in orienting attention can help explain motivational deficits in disorders including schizophrenia (Barch, 2005; Kring & Barch, 2014) and ADHD (Dovis, Van der Oord, Wiers, & Prins, 2012).

Our findings suggest that interventions aimed at changing behavior (e.g., smoking cessation, exercise initiation) could attempt to generate an increase in orienting attention and not just highlight the direct benefits/costs of the target activity. These results predict, for example, that a medicine bottle that beeped varying tones would decrease levels of medical noncompliance, as would personalized, attention-grabbing reminders from a cell phone. Such interventions may be most useful when behavior modification strategies that aim to change behavior via altering valuations (e.g., by instituting rewards or punishment or by providing more valuation related information) are not adequate. In many contexts, such attention-based interventions may be simple and inexpensive to deploy.

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