Motivated seeing and unseeing - Exp. 3 pre-registration document

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# Motivation

In two previous experiments, we aimed to replicate in an online setting findings of motivation effects on perception (Balcetis, Dunning, & Granot, 2012; Leong, Dziembaj, & D’Esposito, 2021; Leong, Hughes, Wang, & Zaki, 2019). Participants performed a categorisation task of noisy images (‘bird or fish?’), and were incentivized to make accurate responses. In addition, on different experimental blocks, bird (Exp. 1) or fish (Exp. 2) images were associated with either a reward or a loss. In both experiments, we found that participants had an overall bias to report seeing birds. Furthermore, in both experiments, associating a stimulus category with point loss made subjects more likely to categorizing stimuli as belonging to the alternative category. However, and in contrast with previous reports of motivated perception (Balcetis et al., 2012; Leong et al., 2021, 2019), we found no effect of associating bird or fish images with a reward on response bias on decision time.

We consider two candidate reasons for our failure to observe an effect of motivation on perception. First, it may be that a bonus payment of £1 was insufficient to reliably affect participants’ behaviour. For comparison, Leong et al. (2019) offered up to $20 of bonus (67% of the base payment), Leong et al. (2021) offered up to $10 (50% of the base payment) and Balcetis et al. (2012) offered a raffle ticket with a top prize of $100 (1000% of the base payment). Second, we consider the possibility that our stimuli were perceived as emotionally aversive, rendering them more difficult to associate with a positive outcome. Previous studies used face/scene images (Leong et al., 2021, 2019) or numbers and letters (Balcetis et al., 2012) which are perhaps more neutral.

In this third experiment we make several changes to our paradigm, to increase our sensitivity to effects of motivation on perception. First, we increase our bonus payment, and offer to double the payment of the highest scoring 30% of our subjects, and triple the payment of the highest scoring 5%. We also include a leaderboard screen to increase motivation. Second, instead of fish and bird images, we now use emotionally neutral noisy grating images as stimuli.

Finally, we fix an issue with our comprehension checks for the reward and loss blocks. In Experiments 1 and 2, subjects’ comprehension was probed before reward block using the following question (the order or answers was randomized between participants):

In addition to getting 10 points for accurate responses, in this block whenever a bird image is presented …

1. I automatically get 12 additional points
2. I get 12 additional points only if I answered correctly
3. I get 12 additional points only if I pressed J/F
4. I automatically lose 12 points

Importantly, subjects that chose any answer but “I automatically get 12 additional points” were presented with the instructions again, until they responded correctly. Critically, this included subjects that erroneously believed these additional points will only be given if they respond in a certain way (responses 2 and 3 above).

In loss blocks, the exact same question was presented, but this time the correct answer was “I automatically lose 12 points”. Critically, and in contrast to reward blocks, here no distractor corresponded to a belief that points will be lost only if subjects respond in a given way. As such, some subjects may have completed loss blocks thinking that their responses could attenuate stimulus-dependent point loss.

To make sure all subjects fully understand the instructions, we now include two additional distractors in both questions:

In addition to getting 10 points for accurate responses, in this block whenever a grating is tilted to the right …

1. I automatically get 12 additional points
2. I get 12 additional points only if I answered correctly
3. I get 12 additional points only if I pressed F
4. I automatically lose 12 points
5. I lose 12 additional points only if I answered correctly
6. I lose 12 additional points only if I pressed F

# Methods

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study.

## Participants

The study was approved by the Research Ethics Committee of Birkbeck, University of London (study ID number 2122050). No adverse effects for participants from participation in the study are expected. Participants will give consent for taking part in the study which can be withdrawn at any time.

One hundred participants will be recruited from the Prolific database. The criteria for recruitment will be a Prolific approval rate of 95%, English as their first language, and an age between 18 and 60. The study will take participants about 15 minutes of their time. Participants will be paid 7.5 pounds per hour. We will double the payment of the top-performing 30% of our participants, and triple the payment of the top performing 5%.

## Procedure

Figure 1 illustrates the experimental design. In a near-threshold categorisation task, participants will report whether a noisy grating was tilted to the right (clockwise) or to the left (anticlockwise). At the beginning of the experiment, participants will be given instructions and their understanding will be checked by a multiple-choice question. Then, participants will be presented with a practice block, which will be repeated until accuracy on the task reaches 75%. The practice round will then be followed by the main part of the experiment, comprising six blocks of 28 trials. At the beginning of each trial a fixation cross will appear on the screen for 500-1000 milliseconds, followed by three grayscale images: a forward mask (presented for 50 ms), the target image (presentation time calibrated to achieve 70% accuracy), and a backward mask (presented until a decision is made). The forward and backward masks will comprise black and white concentric circles. The target image will be a noisy visual grating: 200x200 pixels, where 90% of the pixels show random grayscale values, and the remaining 10% are sampled from a grating (frequency: 62 pixels, phase: random), tilted 45 degrees clockwise or counterclockwise on different trials. Participants’ task will be to judge whether the grating was tilted clockwise or counterclockwise. They will be asked to indicate their decision using the J and F keys on the keyboard, counterbalanced across participants. The next trial will not begin until participants press one of these keys to indicate their decision.

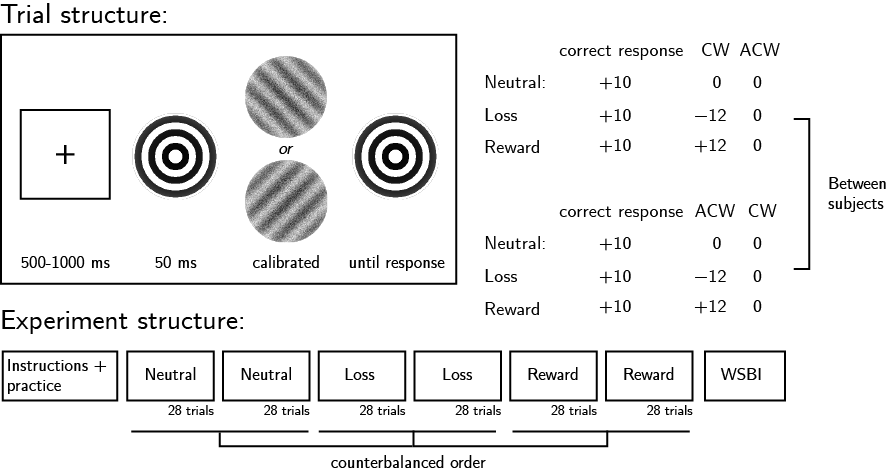
In addition to a base payment, participants will be told that they can accumulate points in the task, and that these points will determine whether or not they get a bonus payment. Specifically, that we will double the payment of the top 30%, and triple the payment of the top 5% participants.

In all blocks, participants will be told that correct responses award them with 10 points. In addition, on two reward blocks, a target orientation (randomized between subjects) will be rewarded with an extra 12 points, and on two loss blocks, the same target orientation will be associated with a loss of 12 points. Two neutral blocks will include no gains or losses for the target orientation. The order of the six blocks will be randomized, with the constraint that the two blocks of each condition are always be presented consequently.

Importantly, in all blocks participants will be motivated to make accurate judgments regarding the content of the presented image, but on some blocks the target orientation (regardless of their decision) will be associated with a gain of points, while on others the target orientation will be associated with a loss of points. Two multiple-choice questions will be used to make sure participants understand these instructions (for example, “To get many points I need to…” correct answer: “press F when the stripes are tilted to the left and J when they are tilted to the right”, and not “press F as many times as possible”; “In addition to getting 10 points for accurate responses, in this block whenever the stripes are tilted to the right…” correct answer: “I automatically get 12 additional points”, and not “I get 12 additional points only if I pressed J”). Neutral blocks will be preceded by the response mapping comprehension question (“To get many points I need to…” correct answer: “press F when the stripes are tilted to the left and J when they are tilted to the right”). An additional question (“In addition to getting 10 points for accurate responses, in this block whenever the stripes are tilted to the right…”, correct response: “I don’t get or lose additional points”) will be presented only to those participants for which this is not the first experimental condition.

Task difficulty will be calibrated by adjusting the target presentation time, starting at 60 ms and following a one-up-two-down procedure with a multiplicative step size of 0.9, which will move closer to 1 following each change in the direction of the calibration process. The calibration will run in the background throughout the entire task.

Upon completion of the main part of the experiment, participants will complete the white bear suppression inventory (Wegner & Zanakos, 1994).



*Figure* *1.*  Experimental design.Top left: Trial structure. The target image’s presentation time will be calibrated to achieve 70% accuracy. Top right: incentive structure on different experimental blocks. Bottom: Overall experiment structure.

### Randomization.

The order and timing of experimental events will be determined pseudo-randomly by the Mersenne Twister pseudorandom number generator, initialized in a way that ensures registration time-locking (Mazor, Mazor, & Mukamel, 2019).

## Rejection criteria

Participants will be excluded if their accuracy falls below 50% in one or more experimental conditions (neutral, loss, reward), and for needing four or more repetitions of block instructions before providing a correct response to one or more of the comprehension questions. We will also exclude participants for having extremely fast or slow reaction times in one or more of the tasks (below 100 milliseconds or above 5 seconds in more than 25% of the trials). Trials with response time below 100 milliseconds or above 5 seconds, as well as error trials, will be excluded from the response-time analysis.

## Data analysis

This study is designed to test several hypotheses regarding the effect of motivation on perception, with a focus on perceptual decisions and response time. Specifically, we plan to test the following hypotheses:

*Hypothesis 1 (MOTIVATED SEEING)*: We will test the null hypothesis that the proportion of reports of seeing the target orientation is similar on reward and neutral blocks, using a two-tailed repeated measures t-test.

*Hypothesis 2 (MOTIVATED UNSEEING)*: We will test the null hypothesis that the proportion of reports of seeing the target orientation is similar on loss and neutral blocks, using a two-tailed repeated measures t-test.

Together, H1 and H2 will test the null hypothesis that the likelihood of reporting seeing the target orientation on loss, neutral and reward conditions is similar.

*Hypothesis 3 (REWARD EFFECT ON DECISION TIME: TARGET STIMULUS)*: We will test the null hypothesis that response times for the target orientation are similar in reward and in neutral blocks, aiming to replicate the finding that decisions consistent with motivation are faster (Leong et al., 2021, 2019). This will be tested using a paired t-test on the median individual level-response times in correct responses only.

*Hypothesis 4 (REWARD EFFECT ON DECISION TIME: NEUTRAL STIMULUS)*: We will test the null hypothesis that response times for the non-target orientation are similar in reward and in neutral blocks. This will be tested using a paired t-test on the median individual level-response times in correct responses only.

*Hypothesis 5 (LOSS EFFECT ON DECISION TIME: TARGET STIMULUS)*: We will test the null hypothesis that response times for the target orientation are similar in loss and in neutral blocks. This will be tested using a paired t-test on the median individual level-response times in correct responses only.

*Hypothesis 6 (LOSS EFFECT ON DECISION TIME: NEUTRAL STIMULUS)*: We will test the null hypothesis that response times for non-target images are similar in loss and in neutral blocks. This will be tested using a paired t-test on the median individual level-response times in correct responses only.

### Exploratory analysis: Drift Diffusion Modelling (DDM).

DDM assumes that perceptual decisions (was the grating tilted clockwise or anticlockwise) are made by sequentially sampling the sensory evidence from a starting point to one of two boundaries until one of the boundaries is reached and a response is made. There are three ways by which the model could account for a bias towards one boundary. First, motivation may bias the rate of evidence accumulation for desired stimuli (drift biasing). In this case the starting point is identical to an unbiased decision-making process but the gradient of accumulation towards the two bounds differs (Ratcliff, Smith, Brown, & McKoon, 2016). Second, motivation may shift the starting point of the evidence accumulation process towards a certain decision boundary (seeing a clockwise tilt when it is associated with a reward), and third, motivation may alter both the starting point and drift rate of the accumulation process - as reported by Leong et al. (2019). We will fit different models to the data to examine which behavioural pattern can best explain our results.

# References

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