



STUDY PROTOCOL

REVISED **Stage 1 Registered Report: How responsibility attributions to self and others relate to outcome ownership in group decisions. [version 2; peer review: 2 approved]**

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Abstract

Responsibility judgements have important consequences in human society. Previous research focused on how someone's responsibility determines the outcome they deserve, for example, whether they are rewarded or punished. Here, we investigate the opposite link: How outcome ownership influences responsibility attributions in a social context. Participants in a group of three perform a majority vote decision-making task between gambles that can lead to a reward or no reward. Only one group member receives the outcome and participants evaluate their and the other players' responsibility for the obtained outcome. Two hypotheses are tested: 1) Whether outcome ownership increases responsibility attributions even when the control over an outcome is similar. 2) Whether people's tendency to attribute higher responsibility for positive vs negative outcomes will be stronger for players who received the outcome. The findings of this study may help reveal how credit attributions can be biased toward particular individuals who receive outcomes as a result of collective work.

Keywords

Responsibility attribution, outcome ownership, outcome valence, self-serving bias, other-serving bias, group decisions.

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Any reports and responses or comments on the article can be found at the end of the article.		

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Author roles: **Jaquiere M:** Conceptualization, Data Curation, Formal Analysis, Software, Writing – Original Draft Preparation, Writing – Review & Editing; **El Zein M:** Conceptualization, Funding Acquisition, Investigation, Software, Writing – Original Draft Preparation, Writing – Review & Editing

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REVISED Amendments from Version 1

We have changed the vocabulary we use to clarify our research questions, by now using 'valence bias' for the higher responsibility for positive vs negative outcomes - and 'ownership bias' for higher responsibility when the outcome is owned vs not owned by the rated participant. We also made sure that our question is about the difference in valence bias and responsibility when the outcome is owned vs not owned, and not whether ownership is 'necessary' which can be interpreted as a different research question. We have added a figure (Figure 1) to clarify our research questions and predictions. We have added a change in the paradigm: when participants rate responsibility, they are shown next to each group member the gamble this member picked and the obtained outcome (next to the member that received the outcome) A clarification for the instructions has also been made to make sure participants do not believe that their choices have no consequence at all.

Any further responses from the reviewers can be found at the end of the article

Introduction

How we judge people's responsibility for the outcomes of their actions has important consequences in our society. This is true for our own responsibility as well as others'. Responsibility judgements are tightly related to whether people get rewarded or blamed for the actions they make^{1,2}, which is crucial for the maintenance of a cooperative and fair society. In many everyday situations, whether in the workplace or with our family and friends, responsibility for outcomes is shared among several individuals because these outcomes stem from collective decisions. Collective decisions can reduce the burden of individual responsibility³⁻⁵, because people feel less responsible when performing an action as a group than when acting alone⁶⁻¹².

While collective decision-making reduces overall feelings of responsibility, fluctuations in feelings of responsibility are also affected by the outcome of a decision. People tend to attribute higher responsibility to themselves for positive as compared to negative outcomes. This is known as the **self-serving bias**, where people claim more credit for positive events, while they duck responsibility for negative events^{6,9,11,12}. This 'valence bias' however does not seem to be purely selfish: it also appears when people judge their group's or another person's responsibility^{13,14}. For example, in the context of advising, people exhibit an **'other-serving' bias** in which they tend to credit more than blame an advisor¹³. In line with this, people also tend to attribute more effort for higher rewards when judging someone else's effort as compared to their own effort¹⁵.

In individual contexts, the rewards naturally seem to belong to the solely responsible person producing a positive or negative outcome. In a group decision where responsibility is shared, however, the outcome may be shared among group members or given to one particular group member (such as a group leader, or the group's representative, or to a particular person the collective decision has been made for). Responsibility underlies ownership: control and intent of an action, which

are directly associated with responsibility attributions^{1,2}, also predict whether a person is perceived as the owner of an object¹⁶. Moreover, a person is attributed outcomes based on how much they 'deserve' that outcome, an effect referred as the 'entitlement effect'¹⁷. If attributions of responsibility predict ownership, is the opposite true? Something that is owned does have a special value in the eyes of its owner. This has been particularly demonstrated with the 'endowment effect' where participants value more positively and prefer to keep goods that are given to them¹⁸. Ownership could, in addition to changing the value of the owned outcome, change the sense of responsibility for that outcome. This change in responsibility as a consequence of ownership would also be consistent with the 'Just World Hypothesis'¹⁹ in which people retroactively ascribe responsibility to people for the situations they are in.

Here we would like to address 1) whether outcome ownership changes attributions of responsibility, and 2) whether the 'valence bias', i.e., increased responsibility for positive versus negative outcomes - that appears both when judging one's own (self-serving bias) and another person's (other-serving bias) responsibility - depends on the judged person being the owner of the outcome or not. We investigate this question in a group decision-making context, where only one member receives the outcome in each round. Participants will perform an online task where they make collective decisions through majority votes, then one member of the group receives the outcome: either a reward or no reward. Finally they rate the responsibility of all group members for the positive or negative outcome. This paradigm will allow us to address both questions stated above: 1) by investigating whether responsibility attribution increases when a group member receives the outcome versus does not receive the outcome, although the control over the outcome is exactly similar - referred to as the 'ownership bias'. 2) By checking whether the valence bias of higher responsibility ratings for positive outcomes depends on whether the judged person receives the outcome of the group decision or not. In other words, in this second point, we aim to answer the question: do people exhibit the same valence bias when judging the responsibility for an outcome that is attributed not to them, but to another member of their group? Do they exhibit the same valence bias when judging the responsibility of another group member who received vs did not receive the outcome? (See [Figure 1](#) for the predicted effects)

The results of the study will allow assessment of the link between outcome ownership and responsibility judgements, and comparison of how the valence bias for self and other is affected by outcome ownership. It may help identify biases in group responsibility attributions based on how the outcome is distributed.

The literature predominantly focuses on questions such as 'who deserves a specific positive or negative outcome based on contributions and actions?'. However, it is often the case that specific people, powerful leaders for example, receive outcomes for actions they were probably only partially or not responsible for. The work here investigates how observing a person getting

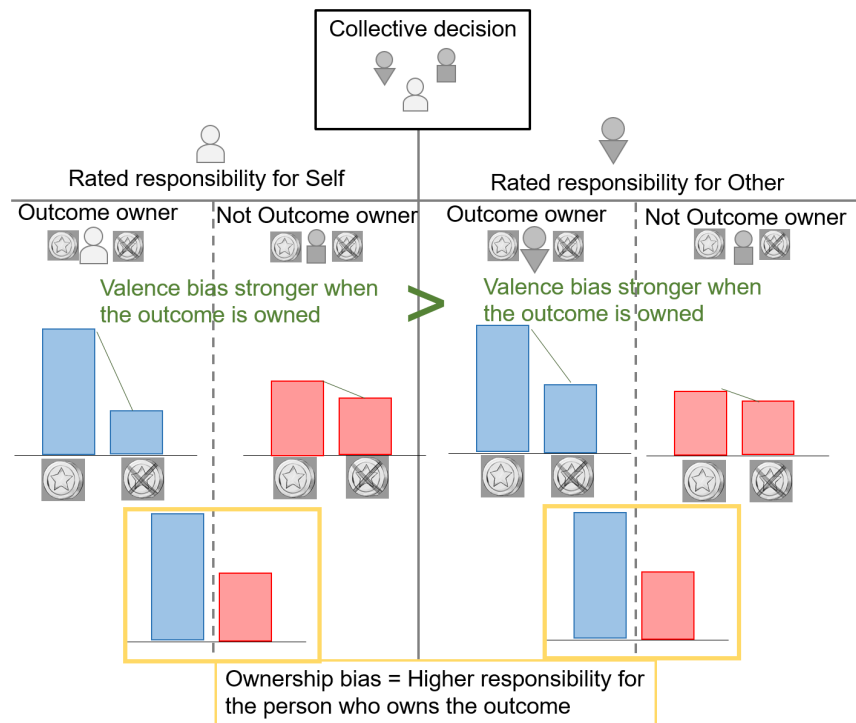


Figure 1. Expected responsibility ratings when people judge their own responsibility (self) and the responsibility of another group member (Other). The group member that receives (blue) vs does not receive (red) the outcome is rated as more responsible – in yellow: ownership bias, present both for responsibility ratings of Self and Other (Main effect of ownership). The valence bias (green) predicts higher responsibility for reward vs no reward (Main effect of outcome valence). This valence bias is predicted to be stronger when the rated person owns the outcome (OwnershipXOutcome valence interaction). This stronger valence bias for owned vs not owned outcome is also predicted to be more important for Self vs Other ratings (OwnershipXOutcome valenceXRated(self/other) interaction).

an outcome can change responsibility attributions, possibly explaining how particular people may end up receiving all the credit for a collective work, both in their own eyes and others’.

Methods

Materials

Experiments were custom-written in HTML / CSS / JavaScript using the jsPsych framework²⁰ and undertaken by participants over the internet using their own devices. The experiment has to be performed on a desktop using a recent Google chrome or mozilla firefox browser. A demonstration version of the experiment is available at <https://tinyurl.com/r-by-r-3/ATTRRESP/?demo=Y>

Procedure

The entry point to the study is through recruitment on the Prolific (<https://prolific.ac/>) participant recruitment platform. The study is approved by the UCL Research Ethics Committee as Project ID Number: 5375/001. The only eligibility criterion is that participants have to be aged 18–40years. After accepting the study, they are forwarded to the experiment website. They first read an information page including ethics and data protection information. The next page is a consent form that is written in the form of sentences next to tick boxes, participants had to tick the four boxes in order to proceed: By checking the boxes below, I agree that:

1. I have carefully read the information page.
2. I have been given contact details of the researcher to ask any question or discuss the study.
3. I understand that I am free to withdraw at any time, without giving a reason, and without incurring any penalty.
4. I am over 18 years of age.

The experiment begins with detailed instruction pages which describe the structure of each round in the game, with screenshots of each stage, followed by two training trials. Once they have read the instructions and familiarised themselves with the game, participants begin the main experiment, which consists of 3 blocks of 24 trials. The 24 trials are a randomised sequence of 2 repetitions of each of the 12 unique trial types (as defined by whether the outcome is good/neutral; whether the participant is in the majority/minority; and which of the three players receives the outcome). The structure for each trial is shown in [Figure 2](#).

Each trial begins with a display of the three players lasting 2s. This is followed by a screen lasting 2s in which the participant selects one of two gamble images. Gamble images are selected from a collection of 20 hand-drawn images of

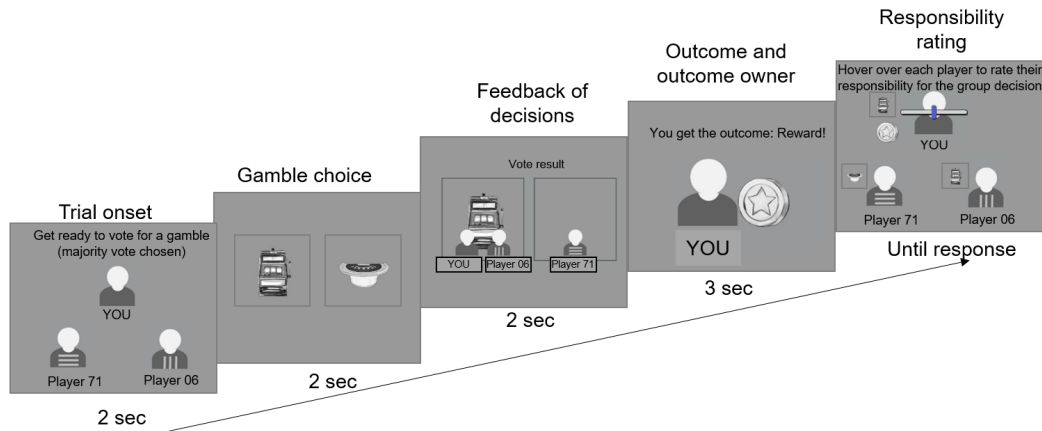


Figure 2. Experimental paradigm. At each trial, participants first see the group for 2 sec, then see the pair of gambles and have to pick one of the gambles by clicking on it within 2 sec. Afterwards, they see which gamble they and the other members of their group picked for 2 sec (Here the participant and Player 71 picked the left gamble that is therefore the majority choice, i.e. the group choice, while player 06 chose the right gamble). Following this, they see which player received the outcome, and whether that player was rewarded or not rewarded (Here, the participant receives the outcome and is rewarded). Finally, they have to rate the responsibility of each player for the outcome with no time limit except that once they finish rating the last player, the experiment continues to the next trial.

gambling devices and paraphernalia, and each pairing of images in each trial is unique. Participants are told the different gambles have different probabilities of winning and losing and that they should try and pick the one that has the higher chances of reward. However, unbeknownst to the participants, which gamble is selected has no actual influence on the outcome of the trial, which is predetermined. Once the participant selects a gamble their player icon is drawn below that option.

If the participant has not selected a gamble by the end of the 2s choice window, the rest of the trial plays out invisibly behind a warning message which tells the participant that they have failed to make a choice in time. If the participant did select a gamble, the next screen is a 2s display of the votes from all three players indicating which gamble is to be selected. The gamble which received 0 or 1 votes is removed, and an 1.25s animation follows in which the gamble is allocated to one of the players and its outcome is shown (a coin for a rewarded trial or a coin with a cross through it for an unrewarded trial). The outcome then remains on the screen for 3s, showing both the valence (good/neutral) of the outcome and the player to whom it has been allocated.

Finally, all the players' icons are restored to the screen (and next to each player is shown the gamble that they chose and their outcome if they had received the outcome on that trial). Participants assess each player's responsibility in the order that they pick: if they drag the mouse toward one of the players, the slider for that player appears and they indicate the responsibility on this slider. The responsibility rating phase lasts until the participant submitted responsibility ratings for all the players.

Once all 72 experimental trials have been completed, participants are debriefed, thanked, and returned to Prolific. Payment (£3.5) follows once all participants have completed the study and

bonuses have been calculated. The bonus is given based on one randomly selected trial: if that trial is a 'reward' trial then they are allocated the bonus of £0.5.

Pilot experiments

The design for the study was developed over the course of three pilot experiments. The final pilot experiment used the method of the main study. We wish to pursue two questions: 1) Does being the outcome recipient produce a difference in perceived responsibility? 2) Is the tendency to attribute more responsibility for good outcomes (valence bias) more pronounced for the outcome recipient's perceived responsibility?

We will also explore, though in a more limited manner, whether the extent to which an agent's responsibility for a group decision is affected by whether they were in the majority or minority.

Pilot experiments are seldom useful for giving answers to scientific questions²¹, although the pilot experiments reported here may be sufficiently large (N = 47, 43, and 56) to give an indication.

Pilot experiments were preregistered where possible, and analyses and links to preregistration details, methods and results are available as follows: Pilot 1 - <https://tinyurl.com/r-by-r-3/analysis/pilot-1.html>; Pilot 2 - <https://tinyurl.com/r-by-r-3/analysis/pilot-2.html>; and Pilot 3 - <https://tinyurl.com/r-by-r-3/analysis/pilot-3.html>. The source code, data, and analysis results for the Pilot experiments can also be found via Zenodo²².

Pilot Experiments 1 and 2 used groups of 5 players (of which the participant was one), had only one player's responsibility rated on each trial, and did not show information about which players voted for which gamble. In other respects they were

similar to Pilot Experiment 3, which used the design proposed for the main study and is detailed in the Procedure section.

We observed that pilot participants consistently provided higher responsibility ratings for good as compared to neutral outcomes, both for themselves (Pilots 1 and 3) and others (Pilots 2 and 3). We also observed that the outcome recipient was seen as having a greater responsibility for the joint decision than the other players (all Pilots). Finally, we saw that the increased attribution of responsibility for good over neutral outcomes was greater when the rated person was the recipient of the outcome (all Pilots).

Bayesian statistics

We explored the use of Bayesian statistics in the pilot experiments, but the results of the analyses proved difficult to interpret. In the power analysis and planned analysis of future data we therefore use the frequentist ANOVA.

Power analysis

We conducted a power analysis to determine how many participants we would need to detect effects of half the size found in the third pilot experiment. The effect for determining power was the most complicated interaction we were interested in, namely the three-way interaction which indicates a different size of effect for the valence bias increase when the outcome is owned and participants are judging the self vs another player. Power analysis was performed using custom simulation code written in R version 4.0.2²³. Participants analysed in Pilot 3 were sampled randomly (with replacement) up to N participants. Each of the N participants were then used as the basis of a generative model by extracting parameters from linear regression on the participant's pilot data. The effect size of the three-way interaction was replaced with a draw from a normal distribution with mean E and standard deviation equal to that observed in the pilot data (0.44). A grid search was conducted over some plausible values of N and E with 1000 simulations/cell. True (or false for $E = 0$) positive rates were calculated by running ANOVA on the data for each simulation. The power analysis indicated that 500 participants would provide around 93% power to detect an effect size of $d = -0.07$ (half of the effect size identified in Pilot 3, $d = -0.14$).

Future analysis plan

First, data will be excluded based on the following rules:

- All data for subsequent attempts from participants attempting the experiment more than once will be dropped.
- All data for participants failing to choose a gamble on 10 or more trials will be dropped.
- All data for participants who fail to use both response buttons in choosing gambles in each block will be dropped.

- All data for participants whose data does not include all 72 trials will be dropped.
- Trials where the participant failed to respond will be dropped.
- Trials where participants stayed longer than 15 sec on the responsibility rating screen will be dropped.
- All data for participants who stayed more than 15sec on the responsibility rating screen on 10 or more trials will be dropped.

The data will then be converted into a long format where each trial provides three observations - one responsibility rating for each player. The data will be analysed (without further truncation or cleaning) using a 2 (reward vs no reward outcome) \times 2 (rated player did vs did not get outcome) \times 2 (rated player is vs is not participant) ANOVA with the alpha level set at .05. Participant-level data will be collapsed into means for each of the six contingencies for the purposes of ANOVA.

The draft of the analysis script, as it stood at Stage 1 submission time, is available at <https://github.com/mjaquiere/responsibility-by-reward/blob/2b0eb49760332f3121a9472dfd1cd2311e2121cd/analysis/main.Rmd>.

Study status

Three pilots experiments were conducted for this study. The main study and current pre-registered report went through a first round of peer-review. This is our revised version and we will wait for the study to be approved before conducting the study.

Dissemination

The study results will be disseminated in internal lab meetings, national and international conferences.

Data availability

Underlying data

Data for the pilot experiments, along with data dictionaries describing the variables, are available in .csv format from .data directory of the GitHub repository (<https://github.com/mjaquiere/responsibility-by-reward/tree/master/data>)²².

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Software availability

Code for experiments available here: <https://github.com/mjaquiere/responsibility-by-reward/tree/master/ATTRRESP>

Archived code as at time of publication: <http://doi.org/10.5281/zenodo.4452004>²² License: CC-BY 4.0

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Open Peer Review

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 **John Dewey** 

Department of Psychological Sciences, University of North Georgia, Dahlonega, GA, USA

The amendments look good.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Sense of agency and responsibility attributions

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 30 June 2021

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 **Nura Sidarus** 

Royal Holloway University of London, Egham, UK

The authors' detailed response is appreciated and the revisions have addressed the key concerns, with the manuscript being improved.

The addition of figure 1, outlining the research design and predictions, is also appreciated, however, I believe its current form is considerably confusing, in terms of what's depicted and how, the definitions of concepts, how the various predictions are depicted, etc.

For some examples: the equal green text on both sides of the middle line is confusing when intending to depict an interaction; it seems the authors predict a main effect of ownership (fig

legend), but the repetition of equal bars on both sides rather imply a prediction of *no* interaction between the ownership bias and who is being rated; the 3-way interaction prediction isn't very evident from the figure (e.g. the blue bar for the outcome owner with positive outcomes seems the same height on the self vs other rated side, whereas a plausible main effect of who's rated would predict lower ratings for other). Perhaps starting from the main effect of ownership, and working downwards towards the 3-way interaction, or depicting the various effects separately, could facilitate interpretation, or the authors may find other solutions.

I understand this is a difficult figure to draw to ensure clarity, but I trust that it can be revised and it will be a helpful addition to the paper.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Cognitive neuroscience, sense of agency (/responsibility attribution), metacognition, decision making

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 06 April 2021

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Nura Sidarus 

Royal Holloway University of London, Egham, UK

This article investigates how responsibility judgements are influenced by whether action outcomes are desirable or not, and how that effect is influenced by being the owner, or recipient, of the outcomes, as well as whether one is judging oneself or others. Pilot studies support the presence of an ownership bias, where responsibility is higher for the outcome owner than non-owners, and for a valence bias for the outcome owner, which is seen as more responsible for positive than negative outcomes, which is larger for oneself (self-serving) than for others (other-serving bias). These are very interesting research questions and methods, bridging between fields of research that refer to related concepts, combining information to arrive at new hypotheses and providing a strong way to operationalise and test the ideas. The transparent sharing of the details of data collection and analysis already performed is commendable, helping to clarify the research ideas and demonstrate the researchers' strengths to competently conduct the planned research. The pilot studies provide a strong grounding for the planned study and for the detailed power analysis based on simulations to estimate the necessary sample size for the main study to test the relevant 3-way interaction. I believe the study should be completed and the manuscript published, but that

the authors should first consider the following points, which essentially concern revisions to the manuscript.

1. The various ways of rephrasing the two research questions, especially for Q2, can seem to imply different things. Some of the writing seems to imply that the biases will exclusively appear for the owner, whereas other parts imply rather that the extent of the bias will be moderated by ownership. Some of the questions phrased seem a bit different from the initial point, and somewhat confusing regarding what comparisons would test them. For example: *"whether outcome ownership is **necessary** for the self-serving and/or other-serving bias (more responsibility for positive versus negative outcomes) to appear. "*

[the bias] *"depends on who gets the outcome"*

" In other words, in this second point, we aim to answer the question:

- 1) *do people exhibit the same self-serving bias when judging the responsibility for an outcome that is attributed to another member of their group?*
- 2) *Do they also still exhibit an 'other-serving' bias when judging the responsibility of another group member who did not receive the outcome?" (p.3)*

Phrasing the question as whether outcome ownership is "necessary" for a self/other serving bias leads me to wonder how that could really be addressed here if there's always one person receiving the outcome. If the other-serving bias is similar to, even if smaller, than the self-serving one, then if a person receives the outcome, one would still predict some valence bias to be present. Therefore, I'd think the "necessity" of outcome ownership for the bias could only be demonstrated by including a condition in which "no one benefits", as a hypothesised "control" condition in which no valence bias would be present. Instead, the authors may rather aim to test whether there's an interaction between the effect of valence and being the owner vs not – as stated in the abstract - in more specific terms relating to the current operationalisation.

Some of the confusion seems related to whether the "self/other -serving" bias is assumed to appear as a function of who's being judged vs. who gets the outcome. Sometimes it seems "self-serving bias" being used to refer to when judging the self as having greater responsibility for positive over negative outcomes only when it's the "owner" of outcomes, vs. asking whether that happens regardless of ownership. Perhaps using more general terms like "valence bias", and perhaps "self bias" (to indicate a bias to judging higher responsibility for the self than other regardless of outcome valence), could make it easier to distinguish when that's expected to be affected by who's being judged, vs. who gets the outcome.

What is intended is made more evident from their pilot analysis linked, but the introduction can be improved to ensure the key questions and hypotheses are clearly stated and it is evident how the data could support or not different hypotheses (i.e. which comparisons test the hypotheses). It may also be useful to draw graphs of the hypothesised results depicting the patterns of results/interactions that would support different, or competing, hypotheses. This is important for demonstrating the adequacy of the study design and of the conclusions that can be drawn from the results.

2. The authors stated that the primary analysis is a 2x2x2 ANOVA, but their detailed analysis scripts don't start with that test, but rather by addressing a series of more specific questions with more specific tests (e.g. t-test on being the owner vs not, which would seem equivalent to the main effect in the ANOVA). While I understand their logic, seems more consistent to start with the planned primary statistical test, describe that and then run whichever other tests, or rewrite the planned analysis in the manuscript. Relatedly, it seems the authors plan to run Bayesian statistical tests, but only note in the manuscript using frequentist tests, but I don't see why they wouldn't say in advance they plan to use both.
3. Methods, state: "Finally, all the players' icons are restored to the screen and each player's responsibility is assessed by the participant by clicking on an icon and then indicating the responsibility using a slider. The responsibility rating phase lasts until responsibility ratings have been submitted for each player." – please add clarification of whether the order of ratings is fixed (e.g. always "You", then "Player 06", then "Player 71") or randomised.
4. Text on the task figure is too small to read even when enlarged on the website.

Have the authors pre-specified sufficient outcome-neutral tests for ensuring that the results obtained can test the stated hypotheses, including positive controls and quality checks?

Yes

Is the rationale for, and objectives of, the study clearly described?

Partly

Is the study design appropriate for the research question?

Yes

Are sufficient details of the methods provided to allow replication by others?

Yes

Are the datasets clearly presented in a useable and accessible format?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Cognitive neuroscience, sense of agency (/responsibility attribution), metacognition, decision making

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 23 Apr 2021

Marwa El Zein, University College London, London, UK

This article investigates how responsibility judgements are influenced by whether action

outcomes are desirable or not, and how that effect is influenced by being the owner, or recipient, of the outcomes, as well as whether one is judging oneself or others. Pilot studies support the presence of an ownership bias, where responsibility is higher for the outcome owner than non-owners, and for a valence bias for the outcome owner, which is seen as more responsible for positive than negative outcomes, which is larger for oneself (self-serving) than for others (other-serving bias). These are very interesting research questions and methods, bridging between fields of research that refer to related concepts, combining information to arrive at new hypotheses and providing a strong way to operationalise and test the ideas. The transparent sharing of the details of data collection and analysis already performed is commendable, helping to clarify the research ideas and demonstrate the researchers' strengths to competently conduct the planned research. The pilot studies provide a strong grounding for the planned study and for the detailed power analysis based on simulations to estimate the necessary sample size for the main study to test the relevant 3-way interaction. I believe the study should be completed and the manuscript published, but that the authors should first consider the following points, which essentially concern revisions to the manuscript.

We thank the reviewer for acknowledging the interest of the research question and methods and for providing important revisions that improve the paper.

The various ways of rephrasing the two research questions, especially for Q2, can seem to imply different things. Some of the writing seems to imply that the biases will exclusively appear for the owner, whereas other parts imply rather that the extent of the bias will be moderated by ownership. Some of the questions phrased seem a bit different from the initial point, and somewhat confusing regarding what comparisons would test them. For example: "whether outcome ownership is necessary for the self-serving and/or other-serving bias (more responsibility for positive versus negative outcomes) to appear. "

[the bias] "depends on who gets the outcome"

"In other words, in this second point, we aim to answer the question:

- 1) do people exhibit the same self-serving bias when judging the responsibility for an outcome that is attributed to another member of their group?*
- 2) Do they also still exhibit an 'other-serving' bias when judging the responsibility of another group member who did not receive the outcome?" (p.3)*

Phrasing the question as whether outcome ownership is "necessary" for a self/other serving bias leads me to wonder how that could really be addressed here if there's always one person receiving the outcome. If the other-serving bias is similar to, even if smaller, than the self-serving one, then if a person receives the outcome, one would still predict some valence bias to be present. Therefore, I'd think the "necessity" of outcome ownership for the bias could only be demonstrated by including a condition in which "no one benefits", as a hypothesised "control" condition in which no valence bias would be present.

Instead, the authors may rather aim to test whether there's an interaction between the effect of valence and being the owner vs not - as stated in the abstract - in more specific terms relating to the current operationalisation.

Some of the confusion seems related to whether the “self/other -serving” bias is assumed to appear as a function of who’s being judged vs. who gets the outcome. Sometimes it seems “self-serving bias” being used to refer to when judging the self as having greater responsibility for positive over negative outcomes only when it’s the “owner” of outcomes, vs. asking whether that happens regardless of ownership. Perhaps using more general terms like “valence bias”, and perhaps “self bias” (to indicate a bias to judging higher responsibility for the self than other regardless of outcome valence), could make it easier to distinguish when that’s expected to be affected by who’s being judged, vs. who gets the outcome.

What is intended is made more evident from their pilot analysis linked, but the introduction can be improved to ensure the key questions and hypotheses are clearly stated and it is evident how the data could support or not different hypotheses (i.e. which comparisons test the hypotheses). It may also be useful to draw graphs of the hypothesised results depicting the patterns of results/interactions that would support different, or competing, hypotheses. This is important for demonstrating the adequacy of the study design and of the conclusions that can be drawn from the results.

We thank the reviewer for noting this important point about the vocabulary we use, as we now realize how our formulation of hypotheses may have been unclear. We rephrase our sentences to avoid using ‘necessary’, because indeed, we aim to test the interaction between the valence effect and being the outcome owner or not. We adopt the terminology suggested ‘valence bias’ and ‘ownership bias’ and thank the reviewer for these suggestions as we agree they are more accurate to clarify the expected effects. All the cited sentences are re-phrased as follows and we hope our edits to the introduction clarified our questions:

‘whether the ‘valence bias’, i.e., increased responsibility for positive versus negative outcomes, - that appears both when judging one’s own (self-serving bias) and another person’s (other-serving bias) responsibility - depends on the judged person being the owner of the outcome or not.’

*‘...depends on whether the judged person receives the outcome of the group decision or not.’
‘In other words, in this second point, we aim to answer the question: do people exhibit the same valence bias when judging the responsibility for an outcome that is attributed not to them, but to another member of their group? Do they exhibit the same valence bias when judging the responsibility of another group member who received vs did not receive the outcome?’*

We also followed the reviewer’s advice to add a figure with the hypothesized results that can clarify our hypotheses and expected results (Figure 1).

The authors stated that the primary analysis is a 2x2x2 ANOVA, but their detailed analysis scripts don’t start with that test, but rather by addressing a series of more specific questions with more specific tests (e.g. t-test on being the owner vs not, which would seem equivalent to the main effect in the ANOVA). While I understand their logic, seems more consistent to start with the planned primary statistical test, describe that and then run whichever other tests, or rewrite the planned analysis in the manuscript. Relatedly, it seems the authors plan to run Bayesian statistical tests, but only note in the manuscript using frequentist tests, but I don’t see why they wouldn’t say in advance they plan to use both.

We follow the reviewer’s advice to start with the ANOVA and then unfold the rest of our

results. This should now be visible in all the pilots' analysis scripts as well as the main analysis script.

Concerning Bayesian statistics, we add the following statement in the text to explain why we do not plan to use them:

'Bayesian statistics

We explored the use of Bayesian statistics in the pilot experiments, but the results of the analyses proved difficult to interpret. In the power analysis and planned analysis of future data we therefore use the frequentist ANOVA.'

Methods, state: "Finally, all the players' icons are restored to the screen and each player's responsibility is assessed by the participant by clicking on an icon and then indicating the responsibility using a slider. The responsibility rating phase lasts until responsibility ratings have been submitted for each player." – please add clarification of whether the order of ratings is fixed (e.g. always "You", then "Player 06", then "Player 71") or randomised.

We hope we have clarified this by changing the sentence to *"Finally, all the players' icons are restored to the screen (and next to each player is shown the gamble that they chose and their outcome if they had received the outcome on that trial). Participants assess each player's responsibility in the order that they pick: if they drag the mouse toward one of the players, the slider for that player appears and they indicate the responsibility on this slider. The responsibility rating phase lasts until the participant submitted responsibility ratings for all the players."*

Text on the task figure is too small to read even when enlarged on the website.

We apologize for this and have fixed the figure so that the text can be easily read.

Competing Interests: No competing interests were disclosed.

Reviewer Report 16 February 2021

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? **John Dewey** 

Department of Psychological Sciences, University of North Georgia, Dahlonega, GA, USA

The authors propose to investigate how outcome ownership influences attributions of responsibility for group decisions (i.e. if you personally receive a payment based on the decisions of the group, do you feel more responsible for that group decision?). The idea behind the proposal is interesting. I do have a few minor concerns regarding the details of the methodology, however:

- The instructions in the demo version say "Your aim is to find which gambles are likely to make you win and choose them. Please be aware that there is no link between the type of image depicted (roulettes, dice, cards) and the actual probability to win."

There are a couple of typos in the instructions. More importantly though, if I was a participant in this study, I would wonder how I'm supposed to find which gambles are likely to make me win if there's no link between the images and the probability of winning. It seems like you're admitting to participants upfront that they will just be guessing at random. Maybe you should omit that first sentence and let participants wonder if there is an optimal strategy to discover, similar to the Iowa Gambling task. I think this would add more variance to your data, which might seem like a bad thing, but it would also reduce the chances of people mindlessly applying a response set. Specifically, if participants know that the image doesn't matter, they decide on a simple rule like "the people in the majority are always responsible", or "we're all equally responsible for every outcome, since it's all just random anyway".

- Because the experiment has a quick pace, I think participants will often fail to notice (or quickly forget) who voted for which outcome. When you present the screen for judging the responsibility of each actor, it might be good to add a visual reminder of how each person voted.
- Under the 'Data Availability' section, the GitHub link leads to the /ATTRRESP subdirectory. I believe it should lead instead to the /data subdirectory.

Have the authors pre-specified sufficient outcome-neutral tests for ensuring that the results obtained can test the stated hypotheses, including positive controls and quality checks?

Yes

Is the rationale for, and objectives of, the study clearly described?

Yes

Is the study design appropriate for the research question?

Yes

Are sufficient details of the methods provided to allow replication by others?

Yes

Are the datasets clearly presented in a useable and accessible format?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Sense of agency and responsibility attributions

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 23 Apr 2021

Marwa El Zein, University College London, London, UK

The authors propose to investigate how outcome ownership influences attributions of responsibility for group decisions (i.e. if you personally receive a payment based on the decisions of the group, do you feel more responsible for that group decision?). The idea behind the proposal is interesting.

We thank the reviewer for noting the interest of our work.

I do have a few minor concerns regarding the details of the methodology, however: The instructions in the demo version say "Your aim is to find which gambles are likely to make you win and choose them. Please be aware that there is no link between the type of image depicted (roulettes, dice, cards) and the actual probability to win." There are a couple of typos in the instructions. More importantly though, if I was a participant in this study, I would wonder how I'm supposed to find which gambles are likely to make me win if there's no link between the images and the probability of winning. It seems like you're admitting to participants upfront that they will just be guessing at random. Maybe you should omit that first sentence and let participants wonder if there is an optimal strategy to discover, similar to the Iowa Gambling task. I think this would add more variance to your data, which might seem like a bad thing, but it would also reduce the chances of people mindlessly applying a response set. Specifically, if participants know that the image doesn't matter, they decide on a simple rule like "the people in the majority are always responsible", or "we're all equally responsible for every outcome, since it's all just random anyway".

We are sorry for the typos and hope we have corrected all of them. We completely agree with the point raised by the reviewer and we thank him for noticing that this instructions sentence can be understood in this way as we did not mean for it. What we meant to convey with '*Please be aware that there is no link between the type of image depicted (roulettes, dice, cards) and the actual probability to win.*' was related to the 'type' of the image not the image itself: if a participant is familiar with gambling and knows that in real life, roulettes have higher chances to win than dice for example, this doesn't apply in the experiment. Rather, different images of gambles are associated with different probabilities of winning independently of their chances of success in real life. To avoid this misunderstanding, we followed the reviewer's advice and removed this sentence keeping '*You will have to decide which gamble to choose by pressing on the left or right gamble. The images will only appear for 2 seconds, and you only have 2 seconds to make your choice. Each gamble has different probabilities of winning and losing. Your aim is to find which gambles are likely to make you win and choose them.*'

Because the experiment has a quick pace, I think participants will often fail to notice (or quickly forget) who voted for which outcome. When you present the screen for judging the responsibility of each actor, it might be good to add a visual reminder of how each person voted.

We followed the reviewer's recommendation to add a reminder at the time of the ratings of who voted for which gamble next to each group member, as well as the obtained outcome next to the person who received it. We changed Figure 1 accordingly and this is now also visible in our demo experiment.

Under the 'Data Availability' section, the GitHub link leads to the /ATTRRESP subdirectory. I believe it should lead instead to the /data subdirectory.

Thank you for noting this, we have fixed it.

Competing Interests: No competing interests were disclosed.
