

Review of: "Effect of Self-Movement on Visually Directed Throwing: Implications for Distance Perception"

Simone Toma¹

¹ Arizona State University

Potential competing interests: No potential competing interests to declare.

The following comments refer to a previous version of the submitted manuscript, so does my overall evaluation above (stars).

Unfortunately, I was not informed of a revised version of the manuscript so please disregard those comments that you may have been already addressed in the new version.

In the present study, authors investigate the influence of action in distance perception.

In a first experiment, authors quantified the extent to which distance perception is influenced by running versus standing (Exp. 1). Then, in a second experiment, authors explore potential interplay between the execution of goal directed actions (e.g., throwing a ball into a hoop) and distance estimation (Exp. 2).

In Exp. 1, participants were asked to either stand or run on a treadmill while judging their distance from a target. Participants provided their egocentric distance estimations by guiding the experimenter to place a distance indicator at the same exocentric distance, i.e., where target-indicator distance was perceived as equal to participant-target distance. Participants' estimation from the target was quantified by the selected target-indicator distance (matching procedure). Authors reported consistent selection of shorter indicator-target distance relative to the actual target-participant distance. This finding, characterizing both testing conditions, was interpreted and discussed as evidence of participants' distance underestimation.

In Exp. 2, participants either stand or run on a treadmill, this time while throwing a ball into a target-hoop whose location was shown rapidly, then occluded, prior to the throwing action. Two target-hoop heights conditions were tested, i.e., lower and higher hoop position. Participants distance estimation was extracted by calculating the distance of the ball from the target-hoop at the time when the ball trajectory reached the same height of the hoop. Authors reported an overall participants' tendency to produce shorter shots for all testing conditions. Main effect of locomotion (running vs standing), hoop height (higher vs lower) and their interaction were found statistically significant.

Results from Exp. 2 were interpreted as an overall tendency to overestimate target locations during blind throwing in both running and standing conditions. These findings were discussed as evidence in support of the interaction between goal directed actions, e.g., throwing, and distance estimation.

OVERALL COMMENT

Authors explored an interesting aspect of the action and perception loop. Contributions to this topic are needed as the interaction between action and perception has been getting new and multidisciplinary attention during the last decade (see for instance recent research supporting the embodied cognition theory as well as active sampling and perceptual decision-making studies).

A commendable feature of the present work is that while distance perception, throwing performance and self-movement have been extensively investigated in terms of motor behavior and perceptual performance alone, authors presented here an original attempt to investigate their interplay.

Despite the originality of the study rationale and the potential contribution of this type of research, though, to gain scientific validity and meet the standard of scientific publications, authors should address few major issues and some minor ones. On the one hand, the lack of details about the protocol and statistical analysis prevents the present version of the manuscript from meeting scientific communication standards. On the other hand, the current experimental design strikes me as being scientifically weak to support the main authors' conclusions and test their model.

Compared to the elegant design and robust statistical analysis presented in the authors' previous work on distance perception (2019), the present study seems to suffer from a less thorough study design and data analysis, as from a rushed and poorer scientific report.

In the following, I will provide my personal suggestions on how the present work could improve scientific validity and communication standards to enhance the relevance and visibility this research topic deserves.

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TITLE:

1. I found the present title a bit misleading and not entirely consistent with the main hypothesis elaborated in the rest of the manuscript. If I understand well, the object of investigation is the interaction between perception of distance and two types of actions: the self-movement (i.e., running), and the goal-directed (i.e., throwing). Moreover, in the abstract and the main text authors claim that the throwing action was used to indirectly estimate distance perception, as more classic verbal report methods showed low reliability. Thus, the stress of the title on the throwing component is not always consistent in the text. This discrepancy may confuse the reader who is wondering: is the throwing performance a mean to quantify distance estimation or it is object of investigation itself? I will elaborate on this point in a forthcoming comment. As for the title I suggest introducing keywords like distance estimation, action and perception, goal directed and self-movement etc.

I suggest adding lines number to make the revision process easier (e.g., communications, edits).

ABSTRACT:

1. My recommendation for this section is to provide a clearer introduction of the rationale and findings of both experiments. In particular, I would try to deliver with more clarity the overarching goal of the study as well as the subgoals of each experiment. For instance, the very first sentence strikes to be at odds with the title and the rest of the assumptions made later in the paper, as no mention to the throwing task or goal-directed action are made.

Consequently, based on the abstract the overarching goal of the study strikes as being uniquely the investigation of the influence of running on distance perception. If this were the case, one may wonder what the rationale for Exp.2 is, and throwing performance was tested under two hoop heights. Indeed, Exp. 1 and the previous published work (2019) can already provide evidence supporting the influence of running on distance estimation.

The concern of not making clear the contribution of Exp.2 from reading the abstract, is that the research may appear to be a mere repetition of the first publication with the only difference of testing shorter distance.

By reading the final part of the abstract (and the rest of the paper), though, it seems clear that the overarching goal of the study goes beyond that. Unless I got wrong, the overarching goal of the study seems to provide insights on whether and how different types of action interact with distance estimation, i.e., quote: ***mutually inhibitory interactions***.

My suggestion to the authors is to work on the abstract to make a more compelling and representative introduction of the intended contribution of the present work.

1. Towards the end of the section, the results of Exp.2 are introduced. Authors claim that participants exhibited distance estimation error, yet throwing performance were accurate. This is quite confusing, and it seems at odds with Figure 3 and the title itself. If the throwing performance was used to measure distance estimation, estimation errors are expected to be associated with inaccurate throwing performance, rather than with accurate. Moreover, Figure 3 clearly shows participants tendency to produce shorter shot in all tested conditions, demonstrating quite inaccurate throwing performance. Finally, the title itself anticipates the presence of inaccurate throwing performance, rather than accurate.

While revising the abstract, and in particular in presenting Exp.2, authors should avoid contradicting information and keep consistency with the rest of the manuscript.

INTRODUCTION:

1. Overall, the introduction looks well organized, clear, and mainly consistent with the rest of the paper. However, since the formulations introduced in this section are never used or reconsidered (for instance to test the model as authors did in their previous publication), I am wondering why are reported in such a detailed way. As a matter of fact, the same formulations are presented in the 2019 paper. Importantly, while one of the novelties of this study is the throwing experiments, throwing performance itself is not used to feed the model (as authors did with distance estimation in the 2019 paper).

Therefore, I personally suggest the authors to either build a solid link between the formulations and the throwing

performance, or just get rid of that part but simply referring to the 2019 paper.

1. As in the abstract, after reading this section it is not clear to me the rationale for choosing the throwing action. Since most of the introduction focuses on the parameters of the model such as self-movement velocity and distance estimation, the throwing action seems to be just a tool to further demonstrate that running influences distance perception. In this case, authors should elaborate a bit to explain the link between throwing actions and distance estimation, perhaps providing previous empirical evidence showing that throwing performance relies on and reflect distance estimation.

Surprisingly, though, authors in the last two sentences of the intro claim that the study was not just aimed at using throwing as a tool to quantify the influence of running, but also to explore correlations between running, perceptual estimation and throwing performance (which explains why two throwing conditions were tested).

In conclusion, once again, authors should provide a clearer presentation on the rationale for the use of throwing actions: is throwing use as indirect measure of distance estimation, or the relation between throwing performance and running is also an objective of this study?

GENERAL METHODS:

1. As for the abstract and introduction, authors should clarify and elaborate further the rationale and contribution of Exp. 2, i.e., link between throwing actions, running and distance perception (see comment 2 in intro)

LOCATION AND APPARATUS:

1. The very last part of this section gives some information about the way perceived distance is manipulated by using the treadmill. This description must be elaborated further as it is crucial element of the apparatus.

The few information provided rise few questions/issues I believe should be addressed by the authors:

- The moving treadmill is used to change the physical distance, not necessarily the perceived one which, as shown, may not be in agreement (i.e., misperception).

I suggest authors to edit the statement accordingly.

- If I understand correctly, the absolute target-participant distance was always the same (6m). Correct? If so, experimenter only changed the relative distance of target and participant with respect to the environment. Few details about how the apparatus was used would probably prevent the reader to not get confused.
- In general, I suggest authors to avoid sentence like 'to manipulate the perceived distance' as the perceived distance is the dependent variable, hence the variable under observation rather than the variable that is manipulated (e.g., physical distance, running/standing).

EXPERIMENT 1:

1. I strongly suggest authors adding a figure representing the set-up of experiment 1. This will help the reader quickly

understand what is meant by sagittal/frontal plane etc. Authors may want to use the same figure used for their 2019 publication

2. Authors should elaborate further whether this experiment was introduced uniquely to test shorter distance range, or instead as control experiment for the investigation of the throwing conditions introduced in EXP. 2. Importantly, if results from Exp. 1 are propaedeutic for Exp. 2, the interpretation of the former should mention the design and expectations of the latter

Participants:

1. More details on the G-power analysis should be provided.
 - Was this analysis performed on pilot data?
 - What were the setting parameters for this analysis (level of significance, size effect)?
 - Can authors provide some literature to support their choice of G-power analysis parameters?
 - What was the minimum number of participants? And to reach what level of significance?
 - What was the software used to run this analysis?

I believe the details of this analysis as quite important as the $n=5$ within-participant repetitions seems quite a small number at first sight. I am reasoning that this low number of repetitions would increase the within participants variance and perhaps affect the data. The G-power output, though, could support this choice if the input data for this analysis were consistent with the designed used in the present study.

Procedure:

1. I suggest replacing the term 'motor stimulation' with something like, motor/locomotion condition. This is because 'stimulation' may be misinterpreted as an intervention of the experimenter on the participant (e.g., mechanical/electrical stimulation).
2. I would also suggest introducing and defining what is meant by 'adaptation' earlier in the text (e.g., introduction, general methods). This is to avoid potential different interpretations of the word adaptation relative to the reader disciplinary background. From my understanding, here 'adaptation' is used to describe participant getting used to the imposed running pace. The confusion that may arise by using the word 'adaptation' is that, being the pace set since the beginning of the run, actually, participants do not change their motor behavior to adapt it.

Results & Interpretation:

1. Basic and detailed information about the statistical analysis performed are missing. This lack of information makes this version of the manuscript unsuitable for a scientific publication. Below are some information that authors must provide about their analysis:
 - Descriptive statistics must be reported on the text and refer to the figure. As box plot description is used, I would expect to see at least the medians and the lower/upper quartiles of both groups

- To run a parametric paired sample t-test, assumption of normality should verify. If it is not confirmed, alternative non-parametric analysis should be used
- All statistical outputs should be provided: mean (or median) difference, std (standard error or confidence intervals for non-parametric), t-value (z-value for non-parametric), p-value, portion of the distribution considered (90/95/99%) and effect size (e.g., Cohen's d). The latter is extremely relevant for small data-set (low within-participants repetitions) that have the tendency to exhibit higher variance and non-normality distribution.
- As for the interpretation of this results, my concern is about the high significance of level obtained ($p < 0,001$) despite of the evident overlap of a portion of the two distributions and the numbers of outliers (which indicates high data dispersion).
- Authors interpret their results by mentioning a compression effect of distance perception already shown in the literature. I suggest introducing this effect in the introduction as it seems quite relevant for the entire paper and the expectations on both Experiment outcomes.
- While interpreting these results authors did not make any reference to their previous publication (2019), nor to the Exp. 2. To make much sense on the reason of this experiment, authors should interpret this results in terms of consistency with their previous publication and, more importantly stress the implications of this results for the design and expectations of Exp.2. For instance, aren't these results a warning sign that compression effect may confound the outcome of Exp.2? That is, if compression effect influences distance perception, whether participants were running or not, did authors considered the potential interference of the compression effect on Exp. 2 design?

EXPERIMENT 2:

1. As introduction to the Exp 2, authors cite a previous work that, similarly to the present one, aims at investigating the relation between distance estimation, walking (blindfolded) and throwing (Loomis et al, 2008). This previous work strikes to be quite relevant for the assumption and design of the current study.

I suggest authors to spend more words across the manuscript in describing and referring to this study in terms of design, parameters chosen for the analysis and rationale in considering the throwing task.

I recommend authors to highlight similarities and differences of the present design with respect to this and the few other papers investigating locomotion, throwing and distance perception. I am sure that it would result in stronger argument (than the present ones) in favor of the decisions and interpretations authors have made for the present work.

1. On a similar page, since the above-mentioned literature (e.g., Loomis et al., 2008) investigates contexts very similar to the those presented here, authors should provide clear evidence of the contributions and novelty of the current work relative to previous one.

I recommend this as I believe it would strengthen the relevance of the present work and hopefully reached a wider audience interested in action and perception in the context of locomotion

Results & Interpretation:

1. While the results description is characterized by more statistical information, I recommend to provide more details essential for the reader to judge your results (see my previous comments for results section of Exp. 1)
2. Importantly, as stated above, parametric analysis (paired-sample t-test) should be first supported by normality of the data. Authors should provide evidence of that
3. Authors mentioned they have run multiple paired-sample t-test to check effects within conditions, e.g., lower and higher hoop. These results should be obtained by post-doc comparison tests whose p-values are already corrected for multiple testing. Running multiple individual and independent, within-groups statistical tests is actually an incorrect statistical practice and should be avoided to reduce the probability of type 1 error.
4. I am wondering why authors did not test for different running speeds as they did in their previous work to test their model.
5. Also I am wondering why authors tested for different hoop heights, even though hoop height factor is not of any support to the formularization provided in the introduction that involves speed as one of the main factors explaining distance misperceptions.

OVERALL DISCUSSION:

1. As anticipated in my first comment, to me, the experimental design and the analysis performed here are not enough to support authors' arguments explaining their findings in relation to their formulation (Eq. 3).

My main concern is that with the current protocol, and consequently the analysis, authors cannot provide any insight on the formalization of Eq.3. While it ought to be noted that the present work provides evidence suggesting the influence of running in throwing performance and (indirectly) distance estimation, it does not provide solid support for authors main explanations formularized in Eq.3. To my surprise, in this paper the authors, unlike the compelling approach used in their previous work, did not test different speeds nor the condition with visual input (both essential parameters of their formulation - Eq. 3 -).

On the one hand, testing the contribution of visual input while running and throwing would provide evidence for or against the hypothesis proposed by the authors that longer shots while running are due to the act/effort involved. If so, longer shots should be exhibited also in visual conditions (at least during the first few shots, since participants may correct their shots based on the visual feedback).

On the other hand, the advantage of testing different speeds would be to respond to the question why both standing and running throwing exhibited negative errors, as well as providing the authors with the opportunity to feed their model with visual condition dataset (as authors have done in their 2019 work).

Moreover, and perhaps more importantly, the choice of testing different speeds would allow authors to extract the 'k' parameters of their model and being able to test on the real data the parameter relating locomotion speed with the throwing and distance estimation performance. Importantly, by replicating the approach used in their previous work (testing at least 3 speeds), authors could also be able to quantify the direction and magnitude of the influence of locomotion speed on throwing and distance estimation performance, hence supporting causal relationships.

1. Finally, to me, the results and conclusions on the ground height hypothesis do not provide any relevant and solid contributions to the main goal of the study. Moreover, the present dataset does not provide evidence in support or against the hypothesis that participants, while throwing, would aim at the base of the occluded target.

Again, the condition with visual input might help in addressing this issue, thereby showing the shift in aiming at the target or at the ground height when visual input are present or absent, respectively