Virtual Reality as a Tool for Pro-Environmental Dietary Change: A Randomized Trial

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Abstract

As the food industry significantly contributes to global carbon emissions, studying new behavioral interventions promoting plant-based diets is crucial for mitigating climate change. This study investigates the impact of an efficacy-focused virtual reality (VR) intervention designed according to instructional design principles on eating behavior.

In the preregistered intervention study, psychology students randomly assigned to nine blocks (analyzed $n = 123$, follow-up $n = 90$) were allocated to either the VR intervention (four groups) or the control (no-treatment) condition (five groups). The study employed a parallel design, and the primary outcome was the effect of the VR simulation on dietary footprint measured from one week before to one week after the intervention.

The VR intervention decreased individual dietary footprints ($d = 0.4$) significantly more than the control condition. Similarly, response efficacy and knowledge increased to a larger extent in the VR condition compared to the control. For knowledge, the effect persisted for one week. The VR intervention had no impact on intentions, self-efficacy, or psychological distance. Additional manipulation of normative feedback enhanced self-efficacy; however, manipulation of geographical framing did not influence psychological distance.

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1. Introduction

Climate change is unequivocally linked to human activity, leading to unprecedented warming of the planet[1]. Yet, despite the urgent need to reduce greenhouse gases (GHGs) emissions, technological and governmental solutions are not being implemented fast enough to reach the desired goals. Individual behavior change would make an important contribution to reducing GHGs emissions without the need to adopt new technology[2]. Nevertheless, available behavioral interventions commonly focus only on low-impact behaviors, such as recycling or water management, and report small effects ($d = 0.093$) that rarely persist beyond the intervention context[3]. A more consequential, but perhaps more challenging, the target would be to alter habits around food choice. Today's food supply chain contributes to 26% of the current GHGs emissions, with the highest emissions linked to beef production[3], and adopting more plant-based diets could reduce GHGs emissions by 29–70%[4,5]. In the context of such figures, identifying effective new interventions that would facilitate a switch to more sustainable diets would seem a priority. Engagement in such consequential pro-environmental behaviors (PEBs) typically requires the suppression of self-interest, or deeply ingrained habits, in favor of long-term societal consequences. To create such change, more sophisticated and emotionally-rich interventions that target specific psychological barriers are necessary.

Emerging evidence suggests that immersive Virtual Reality (VR) can be a powerful tool to promote pro-environmental behavior[6]. For example, VR-mediated natural experiences have been shown to increase connectedness to nature[7,8] and to promote pro-environmental behavior as effectively as a real-life nature hiking experience[9]. Immersive VR enables the creation of realistic and embodied situations which provide rich sensory input[10], ensuring that virtual experiences nonetheless feel proximal to the individual[11]. According to some[12, 13], the experience of proximity to the self is central to action against climate change – the consequences of which often remain too abstract, or too spatially and temporally distant, to trigger risk perception and readiness to act. Nevertheless, low-risk perception is not the only barrier to action: heightening risk preceiptions can also trigger defensiveness in the face of threat[12–14]. One important determinant of whether people respond adaptively or maladaptively to perceived risks and feelings of threat is the efficacy they perceive in taking action. Consistent with this, both perceived self-efficacy (the belief in the personal capacity to execute desired actions) and response-efficacy (the belief that the actions will contribute to the solution) have also been identified as important drivers of pro-environmental behavior [15]. Interventions that simultaneously induce risk perceptions and build up efficacy beliefs should be maximally effective, both in general[16] and in the specific context of attempts to promote climate-friendly diets[17].

VR has a number of features that dovetail nicely with the identified psychological features of climate action. A recent theory of immersive learning[18] describes how the dual affordances of presence (the feeling of being physically and socially present in the virtual environment[19]), and agency (the sense of being in control of one's actions in the virtual environment[20]), make VR a potentially effective tool for learning and behavioral change. Both presence and agency are especially high in interactive simulations experienced through head-mounted displays (HMDs)[21] and can lead to enhanced motivation, self-efficacy, and response efficacy (factors crucial for eliciting behavioral change[18,22]) when VR simulations are developed according to instructional design principles[23,18,20,24]. Consistent with this model, recent research shows that VR provides mastery experiences that positively impact self-efficacy and response-efficacy beliefs[22,25], and that VR can help individuals to visualize the impact of their behavior on the natural environment[26].

Despite the emerging evidence that VR can promote pro-environmental intentions and, in some cases, behavior, there is only limited evidence about the ability to facilitate the switch to plant-based diets[26,27]. One very recent study by Meijers et al.[26] reports the influence of climate impact messages on behavior in a virtual supermarket, and the indirect effect of these on self-reported consumer decision-making one week after the experiment. Although this study identified personal response efficacy as an important mechanism for change in response to VR, immediate behavior change was not separate from the manipulation of impact messages, and delayed behavior change was self-report. As such, consequences for reductions in individual carbon footprints are unknown. In another recent study, Fonseca and Kraus[27] reported preliminary evidence that VR can be a suitable tool for promoting change in sustainable dietary behavior. According to their results, an immersive VR video resulted in a larger preference for vegetarian meals immediately after the intervention compared to a control group, and this was also reflected in spontaneous choices of vegetarian over non-vegetarian snacks after the simulation. However, the sample size for this study was very small (n = 36 for 3 conditions) and the behavioral consequence of VR was not distinguishable from less immersive presentations (i.e., viewing the same video on a tablet).

Here we tested the behavioral consequences of a novel VR intervention designed to promote self-efficacy and response-efficacy beliefs. The intervention was designed using instructional design principles (e.g., embodiment, personalization, and modality principle) to facilitate the impact of agency and presence on the behavioral outcome[18,23]. Furthermore, similar to previous studies, we aimed to increase response-efficacy by visualizing the impact of individual behavior[26,28,29], in our case the impact of food choices on the natural environment. As previous VR research shows the importance of gradual changes[30] and vivid messages[31] for behavioral change, the impact of current food choices on the environment is visualized continually by transporting participants 30 years into the future. Furthermore, the educational part of the intervention provided users with explicit instruction for how to behave environmentally as some research highlights how the lack of specific guidelines can limit transfer to real-life behavior[32] and actual impact in terms of carbon emissions[26]. Finally, to build self-efficacy using mastery experience[33], users were allowed to change their behavior and were given customized feedback about their choices through the gradual restoration of nature.

In this study, we compare the effectiveness of this VR intervention against a passive control condition. As stated in the preregistration, we hypothesized that:

H1: The VR intervention will lead to a larger decrease in the carbon footprint compared to the control group.

H2A-E: The VR intervention will impact all predictors (intentions, self-efficacy, response-efficacy, knowledge, psychological distance) of pro-environmental behavior to a larger extent compared to the control group.

H3A-D: In the follow-up, the IVR intervention will impact all predictors (self-efficacy, response-efficacy, knowledge, psychological distance) of pro-environmental behavior to a larger extent compared to the control group.

Furthermore, we explored if the VR treatment can be enhanced by other interventions that have been tested within environmental research: normative feedback and geographical location (distant vs. proximal). Previous research shows that social norms, (alongside self-efficacy, response efficacy, and negative emotions), play a crucial role in regulating climate-related behavior[15]. Properly administered normative feedback (i.e., about one's performance relative to significant others) has been demonstrated to be useful for motivating behavior change[34], and for supporting individual feelings of self-efficacy[35], across a variety of domains, including the environment. Furthermore, the perception that climate change is distant from the individual – that is, happening to people who are far away from both in time and space - is often argued to be the leading barrier of climate change inaction[36,37]. Yet, despite this common assumption research manipulating psychological distance has produced mixed findings [38–40], suggesting that this approach can only have limited utility within interventions designed to encourage climate-related action. Because immersive VR allows realistic visualization of climate change on nature at different geographical and temporal scales, it seems to be a perfect tool for further investigating the role of psychological distance in motivating action. Supportive of this idea a previous study conducted using non-immersive VR showed that navigating a polluted river framed as geographically closer resulted in higher risk perception, which, together with self-efficacy, predicted self-reported pro-environmental behavior[41]. Building on these ideas, our study further explored the role of both normative feedback and geographical distance in shaping the effects of the VR intervention.

2. Method

This study's design, data collection, and analysis plan of this randomized control trial were preregistered at Open Science Foundation on 15/09/2021, prior to data collection with the number 10.17605/OSF.IO/2AXF3. Unless otherwise stated, the presented study followed the preregistered plan (access here https://bit.ly/34hFpT4). The study was approved by the Institutional Review Board at the Psychology Department, University of Copenhagen, approval number IP-IRB / 02092021, and was performed in accordance with the ethical standards of the Declaration of Helsinki (1964) and its subsequent amendments. Informed consent was obtained from all participants.

2.1 Recruitment

Participants were recruited from an Educational psychology course at a large Scandinavian university and tested between September 16 and October 7, 2021. The participants who completed the post questionnaire (N = 123) were used for the relevant analyses (Hypothesis 2). For the analyses of food behavior and the long-term impact of the intervention (Hypotheses 1 and 3), we used only participants who completed the whole procedure (N = 90). As the sample size was determined by the number of students willing to participate in the experiment, we calculated the minimum detectable effect size (MDES) for the reached sample size. The MDES was f^2 =0.11 for the preregistered analyses of the follow-up data (Hypotheses 1 and 3) and f^2 =0.08 for Hypothesis 2. These values correspond to small effects[42]; thus, our sample size for the main analyses was considered sufficient for detecting desired effects. Table 1 contains the baseline characteristics of the groups.

Table 1
Baseline characteristics of the analyzed sample. The continuous variables are summarized as mean (standard deviation).

Sample characteristics	**Control** *N* = 56	**VR** *N* = 67
Age	24.9 (6.50)	25.1 (6.36)
% Female	82%	75%
% Omnivorous diet	59%	66%
Previous VR experience (median)	Never	Never
Preexisting knowledge	3.70 (1.28)	3.79 (1.44)
Pre-treatment self-efficacy	4.04 (0.69)	4.20 (0.75)
Pre-treatment response-efficacy	3.54 (0.86)	3.52 (0.80)
Pre-treatment psychological distance	5.09 (2.13)	5.03 (2.04)
Pre-treatment dietary carbon footprint	118 (64.9)	124 (82.2)

2.2 Randomization and blinding

Prior to the study commencement, participants were randomly assigned to nine seminar groups of equal sample size by the faculty administrators (not study administrators). We consequently randomly assigned four of these groups to the VR condition and five groups to the control condition. Participants were not aware of the assignment to different treatment groups. Additional simple randomization (random numbers) was implemented in the VR treatment condition to assign participants to the specific VR treatment.

2.3 Design and procedure

The trial followed a parallel design, with between-subjects repeated measures (pre; post; follow-up) with VR intervention as experimental condition and the passive group as the control condition. Participants filled out the pretest questionnaires on their personal smartphones or computers using SurveyMonkey one week before the experiment, immediately after the intervention, and one week after the intervention. Participants in the control condition did not receive any intervention but were given the VR intervention after the data collection was completed, not disadvantaging any students from the course. To investigate the potential impact of different design principles, we administered the VR treatment in 2x2 design varying geographical location (distant vs. proximal) and normative feedback (general vs. normative feedback), which resulted in four experimental conditions.

Participants took part in the experiment over the course of three weeks during their Educational psychology class. In the first week, participants completed the questionnaire in their classroom. In the second week, participants in the VR intervention condition were randomly assigned to either distant or proximal geographical location and to general or the normative feedback condition. They completed the VR simulation using Oculus Quest 1 and 2 distributed evenly across the conditions in two different laboratories. The intervention lasted approximately 15 minutes. Immediately after the VR intervention, they were asked to complete the post questionnaire. In the control condition, participants were asked to fill out the post questionnaire during their class in the second week of the experiment. Finally, in the third week, all the participants completed the questionnaire in the classroom. The participants' flow is depicted in Fig. 1, and the complete protocol is available in the supplementary material online https://bit.ly/3C6ZlEO. In the section below, we describe the VR treatment and its variants.

VR simulation and conditions. Phase 1 of the VR intervention started with an online shopping simulation in which participants selected the foods they typically purchase for lunch, breakfast, dinner, and snacks (depicted in Fig. 2A).

In Phase 2, the participant was transported to a natural park. The park's stated geographical location depended on the condition to be either distant (Rocky Mountains, USA) or proximal (Sonfjället National Park, Sweden). The choice of these two locations was based on their plausible visual similarity - both the Rocky Mountains and Sonfjället in Sweden are open, mountainous landscapes with similar flora and fauna – and their difference in distance from individual participants (who were Scandinavian, and therefore closer to Sweden than the USA). In both locations, the simulation transported participants 30 years into the future, so that they could witness the gradual degradation of this natural environment as a consequence of the current food-related GHG emissions (see Fig. 2B). Based on their own selection in Phase 1 (i.e., their food choices), the agent informed them about their current dietary carbon footprint. This information contained either normative feedback (i.e., was in comparison with other Scandinavians: Fig. 2C) or was generic (i.e., provided information about emissions without any comparison: Fig. 2D). The dietary carbon footprint was calculated using values reported by the CONCITO climate database[44] multiplied by the standard portion. Within the simulation, a pedagogical agent in the form of a park ranger educated the participant about the environmental consequences of the specific foods (see Fig. 2E).[43,44]

In the final phase (Phase 3), participants again selected the food in the shopping simulation and were instructed to choose the food with lower impact (the categories were highlighted). According to their new choices, the natural environment changed (according to 10 possible levels) based on what would happen if everyone adopted the same diet (see Fig. 2F).

2.4 Outcome measures

The primary outcome variable was the change in *dietary carbon footprint* calculated from the results of the food frequency questionnaire administered one week before and one week after the intervention. The average carbon footprint for each category[44] was multiplied by the frequency indicated by the respondents and pooled into the general dietary footprint.

Self-efficacy was measured with two items adapted from Huang et al.[45] and two items adapted from Hunter and Röös.[17] The two items from Huang et al.[45] were later considered being too general to measure the self-efficacy concept, leading to deviation from the preregistration plan as only the two items from Hunter and Röös were used for the following analyses. Nevertheless, the exclusion of the two items did not influence the conclusions of this study. We report the results of the analyses including all four self-efficacy items in the supplemental material. Three items measuring *response efficacy*, and four items measuring *behavioral intentions* were adapted from Hunter and Röös [17]. *Psychological distance* was assessed using five items adopted by Spence et al. [36]. *Knowledge* was measured by asking participants to indicate the level of emissions for 15 foods presented in the simulation. Self-efficacy, response efficacy, and psychological distance were measured one week before, immediately after, and one week after the intervention. Knowledge was measured immediately after and one week after the intervention.

Finally, a one-item *preexisting knowledge* variable (seven-point scale from Very low – Very high) and reported dietary lifestyle were used as a covariate in the analyses. The supplemental material details the wording of all measures collected in the study.

3. Results

To investigate if the VR intervention has the potential to facilitate the switch towards a more sustainable diet, we compared the treatment effects of VR and control conditions on dietary carbon footprint. The average change in dietary footprint for the VR and control conditions is depicted in Fig. 3.

Figure 3 shows that there was a significant difference between the VR and control conditions in their average change in dietary footprint from one week prior- to one week after the intervention. The VR treatment led to a dietary footprint decrease of 20.1 kg $C0_{2,}$ which was significantly larger than the control condition, $b = -22.28$, 95% CI $[-44.26, -0.30]$, $t(87) = -2.01$, $p = .047$. Therefore, we accepted Hypothesis 1. As specified in the preregistration we investigated the robustness of this finding. The effect size of the reported change in the dietary footprint compared to the change in the control condition was medium $d = 0.4$. The effect of condition remained significant when dietary lifestyle was accounted for, $b = -40.53$, 95% CI $[-77.88, -3.17]$, $t(85) = -2.16$, $p = .034$.

Furthermore, we compared the impact of the VR and control condition on the identified psychological predictors of pro-environmental behavior: intentions, self-efficacy, response-efficacy, knowledge, and psychological distance. We found that the VR treatment increased response-efficacy by 0.34 on a 5-point scale, and the increment was larger than in the control condition when controlled for the pre-treatment score, $b = 0.20$, 95% CI $[0.00, 0.40]$, $t(120) = 2.02$, $p = .045$. Similarly, the VR condition resulted in a significantly larger increase in knowledge compared to the control condition when controlled for the preexisting knowledge,$b = 2.16$, 95% CI $[1.62, 2.69]$, $t(120) = 7.95$, $p < .001$. Nevertheless, we did not find a significant difference between the groups on behavioral intentions when controlled for dietary lifestyle, $b = -0.01, 95\% CI[-0.28, 0.26], t(120) = -0.05, p = .964$, on self-efficacy when controlled for the pre-treatment score,

$b = -0.02, 95\% CI[-0.22, 0.18], t(120) = -0.21, p = .835$or psychological distance when controlled for the pre-treatment score, $b = 0.10, 95\% CI[-0.08, 0.29], t(120) = 1.09, p = .278$. Therefore, hypothesis 2 was partially supported (Hypotheses 2C and 2D were confirmed). For the comparison of the effects, see Table 2.

Table 2
Comparison of the effect of the VR treatment and control condition. All variables are calculated as change scores from baseline to the second measurement, except for Intentions and Knowledge, which are presented as post-treatment scores. Beta coefficients report the impact of the VR intervention compared to the control condition when controlled for the pre-treatment scores.

	Control (*n* = 56)	**VR Treatment (*n* = 67)**	**Beta (95% Confidence interval)**
Dietary footprint	-5.09 (42.1)	20.1 (79.8)	-22.28, 95% CI [-44.26, -0.30]
Self-efficacy	-0.03 (0.59)	-0.13 (0.70)	-0.02, 95% CI [-0.22,0.18]
Response-efficacy	0.02 (0.62)	0.23 (0.60)	0.20, 95% CI [0.00, 0.40]
Psychological distance	-0.05 (0.51)	-0.15 (0.55)	0.10, 95% CI [-0.08,0.29]
Intentions Post	14.0 (3.08)	13.9 (3.33)	-0.01, 95% CI [-0.28,0.26]
Knowledge Post	4.05 (1.26)	6.22 (1.69)	2.16, 95% CI [1.62, 2.69]

Furthermore, as stated in the preregistration, we compared the impact of the VR intervention on the predictors measured in the one-week follow-up controlling for the pre-treatment scores (or preexisting knowledge in case of knowledge). The results showed that the VR intervention (versus control group) showed significantly higher knowledge at follow-up compared to when controlled for preexisting knowledge, $b = 2.47$, 95% CI $[1.88, 3.07]$, $t(88) = 8.27$, $p < .001$. Nevertheless, we did not find a significant difference between the conditions on self-efficacy, $t(89) = -1.72$, $p = .088$, response-efficacy, $t(89) = -0.85$, $p = .397$ or psychological distance, $t(89) = -0.64$, $p = .523$. Therefore, only Hypothesis 3C was supported.

To unpack these findings, we conducted exploratory analyses (not preregistered) to probe the impact of the specific VR intervention conditions. Our 2x2 design aimed to (1) decrease the psychological distance of the climate change using geographically proximal (Scandinavia) or distant (USA) location and (2) to increase self-efficacy using normative rather than generic feedback. Both manipulations were focused on enhancing the persuasive impact of the VR intervention and reducing the dietary footprint.

First, we compared the impact of the normative feedback (*n* = 32) on self-efficacy to the generic feedback condition (*n* = 35). There was a significant difference in self-efficacy favoring the normative feedback condition compared to the generic feedback condition, $b = 0.29$, 95% CI $[0.01, 0.58]$, $t(63) = 2.08$, $p = .041$. Comparison of the distance conditions did not show any difference in psychological distance between the proximal (*n* = 33) and distant conditions (*n* = 34), $t(63) = 0.17$, $p = .867$. We also did not find any effect of geographical location (*n* = 25), $t(45) = 0.41$, $p = .683$, or normative feedback (*n* = 24) on the reported carbon dietary footprint, $t(45) = 0.46$, $p = .651$.

4. Discussions

The results of this preregistered randomized trial suggest that an efficacy-focused VR intervention designed according to instructional design guidelines can effectively reduce individual dietary footprints. Compared to the participants in a passive control condition, our VR treatment significantly reduced dietary footprints with a medium effect size ($d = 0.4$). Notably, this finding was robust controlling for dietary lifestyle and is larger than the typical effect size reported in a previous meta-analysis of behavioral interventions to promote household actions mitigating climate change ($d = 0.093$)[46]. Consistent with the intention behind our intervention, which was based on previous theory and research[26,32], the findings also support our contention that being able to visualize the consequences of food choices and witness the impact of changing these, in immersive VR can be an effective tool for fostering response-efficacy, which is identified as a crucial predictor of pro-environmental actions[15].

Contrasting with our predictions, the VR intervention, in general, did not result in a larger increase in self-efficacy beliefs compared to the control condition. However, we did find that the VR intervention had a significantly more positive impact on self-efficacy beliefs when normative feedback was included compared to generic feedback, which is in line with research indicating that relevant normative feedback can increase self-efficacy beliefs [35,47]. Our sample reported generally high pre-treatment self-efficacy beliefs (4.2 on a five-point scale), and there is some evidence that initially high self-efficacy can decrease in the first phases of acquiring a new skill[48]. Along these lines, it is plausible that the VR experience results in a revision and correcting of individual beliefs, an idea that is supported by the fact that self-efficacy decreased immediately after the VR intervention for the normative and generic feedback groups, though this change was not significant.

Similarly, and despite the observed changes to individual carbon footprints, we did not find any effect of the VR intervention on reported behavioral intentions. One explanation for this lack of finding is that the items measuring intentions may have been too specific (e.g., “In the future, I intend to refrain from eating meat completely.”) and binding for a climate-aware sample. The low, and non-significant correlation between the observed change in dietary footprint and the measure of intentions ($r = -0.14$, $p = .0.16$), contrasts with meta-analytic findings of a substantial correlation of $r = 0.54$ between intentions and environmental behavior[49]. This is again suggestive of issues with the measure of intentions. Based on this, we would suggest that future research into the impact of the VR simulations on behavioral intentions ensure that measures of behavioral intentions are valid and plausible within the target population.

Finally, the VR intervention had no impact on the perception of the psychological distance of climate change, and this was not enhanced by the explicit manipulation of distance by locating the simulation somewhere close to (Scandinavia) or far from (USA) participants’ own location. Similarly, the geographical location of the simulation had no bearing on observed changes to dietary footprints. This may have been due to the fact that the proximal condition was still not located within the participants' own national environment (Denmark), or it could be further evidence that the effects of distance manipulations are not as simple or straightforward as is often assumed[13, 41]. Irrespective of this, any findings concerning our manipulations of geographical distance and normative feedback should be considered as preliminary in the context of the small cell size for each of the VR conditions.

Beyond the overall caveat connected to the small sample size, the results of this study should be interpreted based on several additional potential limitations. Firstly, the passive control condition allowed us to control for demand characteristics linked to social desirability bias but not to information bias provided as the participants in the control group did not receive any information. Although some findings indicate that the use of active vs. passive control groups does not result in a significant difference in measured outcomes[50], future research should focus on comparing the effectiveness of the VR intervention with other methods or environmental communication.

Secondly, recruiting participants from a psychology course resulted in a sample with specific demographic characteristics – the majority were young, female university students, resulting in a more climate-aware sample which could limit generalizability. While previous research shows that climate-aware respondents[51] are driven to climate action by similar predictors as the general population[15], that is, efficacy beliefs and social norms, the presented results should be replicated in more diverse samples. Furthermore, future studies should consider environmental anxiety and investigate how people with higher anxiety levels respond to similar simulations.

Finally, in this study, we used a food frequency questionnaire to obtain an estimate of dietary carbon footprint over the course of one week[52]. Compared to retrospective items measuring general food preferences, the food frequency questionnaire allowed us to capture detailed information and calculate dietary impact in kilograms of carbon. However, this information is still not behavioral and future research could attempt to measure spontaneous food choices in the laboratory or observe individual consumption outside of the laboratory setting.

Despite these limitations, the study provides novel evidence for the effectiveness of VR as a tool to promote a switch to more plant-based diets. Moreover, compared to the results of other randomized controlled trials targetting sustainable household behavior, the effect of this intervention is large. Additionally, the VR intervention focused on behavior that has a significant environmental impact, which contrasts with the lower-level behaviors that are typical of many previous studies[46]. Conceptually, these findings support the importance of instructional design principles and a focus on the main drivers of behavioral change when designing VR interventions[18]. Finally, the fact that the impact of the VR intervention in terms of the carbon footprint was larger than the control condition confirms that the effect cannot be reduced to the study's demand characteristics. Therefore, this study has important implications for the future of environmental communication and the possibility to use immersive VR as a potential tool to support the "green transition."

Declarations

Author contributions

All authors were involved in conceiving the study idea and design. A.P. led the study design and implementation, processed and analyzed data, and drafted the paper. G.M. supervised A.P. A.P., T.M., F.P.C., and G.M. revised the paper.

Competing interests

The authors declare no competing interests.

Data availability statement

Data will be available from the study at the Open Science Framework repository upon the paper acceptance https://bit.ly/3C6ZlEO.

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Figures

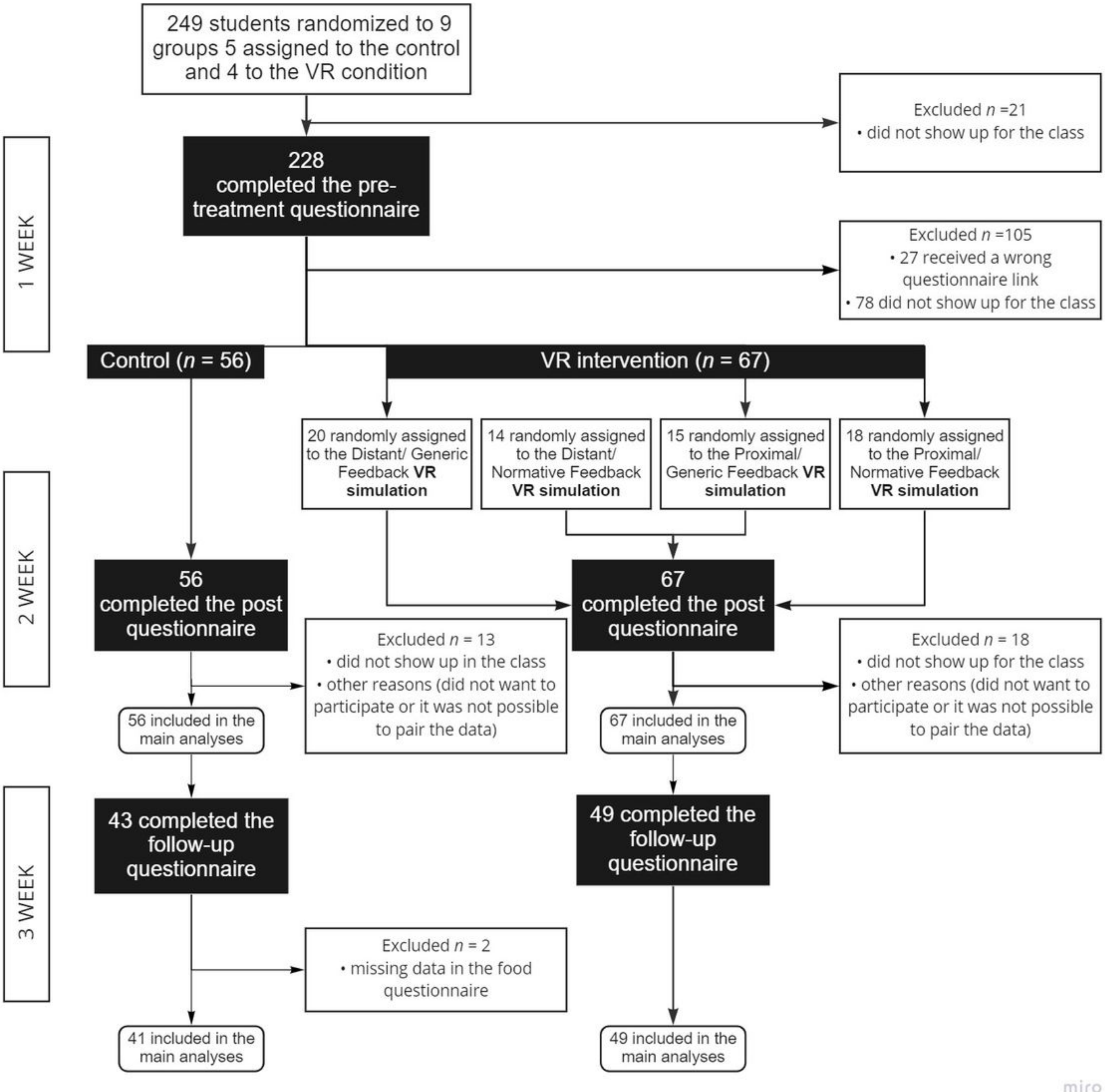

Figure 1

Trial profile shows participants' flow into treatment arms and analyses.

Figure 2

Virtual reality treatment procedure.

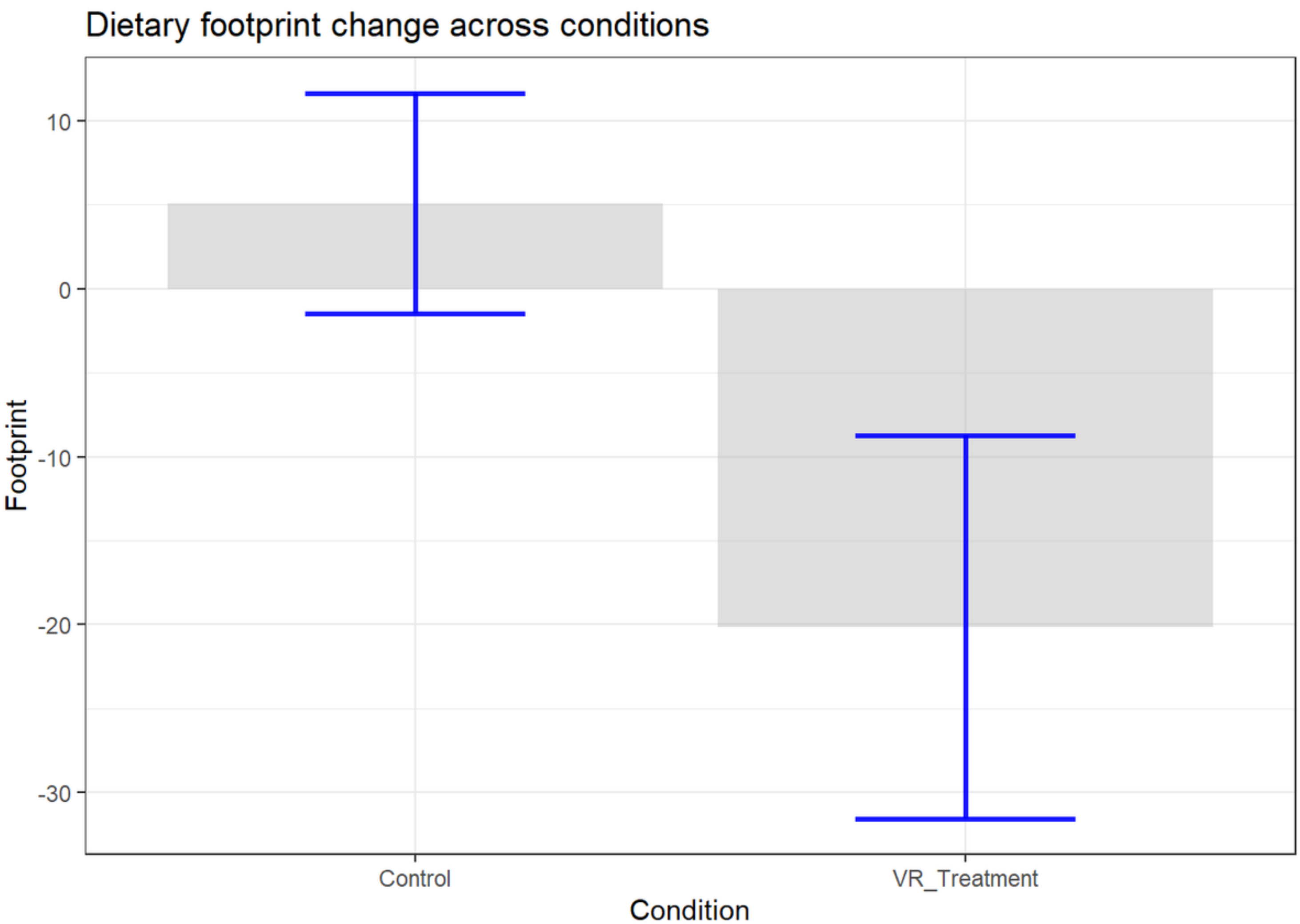

Figure 3

Change in dietary carbon footprint from pre-treatment measurement to the one-week follow-up for both conditions. Negative values indicate a decrease in dietary carbon footprint. Error bars are 95% confidence intervals.

Supplementary Files

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