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Exploring the Impact of Immersive Media on Prosociality: A Comprehensive Meta-Analytic Review

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ABSTRACT

Ten years after the popular claim that virtual reality is the "ultimate empathy machine," this article examines the body of research exploring that relationship. By broadening the analytical scope to include additional influencing factors, we ask whether immersive media might instead be considered the "ultimate prosocial machine". Accordingly, the study aims to understand how—and under what conditions — the consumption of immersive media may enhance prosociality. To this end, we conducted a comprehensive meta-analytic review, synthesizing and updating findings from six prior meta-analyses. Incorporating 85 studies, including 19 recent additions published up to 2024, and performing 68 separate meta-analyses, we examined the extent to which immersive media delivered through virtual reality (VR) headsets influences prosocial responses — namely empathy, attitudes, intentions, and prosocial behaviours — toward outgroup members vulnerable to exclusion, discrimination, or stigmatization. The studies were organized into five distinct sets of meta-analyses to examine potential moderating variables: (1) participant gender, background, and age; (2) the target groups and topics addressed by the immersive productions; (3) the type of prosocial response measured; (4) the type of immersive technology used and the type of immersive experience created; and (5) the modality of experimental design. We found a small-to-moderate statistically significant overall effect, aligning with prior meta-analyses in both effect size and heterogeneity. Given ongoing debates, particular attention was given to the interaction between the type of immersive experience and the specific dimension of empathy evaluated. Our findings suggest that emotional empathy is more responsive to immersive experiences than cognitive empathy, which appears to require more extended and embodied engagement.

Keywords: Immersive Media, Virtual Reality, Prosociality, Empathy, Meta-Analysis.

INTRODUCTION

Six recent meta-analyses (Canet & Sánchez-Castillo, 2024; Lee et al., 2024; Ma et al., 2023; Martingano et al., 2021; Nikolaou et al., 2022; Ventura et al., 2020) have examined the relationship between immersive media and prosociality in different ways, reflecting the growing scholarly interest in this field. Although the results obtained in the studies evaluated by these six meta-analyses have been mixed, their overall findings suggest that immersive media has the potential to promote prosociality. Canet and Sánchez-Castillo´s meta-analysis (2024) is the only one that explicitly outlines this relationship. Drawing on their approach, the term prosociality is used here to encompass all forms of prosocial responses, defined as any type of other-oriented response—such as empathic responding, positive attitudes, behavioural intentions, and prosocial behaviours (e.g., helping, donating, sharing, or cooperating). Prosocial behaviour has historically been defined as voluntary and intentional actions intended to benefit another person (Beilin & Eisenberg, 1982; Mussen & Eisenberg, 1977; Staub, 1978).

Canet and Sánchez-Castillo (2024) use the concept of immersive media to refer to any media productions created using immersive technologies. The two most commonly used immersive technologies are 3D Computer-Generated Imagery (3D-CGI) and 360-degree video technology. Both facilitate the development of Immersive Virtual Environments (IVEs), which can be fully experienced through virtual reality (VR) headsets. While 360-degree video technology has contributed to the growing popularity of immersive productions, 3D-CGI technology is specifically associated with VR. This term, coined by Jaron Lanier in 1989, refers to an alternative reality, distinct from the physical world around us, that is experienced temporarily. As technology enhances immersion, this temporary experience will better deliver "an inclusive, extensive, surrounding, and vivid illusion of reality to the senses of a human participant" (Slater & Wilbur, 1997, p. 604–605). Since its inception, the popularity of VR has waxed and waned over the years, although it has been riding the crest of a new wave since 2014 thanks to the latest technological advances (Fassone, 2017), which have also contributed to what Mandy Rose (2018) has dubbed the "immersive turn."

VR is by far the most common term used to describe the media productions used as stimuli in the studies analysed by Canet and Sánchez-Castillo (2024). In fact, four of the six meta-analyses mentioned above (Lee et al., 2024; Martingano et al., 2021; Nikolaou et al., 2022; Ventura et al., 2020) examine VR, while three (Lee et al., 2024; Martingano et al., 2021; Ventura et al., 2020) focus on the relationship between VR and empathy, one of the prosocial responses most frequently evaluated. In a TED Talk in 2015, Chris Milk made the bold—and unsubstantiated—assertion that VR is the "ultimate empathy machine." Numerous studies have since attempted to produce experimental evidence to support or refute this claim, with mixed results (Ma et al., 2023; Ventura & Martingano, 2023). The debate on this question has become particularly contentious due to the findings of three of the meta-analyses considered in this study: While Ventura et al. (2020) found that immersive media productions are more effective in triggering the cognitive dimension of empathy, Martingano et al. (2021) found they are more effective in fostering the emotional dimension. More recently, the meta-analysis by Lee et al. (2024) has supported the former conclusion.

The contradictory nature of these findings seems to be related to the dimension of empathy being evaluated. Empathy is a multidimensional variable (Davis, 1980, 1983), with the emotional and cognitive dimensions being the two given the most attention (Yin & Wang, 2023). Studies in neuroscience have demonstrated that these two dimensions involve different pathways in the brain (e.g., Decety & Jackson, 2004; Zaki and Ochsner, 2012). As suggested by Cummings et al. (2021), treating empathy as a unidimensional concept would lead to misleading conclusions about the effect of immersion on it.

The type of immersive production evaluated as a stimulus in the studies may also have an impact on the findings. Indeed, the importance of both the type of prosocial response and the type of immersive production—and the interaction between them—has previously been suggested in two recent studies (Canet & Sánchez-Castillo, 2024; Ventura & Martingano, 2023). Specifically, Canet and Sánchez-Castillo (2024) propose that different types of immersive experiences may trigger different types of prosocial responses. These authors also highlight the relevance of the topic and social group of the immersive production and the relationship of these elements to the prosocial response being evaluated. The potentially moderating role of the research context, the experimental design model, and the characteristics of the participants are also important to consider.

The aim of this study is thus to evaluate the extent to which these variables, and their interaction, may influence the efficacy of the prosocial effects of immersive media consumption, in order to gain a better understanding of how and under what circumstances exposure to these productions may promote prosociality. To this end, this study presents a set of meta-analyses based on a review and update of the studies included in the six previously mentioned meta-analyses.

METHODOLOGY

Accordingly, this research began with a review of the six previous meta-analyses and the studies they evaluated, followed by an update of those analyses. These initial steps facilitated the identification of homogeneous groups of studies based on the previously considered variables, thereby enabling both intra-group and inter-group comparisons in the subsequent phase. Separate meta-analyses were then conducted for each group identified, followed by a statistical assessment to determine whether the differences between them were significant. The meta-analyses were thus organized into the following five categories: 1) Meta-analyses related to participants' gender and age; 2) Meta-analyses related to the topics and social groups addressed in the immersive productions; 3) Meta-analyses related to the type of prosocial response evaluated; 4) Meta-analyses related to the type of immersive technology used in the creation of immersive productions and the type of immersive experience

offered by these productions; 5) Meta-analyses related to the experimental design model.

In relation to the calculation of effect size for the meta-analyses, it is important to note that the values for each study may be either single or multiple depending on the number of prosocial responses and dimensions evaluated, the number of scales used for this purpose, and the type of experimental design proposed in each case. For example, if a study evaluates empathy using a single scale, the resulting value is single. However, if this prosocial response is assessed using different scales or if additional prosocial responses are considered, the study will present multiple values. Single values were used to calculate the effect size for each study, except in the cases of studies with multiple values, for which a different approach was required.

In general, for the calculation of the overall effect size, the multiple values of each study were collapsed to obtain a single value per study. For the different groups of meta-analyses, the values were calculated based on the characteristics that define each one. For example, in the meta-analysis of studies related to the type of prosocial response evaluated, an effect size was obtained for each of the prosocial responses assessed in each study. This means that if a study evaluated both empathy and attitude, two effect sizes were obtained, one for each prosocial response. The first was included in the calculation of effect size for all studies that evaluated empathy, and the second for all those that assessed attitude. If a study evaluated both dimensions of empathy mentioned above (emotional and cognitive), the two values were collapsed to obtain a single effect size for empathy. However, for the analysis and comparison of these two dimensions, instead of collapsing the values of cognitive empathy and emotional empathy, each value was considered separately for the meta-analysis of each dimension.

If a study evaluates a single independent variable with two conditions, a single effect size is obtained by comparing one condition with the other. If there are three conditions, the number of comparisons increases to three, and thus the study yields three effect sizes. In this case, these three values were collapsed to obtain a single effect size per study. For studies that evaluate multiple independent variables with different conditions, only the relevant variable was considered. For example, in a study with a 2x2 between-subjects experimental design in which two independent variables are evaluated each with two conditions (level of immersion [screen/VR] × emotional personalization [present/absent]), only the values of the independent variable "level of immersion" were considered. Meanwhile, for all other meta-analyses, the values of the independent variables considered in each study were collapsed in order to be able to compare studies that employed designs that compared levels of immersion with those that did not.

If the study reports the main effect, this data of each independent variable was considered instead of the values of their different condition combinations. If the main effect is not reported, the differences between the means of the different combinations were considered, accounting for the sample size of each condition rather than the total number of participants to avoid artificially increasing the study's weight in the calculation of effect sizes. In cases where these values were not provided, we chose to assume equal sample sizes across conditions, since, for the same mean difference, effect sizes tend to be smaller when samples are balanced than when there is asymmetry in the number of participants per condition.

For studies using pretest-posttest designs, the values before and after media exposure for each prosocial response evaluated in the study were considered. As the objective is to assess the effect of immersivity on social responses, whenever studies provide these values, we have prioritized them over those derived from independent variables that do not assess the level of immersion. Negative effect size values were changed to positive in cases where a lower value is considered better than a higher one. For example, in certain cases where attitudes toward others are measured (e.g., Attitudes Toward Blacks scale, Implicit Association Test, Social Distance Scale, or Modern Racism Scale), lower values indicate an improvement in prosocial responses as they reflect a reduction in prejudice or social distance. Finally, to ensure the representativeness of each group, a minimum of four studies were required to conduct the meta-analysis (see the supplementary material for more details on the computation of effect sizes and the statistical analyses conducted).

OVERVIEW OF THE SIX META-ANALYSES

As noted above, six meta-analyses have been conducted over the past five years to evaluate the impact of immersive media on prosociality. Empathy is the prosocial response evaluated the most as an outcome, studied four of the six meta-analyses (Lee et al., 2024; Ma et al., 2023; Martingano et al., 2021; Ventura et al., 2020). Ma et al. (2023) also evaluate the effects of media on persuasion (coded as beliefs, attitudes, behavioural intention, or behaviours), while Nikolaou et al. (2022) focus their meta-analysis on social attitudes. Canet and Sánchez-Castillo (2024) consider all types of prosocial responses instead of examining only one type.

A common feature of all six meta-analyses in terms of the definition of immersive media is the inclusion of

studies that use immersive productions delivered via VR headsets as the experimental stimulus. The one exception is the meta-analysis by Martingano et al. (2021), who propose a broader definition of immersive production that includes not only immersive experiences delivered via VR headsets but also projection VR systems (e.g., VR Cave or Dome) and non-visual experiences involving only the auditory channel.

A total of 174 publications are reviewed in the six meta-analyses, involving a total of 20,583 participants. Both Martingano et al. (2021) and Canet & Sánchez-Castillo (2024) cover more than 5,000 participants, while Lee et al. (2024) come close to this figure. In contrast, Ventura et al. (2020) cover significantly fewer participants, with only 335 (see **Table 1** for the numbers of publications and participants in each meta-analysis). While all of the publications considered by Ventura et al. and Canet and Sánchez-Castillo were articles, the other four meta-analyses also included other types of publications, such as conference papers, book chapters, doctoral dissertations, and master's theses. However, in all cases, articles represent at least 72% of the publications analysed. To ensure homogeneity and maintain quality, this meta-analysis focuses exclusively on articles (k=147), excluding other types of publications (k=27). Of the 147 articles included in the six meta-analyses, 37 duplicates were found, leaving a total of 110 articles in the sample for this review.

The earliest article in the sample was published by Deladisma et al. in 2007. After this, three articles were published in 2009 (Bunn & Terpstra; Groom et al.; Raij et al.), bringing the total number of articles published in the first decade of this century to four (3.64%, or 4 of 110). A total of 43 articles (39.09%, or 43 of 110) were published in the second decade. More than half of the total is comprised of articles published in the first five years of the third decade (57.27%, or 63 of 110), with 2021 being the year of publication of the largest number of articles (20.91%, or 23 of 110). These results confirm that this is a relatively new field of study, as previously noted in the four most recent meta-analyses. The first two meta-analyses only cover publications up to 2018 (although Martingano et al. includes one article from 2019). Nikolaou et al. cover a period up to 2020 (including one article from 2021), while Ma et al. and Canet and Sánchez-Castillo include publications up to 2022. Lee et al. is the most recent study, covering articles published up to 2023 (with a cut-off date of June 19, 2023).

Most of the studies draw their samples from university environments (primarily students) while a much smaller number draw them from the general public. The participants are generally not identified as belonging to any disadvantaged groups, with the exception of six studies (1 to 6, see **Table 2** for the list and details of the publications discussed in this section) in which the participants are identified as people with autism. It seems reasonable to expect that the responses of this particular group might differ significantly from other participants, and in fact, Martingano et al. (2021) found that the positive impact of VR on empathy was three times greater for children with autism. Therefore, to ensure the comparability of the studies, it was decided to exclude this group of studies from this review.

Except for Canet and Sánchez-Castillo, who focus exclusively on immersive productions about social issues, the meta-analyses cover different topics, such as health and environmental issues. Whatever the topic, the subjects of almost all of the productions considered by the studies are human beings, although a few studies were identified that evaluate immersive productions about non-human subjects. Specifically, three studies analyse immersive media productions about animals (8, 9, 10 Study3). Productions analysed in five other studies address environmental issues (11, 12, 13, 14, 15 Study2). Given that we have defined prosociality as beneficial responses toward other people, these eight studies were excluded from this meta-analysis.

Most of the studies reviewed evaluate prosocial responses to individuals facing difficult situations due to their condition or life circumstances—typically, people belonging to vulnerable groups at risk of exclusion, discrimination, or stigmatization. In many studies, these individuals are identified as members of outgroups. Seven studies were found that examine immersive productions focusing on topics or social groups that are not facing such issues, and these were therefore excluded from this review (16-22).

Studies dealing with health issues were categorized into two groups: studies of immersive productions about patients whose condition may make them prone to discrimination, such as individuals with mental illnesses (e.g., schizophrenia); and studies that evaluate particular situations or patients who do not elicit such negative responses. The seven studies placed in this latter group (23-29) were excluded from this review due to their lack of relevance to issues related to social rejection. Conversely, studies were included in cases where the patient's condition may give rise to social exclusion, even if the illness itself is not a direct cause of marginalization. For example, in the case of dementia, while the disease itself may not lead to social exclusion, its association with the elderly (a group that often suffers from discrimination) makes it relevant to this analysis. It is also worth noting that this target group is addressed outside of the context of health as well.

The meta-analyses reviewed focused mainly on studies that evaluate audiovisual immersive experiences using VR headsets, although other types of experiences were also considered: four studies evaluated the simulation of auditory experiences (30-33); three studies assessed immersive experiences in a 360-degree real-world

environment (34-36); two studies evaluated immersive experiences using a web-browser interface (37, 38); one study considered an interactive video clip (39); and another study examined interactions with patients via a wall screen (40). To maintain consistency with the general trend and ensure homogeneity across the studies, we decided to exclude these eleven studies.

Seven studies evaluated the immersive production as part of an educational program, as a complement to other activities, or in combination with other media (41-47). These studies were also excluded because the evaluation was conducted after the entire program or process and not immediately after the immersive experience itself, making it difficult to determine whether the effect was due to the participant's exposure to the specific immersive experience or the procedure as a whole.

Three additional studies were excluded because they either did not evaluate prosocial responses as outcomes or were not focused on their relationship with immersive experiences (48–50). Similarly, three other studies were identified that treat prosocial response as a mediating variable rather than an outcome. Both Shin (2018) and Yang and Zhang (2022) evaluated the effect of the sense of presence—the primary response to immersivity, as will be discussed below—on empathy, and, in turn, its impact on engagement (in the former study) or enjoyment (in the latter). These two studies were included in this meta-analysis because both reported the direct effect on empathy. Conversely, Alvidrez and Peña (2020) did not report the direct effect on prosocial responses and was therefore excluded from this review (51).

All but one of the studies (52) in the sample collected data immediately after the immersive experience, which only collected data one week later and was therefore excluded from this review. Other studies included in the review also collected data at later time points; however, only the data gathered immediately after exposure to the immersive experience were considered in the present analysis.

Thus, of the 110 articles reviewed, a total of 50 were excluded for the reasons outlined above, leaving 60 for the second phase of analysis (including the other studies of articles 10 and 15). Canet and Sánchez-Castillo (94.59%) and Ma et al. (75%) were the meta-analyses that contributed the largest proportion, followed by Nikolaou et al. (57.14%) and Lee et al. (56.10%), while Ventura et al. (42.86%) and Martingano et al. (31.25%) contributed the smallest. Six of the 60 articles reported more than one study, bringing the final total number of studies analysed to 66 (see **Table 3** for the list of studies included and the supplementary material for their full references). This final sample was selected based on the main trends that characterize the dataset, excluding studies that deviated from these trends. The aim of this approach was to achieve the highest level of similarity between studies, thereby ensuring better comparability both within and across groups, while also facilitating the definition of the inclusion criteria for this review beyond the general criteria shared by the six previous meta-analyses. These criteria are outlined as follows:

Prosocial Response Target: The stimuli in experimental designs must consist of immersive productions depicting vulnerable people at risk of exclusion, discrimination, stigmatization, or suffering hardships in their lives.

Participants: The participants in the experimental designs must not belong to any disadvantaged group and must belong to a different social group from that of the subjects of the production, thereby facilitating the evaluation of prosocial responses toward outgroup members.

Immersive Media Productions: The immersive media must be audiovisual productions delivered using VR headsets.

Prosocial responses: Studies that considered empathy as a mediator were included, provided they reported the direct effect on empathy.

Experimental Design Considerations:

Time-frame: Data must be collected immediately after the immersive experience.

The effect of the immersive experience on prosocial responses must be the sole focus of the evaluation and not part of a broader program involving additional activities.

Publication Requirement: The results of the experimental designs must be published as research articles.

UPDATING THE SIX META-ANALYSES

The next step in this research was to update the six previous meta-analyses by adding studies published from the second half of 2023 through to the end of 2024. Since Canet and Sánchez-Castillo (2024) is the meta-analysis that contributes the highest percentage of studies to this review, the search for new publications was primarily

based on its methodological approach. Thus, the main collection of Web of Science (WoS, Clarivate Analytics) was used as a database. The search data fields included were Title, Abstract, and Author Keywords. The search was conducted in January 2025.

Canet and Sánchez-Castillo (2024) found that "virtual reality" is by far the most commonly used term to define the immersive experience. In an initial search, this term was combined solely with empathy as a social response, resulting in 147 references. Although Canet and Sánchez-Castillo recommend the use of "immersive media" as an emerging term, it still appears to lack relevance, as adding it to the search string only yielded three new studies (k=150). For the second part of the search string, the term "prosocial" was added to broaden the range of types of prosocial responses, increasing by 15 from 150 to 165. Finally, following Canet and Sánchez-Castillo's approach, "reduc bias" OR "attitudinal change" OR "donation intention" OR "donation behavi*" OR "charity" OR "charitable giving" was added to the search string. The resulting increase was not very significant, although it did raise the total by six, from 165 to 171 (see **Table 4** for the different search strings conducted and their results).

Thus, 171 was the starting number of items for the updated meta-analysis. Six of these articles were excluded because they not written in English. Of the remaining 165 articles, 25 were review articles. In addition, seven articles were classified by WoS as editorial material, meeting abstracts, corrections, or letters. Due to their nature, these articles were all excluded, leaving a total of 133 articles for review. Three duplicate articles found among the studies in 2023 considered by Lee et al. (2024) and the duplication of a fourth article within the retrieved result were also excluded, leaving a final total of 129. After further review, the sample was ultimately reduced to 18 articles. The reasons for the exclusion of the other 111 are outlined below.

The vast majority of the articles (35.66%, or 46 of 129) were excluded because they did not present the results of an experimental design (1-46, see **Table 5** for the list and details of the studies excluded in this section). These included theoretical approaches, design models, and analyses of the characteristics of immersive experiences, as well as proposals for evaluating prosocial responses using immersive productions. Another major reason for exclusion was that the studies did not focus on prosocial responses or their relationship with immersive experiences (24.81%, or 32 of 129) (47-78). In other cases, the immersive experience was part of an educational program or intervention (10.85%, or 14 of 129) (79-92). Additional reasons, accounting for a smaller proportion of exclusions, are detailed as follows: Three studies that did not use VR headsets for the immersive experience were also excluded (93-95). The latter evaluated an auditory experience, which could be added to the group of four studies found in the previous analysis. Four studies were also found that considered media productions using augmented or extended reality (96-99), a field of research that is receiving increasing attention. Five other studies focusing on environmental issues were identified (100-104), which could be added to the group of four studies found in the previous analysis. Two studies were contextualized in the health field but were not related to vulnerable populations (105, 106), which could be added to the group of seven studies found in the previous section. In one study (107) the participants were not regular individuals. Finally, four studies did not report valid data for the calculation of the meta-analysis (108-111).

With the 18 new articles and the 60 already included from the review of the meta-analyses, the total number of articles considered in this new meta-analysis is 78. As shown in **Table 6**, the boom in research in this area began in 2020, peaked in 2021, saw a significant decline in 2022, and has recovered in the last two years, especially in 2024. Of the 18 new articles, one conducted two studies, bringing the total number of studies added in the update process to 19 (see **Table 7** for the list of newly included studies following the update and the supplementary material for their full references). Thus, in terms of studies, the final total number of studies included in the present review is 85 (66 from the previous meta-analyses plus 19 from the update process). In total, these studies included 11,746 participants. As with the studies extracted from the previous meta-analyses, the data collected by Phillips et al. (2024) over a period of three weeks and the data collected by Branham (2024) five days after exposure were excluded. See Figure 1 for the flow of information through the two phases—overview of meta-analyses and updating—based on the recommendations in the PRISMA Statement (Moher et al., 2015).

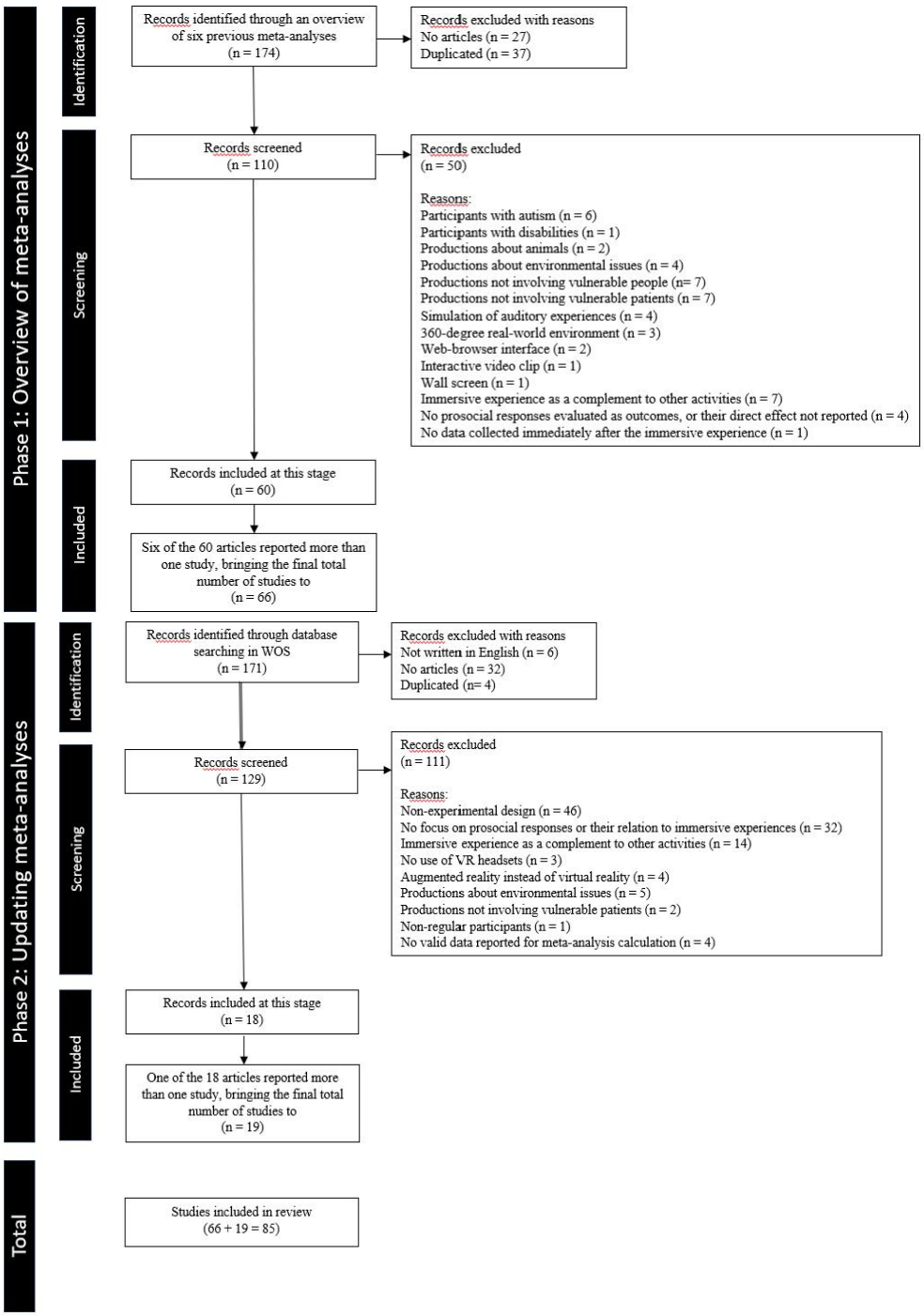

Figure 1. PRISMA Flowchart of the Study Selection Process

REVIEW AND META ANALYSIS

Overall Effect Size

The overall effect size found for the meta-analysis group was Hedges' g = 0.44 (k=66), representing a small-to-moderate effect that is statistically significant ($p<0.01$), suggesting a meaningful relationship across studies. However, the considerable heterogeneity indicates variability in the results ($I2=82.57\%$, 75%–100%), and the confidence intervals show a moderate degree of precision. While small-to-moderate and statistically significant ($p<0.01$), the effect size found for the update group is lower (g=0.36, k=19) and therefore provides less evidence of effect compared to the original group. It also demonstrates a higher heterogeneity ($I2=86.35\%$) and a wider

confidence interval, indicating less consistency in the results (see supplementary material for the list and detailed results of the separate meta-analysis groups conducted). Of the six previous meta-analyses, four reported the overall effect size of the set of studies. As shown in **Table 8**, the effect sizes range from a low of 0.21 to a high of 0.46, all of which were statistically significant. All studies also reported considerable heterogeneity, with I^2 values ranging from 75.9% to 86.81%, except for Nikolaou et al. (2022), which reported moderate heterogeneity (I^2 = 45.00%, 25–50%).

Gender and Age of Participants

This section explores how the gender and age of the participants may moderate the impact of the immersive experience. Nearly half of the studies (49.41%, or 42 of 85) were found to maintain a fairly balanced proportion of females and males, within a range from 40% to 59% (see **Table 9** for the list of studies). A significant percentage of studies (35.29%, or 30 of 85) did not maintain this balance, having more than 60% female participants. Seven studies only included women (8.24%, or 7 of 85). On the other hand, only three studies had a percentage of females below 39%. Finally, three studies did not specify the gender of their participants.

This preliminary review facilitated the identification of three groups with a sufficient number of studies to conduct the meta-analysis (see **Table 10** for a summary of results). Although no statistically significant differences were found between groups with different proportions of female and male participants (see the supplementary material for the results of the comparison between groups), a trend was observed: a higher proportion of women was associated with a larger effect size. The group of studies with more than 60% female participants showed the highest effect size (g = 0.48). This was followed by the studies composed exclusively of female participants (g = 0.46), which also showed the lowest level of variability (I^2 = 48.86%, indicating moderate heterogeneity).

University students between the ages of 18 and 25 were used as participants in just over half of the studies (50.59%, or 43 out of 85) (see **Table 11** for the list of studies). An additional eight studies (9.41%, or 8 out of 85) also identified their participants as university students, although their average age was over 25. Five other studies included participants within the typical university student age range, but described them as “young adults”, aged between 18 and 27, rather than explicitly as students. Finally, nine studies recruited participants from the general public: five of these reported an average participant age over 25, while the remaining four reported an average age under 25 (see **Table 11** for the list of studies not included in this set of meta-analyses, along with the reasons for their exclusion).

A total of six meta-analyses were conducted to study this category (see **Table 12** for a summary of results). The young adult group showed the highest effect size (g = 0.89), indicating a large effect. The effect sizes for both student groups were statistically significant, although it is worth noting that the younger students (aged 18–25) exhibited a stronger and more statistically robust effect than those older than 25 (g = 0.42 vs. g = 0.33). By contrast, in the case of the general public, the results were not statistically significant for the group as a whole (g = 0.29) or for the subgroups of participants over 25 (g = 0.33) or under 25 (g = 0.26). Heterogeneity was considerable across all groups (I^2 = 75%–100%), indicating substantial variability among studies within each group.

Topics and Protagonists of the Immersive Productions

This section examines how the topic of the immersive production and the social group depicted in it may moderate the impact of the immersive experience (see **Table 13** for the list of studies). Immersive productions about people who are marginalized due to their race or ethnicity were found to be the most common among the studies reviewed (40.00%, or 34 of 85). This general category can be subdivided into three groups of topics, the most popular being refugee experiences (50.00%, or 17 of 34), followed by racism against Black people (32.35%, or 11 of 34), and in third place, migration (17.65%, or 6 of 34).

A significant number of studies focused on productions about children as victims (27.06%, or 23 of 85 studies). Within this group, the largest subgroup—representing more than half of it—are studies focusing on immersive productions about refugee children (56.52%, or 13 of 23), with The Displaced (Daily 360, NYT, 2015) and Clouds Over Sidra (Gabo Arora & Chris Milk, 2015) being by far the most popular. Another subgroup consists of four studies examining productions dealing with child mistreatment: three about bullying, and one about parenting and child abuse. A third subgroup consists of three studies analysing productions focused on other types of hardship: two addressing water scarcity in Africa, and one examining a severe cleft lip condition.

The topics themselves are also evaluated in different contexts, such as the context of healthcare. This distinction can be made based on the context of the participants involved in the research. For example, the participants in nine studies were health students (10.59%, or 9 of 85). Three of these studies evaluate immersive experiences about people with schizophrenia, which can be compared to two other studies that evaluate

productions about the same condition outside the healthcare context. Another topic evaluated both within and outside this context is ageism (10.59%, or 9 of 85), with four studies examining this topic within the health context and five studies outside this context. Two of these studies focus on dementia as another example of mental illness, but in this case, one that specifically affects older adults.

Another group identified comprises six studies (7.06%, or 6 out of 85) that evaluate productions addressing various types of disabilities: two studies focus on blindness, one on colour blindness, one on wheelchair users, and two on autism. Both studies addressing the topic of blindness consider the same production, Notes on Blindness: Into Darkness (ARTE France, 2019). Similarly, the two studies dealing with autism both evaluate Too Much Information, a production by the National Autistic Society of Great Britain.

Finally, a group of nine studies was identified (10.59%, or 9 of 85) that address other types of potential stigma-related issues, such as homelessness (five studies), drug or alcohol addiction (three studies), and transgender identity (one study). This group differs from the others in that the responsibility for the stigmatizing condition may be perceived as stemming from the individual's own actions rather than external circumstances. In other words, individuals are often viewed as responsible for their own hardship, and participants may therefore believe that they deserve it to some extent.

A total of ten meta-analyses were conducted for this category (see **Table 14** for a summary of results). The group of studies dealing with topics related to migration, racism, and refugees demonstrated the highest effect size (g = 0.53). Within this group, all effect sizes were statistically significant and relatively similar, although the topic of refugees had a slightly higher effect size (g = 0.56) than the topics of racism against Black people (g = 0.52) and migration (g = 0.50). However, the refugee topic also showed the highest level of heterogeneity, while the only subgroup with moderate heterogeneity was the topic of racism against Black people (I^2 = 44.74%). The next highest effect sizes were found in the groups of studies focusing on individuals with schizophrenia (g = 0.52), children (g = 0.46), and health-related issues (g = 0.42). Disabilities and ageism showed lower but similar effect sizes (g = 0.28 and g = 0.25, respectively), although the effect size for the disabilities group was not statistically significant. The group of studies dealing with populations perceived as responsible for their difficult circumstances showed one of the lowest effect sizes across all meta-analyses (g = 0.09). Indeed, the only statistically significant differences between groups in this category were found for this group, particularly when compared with the group of studies addressing racism, migration, and refugees.

Type of Prosocial Response

This section explores the types of prosocial responses measured in the studies reviewed (see **Table 15** for the list of studies). Just under half of the studies considered a single prosocial response as the dependent variable (45.88%, or 39 out of 85 studies), while slightly more than half considered more than one prosocial response (54.12%, or 46 out of 85). Empathy (k=57) was found to be the most frequently examined prosocial response across the studies reviewed, followed by attitude (k=45). Falling far behind these two were the remaining three responses: behavioural intentions (k=21), the perception of self-other closeness (k=13), and prosocial behaviours (k=9).

The studies that assessed general empathy employed a variety of measurement scales, and no clear trend was identified in the choice of instruments. All of the 28 studies that evaluated dimensions of empathy focused exclusively on the emotional and cognitive dimensions except for one, which also assessed the associative dimension. The emotional dimension was assessed in all studies (k = 28), meaning that whenever the cognitive dimension was evaluated (k = 12), the emotional dimension was also included. Two main trends were identified in the studies assessing the emotional dimension: ten studies used the scale developed by Batson et al. (1997), while eight employed the Empathic Concern subscale of the Interpersonal Reactivity Index (IRI; Davis, 1980, 1983). To assess the cognitive dimension, the most commonly used instrument was the Perspective-Taking subscale of the IRI (k = 6).

Three main patterns were identified in the evaluation of attitudes. The first involves the use of specific scales developed to assess attitudes toward a particular target group. For example, two studies employed the Attitude Toward Disabled Persons Survey (Yuker et al., 1966) to evaluate attitudes toward individuals with disabilities. The second pattern was found in studies that adapted general scales to assess attitudes toward specific target groups. For example, studies adapted the scale developed by Batson et al. (1997) to evaluate attitudes toward individuals with schizophrenia. The third pattern identified involves a common practice of assessing either explicit or implicit prejudice toward outgroup members, with the implicit dimension being evaluated more often (k = 9) than the explicit one (k = 6). While there is no clear consensus regarding the scale that should be used to evaluate explicit attitudes, all of the studies evaluating implicit attitudes employed the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998).

No clear pattern was identified in the assessment of the intention to engage in prosocial behaviours, as the methods used for measuring this response vary widely. For example, some studies assess intention based on participants' willingness to donate money or time, support a cause benefiting a vulnerable group, or share a story on social media. Moreover, prosocial behaviours are most commonly evaluated in terms of monetary donations. The perception of self-other closeness was assessed in all cases using the Inclusion of Other in the Self (IOS) scale (Aron et al., 1992).

Eleven meta-analyses were conducted for this section (see **Table 16** for a summary of results). The first five, broader in scope, assessed the effect sizes associated with each of the five prosocial responses identified. No statistically significant differences were found among the types of prosocial outcomes. However, the empathy group had the highest effect size (g = 0.48), followed by the intention group (g = 0.47), while the attitude group exhibited a more modest effect (g = 0.38), with even lower values observed for the IOS (g = 0.27) and behaviour (g = 0.14) groups. However, the groups with the largest effect sizes — empathy (I2 = 94.16%) and intention (I2 = 94.86%) — showed the greatest variability, whereas the group with the smallest effect size — behaviour (I2 = 22.32%) — exhibited the lowest heterogeneity, indicating a modest but reliable effect with relatively little variability across studies.

The other six meta-analyses focus on the dimensions of empathy and attitude, as well as on the use of different measurement scales. A comparison of the two dimensions of empathy reveals that emotional empathy shows a stronger effect size (g = 0.45) than cognitive empathy (g = 0.20), the latter of which was not statistically significant. Although the use of the IRI to assess the emotional dimension of empathy yielded a higher effect size (g = 0.47) than the use of the Batson scale group (g = 0.34), this result was not statistically significant and exhibited higher variability (I2 = 90.57%). In contrast, the Batson scale group demonstrated low heterogeneity (I2 = 22.75%, 0-25%), making it one of the groups with the lowest variability of all the meta-analyses. Finally, the group of studies that measured implicit attitude using the IAT demonstrated a larger effect size (g = 0.53), higher statistical significance, and slightly more precision than the group that evaluated explicit attitude (g = 0.30), which was not statistically significant. Moreover, the implicit attitude group exhibited only moderate heterogeneity (I^2 = 67.15%) compared to the higher heterogeneity observed in the explicit attitude group (I^2 = 75.58%).

Immersive Media Production Features

This section presents an analysis of the defining features of the immersive productions that serve as media stimuli in the studies reviewed (see **Table 17** for the list of studies). In this respect, it is important to note that one study (Young et al., 2021) evaluated two types of immersive production in their study, which means that a total of 67 productions are considered among the studies drawn from the previous meta-analyses. Another study (Veloso et al., 2024) also created two versions of the same content, using both of the immersive technologies discussed below, thereby adding another production to the update group (k=19), bringing the total to 20 productions. This makes for a combined total of 87 productions reviewed in this section.

Type of Immersive Technology

This review identified two types of immersive technologies: 360-degree video technology, which involves recording reality using 360-degree video cameras; and 3D computer-generated imagery (3D-CGI), consisting of creating 3D environments and the avatars that inhabit them using game engineering software, such as Unity or Unreal Engine. For brevity, the former will be referred to hereinafter simply as 360 and the latter as 3D. The proportion of studies that make use of 360 productions (51.72%, or 45 of 87) is slightly higher than those that evaluate 3D (44.83%, or 39 of 87). The remaining three productions, all of which are from the update group, could not be classified under either category for different reasons. In the first, the immersive environment was developed in 3D, but the content related to the social group depicted was delivered via 2D video, viewable on simulated screens integrated into the walls of the 3D space. In the second, a 3D immersive environment was created, but instead of generating avatars, the production incorporated real images of the characters captured through volumetric video. And the third, could not be classified due to insufficient information regarding the format of the immersive production.

Two meta-analyses were conducted in this section (see **Table 18** for a summary of results). The 360 group demonstrated a slightly larger effect size (g = 0.47) compared to the 3D group (g = 0.39); however, this difference was not statistically significant (p=0.43). Heterogeneity was considerable in both cases, suggesting substantial variability in effect sizes across studies within each group.

Type of Immersive Experience

This section analyses the moderating role played by the type of immersive experience. The type of technology used is a factor that partly determines the type of immersive experience created. While the use of 360 only

supports a three-degrees-of-freedom (3DoF) experience, the use of 3D technology enables a six-degrees-of-freedom (6DoF) experience.

360 Immersive Witnessing (360IW). 3DoF experiences allow receivers to choose their viewing direction at any moment within a filmed 360-degree environment, allowing for directional agency (Williams et al., 2021). This type of immersive experience positions receivers as "observant passive" (Dolan & Parets, 2016) or "observers" (Dooley, 2024), enabling a "witness" role (Nicolae, 2018). Canet and Sánchez-Castillo (2024) identify one of the two main immersive experiences as "immersive witnessing" (IW). This type of immersive experience involves encounters with other people in their own reality: "being there with the other," witnessing their daily lives, and listening to their testimonies narrated in first person.

This review corroborated Canet and Sánchez-Castillo's (2024) finding that IW is the most common type of immersive experience within the 360 group (62.22%, or 28 of 45 studies). This group will be referred to here as 360IW. Empathy (k = 23) is by far the most frequently evaluated prosocial response in the 360IW group. Intention is the second most commonly measured response (k = 10), closely followed by attitude (k = 8). On the other hand, behaviour is the prosocial response assessed the least in the 360IW group (k = 4).

3D Immersive First-Person Experience (3DIFPE). 6DoF experiences provide users with the same features as 3DoF but with the added ability to move around the virtual environment and interact with the objects and characters in it, thereby offering two additional levels of agency: spatial agency and interactive agency (Tucker & Kiss, 2023). This type of immersive experience positions receivers as "participants" (Dolan & Parets, 2016) or "explorers" (Dooley, 2024).

Canet and Sánchez-Castillo (2024) found what they refer to as the "immersive first-person experience" (IFPE) to be the most common type of immersive experience in the 3D group, and their finding is confirmed here (76.92%, or 30 out of 39 studies). These experiences will be referred to here as 3DIFPE. While 360IW is more closely associated with 3DoF experiences, 3DIFPE are more often identified with 6DoF experiences. Rather than just witnessing another person's reality or "being there with the other," 3DIFPE involve "being the other," allowing participants to inhabit a simulated reality from a first-person perspective. For example, while in a 360IW experience the viewer may listen to the testimony of a Black individual who has suffered discrimination, in a 3DIFPE, the participant may embody a Black avatar and directly experience a simulated case of racial discrimination.

In contrast with the 360IW group, the most frequently evaluated prosocial response to 3DIFPEs is attitude (k = 24), followed by empathy (k = 17). Studies analysing this type of experience also measure the perception of self-other closeness (k = 11), an aspect that is never considered in the 360IW group. Conversely, intention is given much less attention in the 3DIFPE group, where it is the fourth most frequently evaluated response (k = 6), while behaviour was evaluated by the fewest studies in both groups (k = 4).

360 Immersive First-Person Experience (360IFPE). Although IFPEs are generally created using game engines such as Unity 3D, this review has also identified cases where it is created using 360-degree video (k = 11), as Canet and Sánchez-Castillo (2024) also found. Unlike 360IW experiences, which reality is filmed primarily in accordance with non-fiction production codes (also referred to in some contexts as virtual reality non-fiction, or VRNF), this type of IFPE, referred to here as 360IFPE, dramatizes that reality from a fictional first-person perspective. Kristofferson et al. (2022) considered both types of 360 experiences in their research. In Study 1, they use a non-fiction production chronicling the life of Nisha, a young girl in India with a severe cleft lip, while in Study 2 they assess a fiction production simulating a shopping experience from the perspective of an 11-year-old child with autism spectrum disorder. Attitude is also the most frequently evaluated prosocial response in studies of 360IFPE productions (k = 7), followed by empathy (k = 6).

Immersive Third-Person Experience (ITPE). The fourth type of immersive experience identified in this review includes media productions (k = 6) that also encourage viewers to adopt the perspective of the other, although they are not presented from a first-person point of view. For example, a production related to the ongoing historical intergroup conflict between Israelis and Palestinians, which is evaluated in three studies, was shot from behind the actors playing a Palestinian couple. In this case, unlike the previous example, the camera is not positioned from the characters' point of view (subjective camera angle) but placed behind them in an over-the-shoulder shot. In their Study 1, Chen et al. (2021a) evaluated a 3DIFPE, while in their Study 2 the same situation is viewed from behind the characters. Since in video games a camera position that offers a view of the scene from behind or slightly above the character is called third-person perspective, this experience is referred to here as an Immersive Third-Person Experience (ITPE). Attitude and empathy are the prosocial responses evaluated the most in the ITPE group, each one being analysed in four studies.

Immersive Self-Intergroup Contact (ISIC). The fifth type of immersive experience identified is comprised of

media productions (k=6) that also focus on intergroup contact, providing participants with the experience of interacting with outgroup members from their own self-perspective, without assuming the other's point of view as described above. In this case, the interaction with outgroup members is facilitated through video games, such as Skyrim, The Sims Social, Hellblade: Senua's Sacrifice; or through VR social network platforms, such as vTime or AltspaceVR. This type of immersive experience is referred to here as Immersive Self-Intergroup Contact (ISIC). Attitude was the primary prosocial response evaluated (k = 4).

Meta-analyses of types of immersive experiences. A total of twenty-four meta-analyses were conducted on the types of immersive experiences (see **Table 19** for a summary of results). No statistically significant differences were found among the five types of immersive experiences identified. Nonetheless, the 360IW group exhibited the highest effect size (g = 0.53), followed by the 3DIFPE group (g = 0.40). The impacts of the other three types were lower and all quite similar: 360IFPE (g = 0.36), ISIC (g = 0.34), and ITPE (g = 0.31). In all cases, the effects were statistically significant. Notably, the first two groups showed very high heterogeneity values, indicating considerable variability across studies. In contrast, the latter three groups exhibited considerably lower heterogeneity, suggesting more precise estimations.

Although the effect size for intention (g = 0.72) in the 360IW group was higher than it was for empathy (g = 0.67), the latter showed a higher level of statistical significance and slightly lower variability than the former. It is worth highlighting a group of seven studies that evaluated the effect of 360IW on empathy toward refugee children (see **Table 20** for the list of studies). This group reported the third-highest effect size in the entire dataset, reaching a large effect (g = 0.81). Although heterogeneity was considerable (I^2 = 86.68%), it was the lowest observed among the empathy-related groups.

In the 3DIFPE group, both empathy (g = 0.59) and attitude (g = 0.37) were quite similar to those observed in the 360IW group. A particularly striking finding was the substantial difference observed for intention, which showed the lowest effect size across all outcomes in this group (g = 0.01) and was not statistically significant (p=0.94). Particularly noteworthy is the effect size reported by the group of five studies that measured implicit racial bias toward Black individuals using the IAT and involved 3DIFPE (see **Table 20** for the list of studies). This group showed the highest effect size (g = 0.68) among those that assessed attitudes, as well as a moderate level of heterogeneity (I^2 = 40.62%).

In the case of the less common types of immersive experiences, it is worth noting that the effects on attitude in both the ISIC group (g = 0.24) and the 360IFPE group (g = 0.24, not statistically significant) were lower than those observed in the 360IW and 3DIFPE groups. Interestingly, however, the effect on attitude in the ITPE group was the highest of all (g = 0.60). It is also noteworthy that while empathy levels in the 360IFPE group were still relatively high (g = 0.54), the effect on empathy in the ITPE group recorded the lowest value (g = 0.31), although it was still statistically significant.

The differences between the two dimensions of empathy are more pronounced in the 360IW group compared to their overall values reported in the previous section. While the effect size for the emotional dimension of empathy (g = 0.50) was slightly higher than its overall value reported in the previous section (g = 0.44), the cognitive dimension showed a substantially lower effect size (g = 0.04 vs. g = 0.20), which was not statistically significant. The effect size for emotional empathy in the 3DIFPE group (g = 0.46) was lower than that of the 360IW group, but slightly higher than the overall value. Only one study in the 3DIFPE group assessed the cognitive dimension of empathy; therefore, no meta-analysis was conducted for this dimension (see **Table 21** for the list of studies).

Experimental Design Model

This section analyses the potentially moderating role of the experimental design proposed in the studies reviewed. In addition to pretest-posttest designs, we identified three distinct types of design models (see **Table 22** for the list of studies).

Immersion Level Comparison Model (ILCM)

Almost half of the studies (48.24%, or 41 of 85) adopt an experimental design aimed at comparing an immersive experience to a less immersive or non-immersive version in terms of prosocial effectiveness. In most cases, the comparison between different levels of immersion involves getting participants to experience the same production on different devices. For example, the same content is viewed either using a VR headset or on the screen of a device (usually a computer screen, although tablets or mobile phones are also sometimes used, or the video may even be projected on a wall). In one case, the production is viewed in 360 degrees, allowing users to alter the field of vision (Screen360). In the other, the production is simply displayed on a screen, without any possibility of interaction (Screen). Thus, while participants in the former can explore the 360º space, participants in the latter can only view the traditional fixed frame. Some studies even compare these three modes: Screen,

Screen360, and VR. In other cases, the comparison is made between a textual version of the production and its consumption using VR headsets. This subgroup also includes studies that propose three conditions: Textual, Screen, and VR.

Perspective-Taking Comparison Model (PTCM)

Immersive experiences that invite participants to take the perspective of outgroup members (3DIFPE, 360IFPE, ITPE) often involve a perspective-taking task, whereby the participant temporarily adopts a different point of view. In this context, another comparative research design model was identified. This model was adopted in eight studies (9.41%, or 8 of 85) with the aim of evaluating the benefits of carrying out perspective-taking tasks in immersive environments compared to traditional methods, such as Mental Perspective Taking (MPT) or Narrative Perspective Taking (NPT). In their study, Ahn et al. (2013) refer to this new media practice as "embodied perspective taking" (EPT), while Herrera et al. (2018) call it "virtual reality perspective taking" (VRPT). Thus, with this immersive media technology, the popular expression of "being in the shoes of" becomes "being in the body of."

Immersive Experience Engagement Comparison Model (IEECM)

Instead of comparing immersive experiences with traditional forms, the third research design model identified compares different ways of engaging in immersive experiences (e.g., avatar customization, conventional or sensorimotor simulation, type of perspective). Thus, in this group, the level of immersion ceases to be the independent variable, with other variables taking on this role. A total of 20 studies were categorized in this group (23.53%, or 20 of 85), whose heterogeneity makes it very difficult to compare them. Despite this, and in relation to the group identified above that measured implicit attitudes toward Black individuals using the IAT, we identified a subgroup of five studies that share a common design: evaluating the prosocial benefits for White participants of embodying a Black avatar (model race).

Meta-Analyses of Experimental Design Models

For this section, three meta-analyses were conducted (see **Table 23** for a summary of results). Although no statistically significant differences were found among the three groups, the IEECM group exhibited the highest effect size (g = 0.48), followed by the ILCM group (g = 0.41). In contrast, the PTCM reported the lowest effect size (g = 0.31) and was the only group that was not statistically significant (p = 0.15). In addition, the IEECM group exhibited moderate heterogeneity (I^2 = 43.71%), whereas the other two groups showed considerable heterogeneity.

Modality Analysis

With the aim of further exploring the effect of the immersion level on prosocial responses, this section presents a modality analysis with a focus on studies that designed their experiments specifically to evaluate the role of the level of immersion as an independent variable. These studies all belong to the first two categories of models reviewed above (ILCM and PTCM). Indeed, two of the six previous meta-analyses (Ma et al., 2023; Nikolaou et al., 2022) restricted their samples to studies that compared the effects of different levels of immersion on prosocial responses, while Lee et al. (2024) consider this variable as a moderator. For the calculation of effect sizes in this modality analysis, the values from the different comparisons for each prosocial response were considered separately. The values of any studies that did not provide the values separately could not be included in these calculations, and conditions that did not strictly address the level of immersion or that evaluated other independent variables were also not considered (see **Table 24** for both these cases).

We identified the use of two different VR headset devices: a high-immersion device, the Head-Mounted Display (HMD), and a lower-immersion option involving a mobile phone inserted into a VR viewer. As these viewers were originally made of cardboard, the term "cardboard viewer" is used in this review to refer to this device condition, although more durable materials have since been used in their construction. As shown in **Table 25**, the most common type of comparison was Screen vs. HMD (ScreenHMD, k = 21), followed by Screen360 vs. HMD (Screen360HMD, k = 11), and Text vs. HMD (TextHMD, k = 6). In other eight studies, the immersive version was experienced using a cardboard viewer and was compared with text screen-based and text-based versions. Additionally, two studies compared HMDs with cardboard viewers. Beyond these combinations, more innovative approaches were introduced in two further studies, which compared a non-interactive HMD version with an interactive one.

Seven meta-analyses were conducted for the modality analysis (see **Table 26** for all related values). ScreenHMD showed the strongest effect size (g = 0.53), which was statistically significant. The use of HMD demonstrated a stronger effect size (g = 0.44) than the use of cardboard viewers (g = 0.15), and the former was statistically significant while the latter was not (p = 0.14). Although the effect size of Screen360HMD (g = 0.28) was close to statistical significance, it did not reach significance (p = 0.08). More surprising were the results for

TextHMD, with an effect size of g = 0.45 that was not statistically significant (p = 0.43). While it might be expected that the advantages of immersive experiences would be shown most clearly when compared to content consumption in text format, the results suggest otherwise. This apparent discrepancy prompted a more in-depth analysis of this group, with a finding that its heterogeneity was the second highest of all groups (I^2 = 98.02%). An analysis of the forest and funnel plots identified three outliers—one from Liu et al. (2023) and two from Kalyanaraman et al. (2010)—that notably deviated from the general pattern (see supplementary material). Although their removal considerably reduced the effect size (g = 0.30), statistical significance was achieved. Moreover, heterogeneity decreased considerably to a moderate level (I^2 = 34.62%), thereby enhancing the overall consistency and precision of the results.

DISCUSSION

Overview of the Meta-Analyses. The first stage of this research involved examining the six meta-analyses and the studies they reviewed. Significant methodological differences were found across these analyses, in areas such as the definitions of immersive media adopted, the types of immersive experience evaluated, the social groups depicted in the productions, and the participant populations involved. In order to facilitate comparisons between homogeneous groups, similar studies were grouped together based on the main trends characterizing the body of research reviewed, setting aside the particularities of each individual meta-analysis. In this way, inclusion and exclusion criteria were established for the studies that would ultimately be included in the meta-analyses conducted in this review. Studies that evaluate prosocial responses toward other people were selected, while those that explore responses related to animals or environmental issues were excluded. More specifically, the focus was on studies dealing with vulnerable people who may be victims of exclusion, discrimination, or stigmatization due to their condition or life circumstances. The productions used as stimuli in the studies were limited to those involving immersive audiovisual experiences using VR headsets, which had to constitute the only activity being evaluated, while the assessment had to be conducted immediately after exposure. Participants in the experimental designs were required to be members of the general population, not belonging to the social group depicted in the production, thereby allowing for the evaluation of prosocial responses toward members of outgroups.

Updating the Existing Meta-Analyses. The second stage involved updating the existing meta-analyses by incorporating studies published over the past two years (2023 and 2024). This resulted in the inclusion of 19 additional studies, which, combined with the 66 identified in the previous meta-analyses, brought the total number of studies in this review to 85. A preliminary analysis of these studies confirmed that the field of immersive media and prosociality is relatively new, as most studies had been published since 2010 and a significant number within the last five years (2020–2024). This updated review has found that although publication numbers peaked in 2021 and then decreased slightly, there was a resurgence in 2024, reflecting growing scholarly engagement with this field of research.

Overall Effect Size. The overall effect size for the meta-analysis group indicates a small-to-moderate, statistically significant impact of immersive media on prosocial responses. However, the high level of heterogeneity suggests considerable variability across studies. Similar trends were observed in previous meta-analyses, which also reported small-to-moderate effect sizes and substantial heterogeneity. The effect size reported in the updated analysis is slightly lower, while heterogeneity is even greater—underscoring the need for cautious interpretation.

Gender of Participants. The findings of this review suggest that participants' gender may moderate the impact of immersive media on prosocial outcomes. While no statistically significant differences were observed between gender-balanced and unbalanced samples, studies with higher proportions of female participants tended to produce larger effect sizes. These findings align with previous research indicating that women are generally more inclined than men to exhibit prosocial behaviour, particularly in terms of empathic responses (e.g., Christov-Moore et al., 2014; Cohn, 1991; Eisenberg & Lennon, 1983; Feingold, 1994; Hoffman, 1977; Thompson & Voyer, 2014). Accordingly, this variable may introduce some positive bias, as our results—like those of Lee et al. (2024)—also confirm the predominance of female participants in the experiments.

Background and Age of Participants. The vast majority of participants were university students between 18 and 25 years of age. Older student populations exhibited weaker effects, while participants drawn from the general public—whether over or under 25—failed to reach statistical significance. These findings suggest that immersive prosocial interventions are currently most effective among younger, university-aged populations. The lack of significant effects among participants from the general public raises concerns about the external validity of existing research, suggesting that results derived from student samples may not be generalizable to broader, more diverse populations.

Topics and Social Groups. The findings of this review also highlight that the nature of the social group depicted in the immersive media productions may moderate participants' prosocial responses. Immersive productions addressing issues related to race, nationality, and migration, particularly those focusing on refugees, yielded the highest effect sizes. This suggests that participants are more likely to exhibit prosocial responses when immersive experiences portray individuals perceived as victims of external circumstances, such as systemic marginalization or displacement. Conversely, topics involving stigmatized groups who may be perceived as responsible for their own hardships, such as individuals experiencing addiction, homelessness, or identifying as transgender, generated the lowest effect size. The statistically significant difference between these groups suggests that the attribution of responsibility may play a potential role in the effectiveness of immersive experiences. In contrast, no statistically significant differences were found based on whether the research was conducted in a healthcare context or not.

Types of Prosocial Responses. We identified five types of prosocial responses, with empathy and attitude being the two most frequently evaluated in the studies reviewed. Although there were no significant differences between the different types of prosocial responses, empathy and intention showed the largest effect sizes. Conversely, prosocial behaviour appeared to be the most difficult response to elicit. Thus, while immersive media seem effective in influencing behavioural intentions, their impact on actual prosocial behaviour is considerably weaker. This discrepancy highlights the well-documented phenomenon in social psychology of the gap between intention and action. Participants may express willingness to engage in prosocial behaviours, such as donating or supporting a cause, but these intentions do not consistently translate into real-world actions. The perception of self–other closeness was assessed only in IFPE, primarily in 3DIFPE, which seems reasonable given that evaluating how close participants feel to the individual whose perspective they are adopting is more meaningful in immersive experiences involving a first-person perspective.

The findings of this study also suggest that the scale used to measure prosocial responses may serve as a moderating factor, influencing both effect sizes and the consistency of results. This is consistent with the findings of Martingano et al. (2021), who identify marginal changes in effect size depending on the specific empathy measures applied. While the effect associated with the Interpersonal Reactivity Index (IRI) was not statistically significant, the effect of the Batson scale was both significant and more consistent, providing more reliable assessments across a diverse range of studies. The latter was used exclusively to evaluate the emotional dimension of empathy, whereas the subscales of the former were employed to assess both emotional and cognitive dimensions, with the full scale also used to measure general empathy. Similarly, in the evaluation of attitudes, implicit measures using the Implicit Association Test (IAT) demonstrated stronger effects and greater precision compared to explicit measures. These findings suggest that immersive media may be particularly effective in influencing implicit biases, even when explicit attitudes remain unchanged, with the moderate heterogeneity observed indicating relatively stable outcomes for future research.

Immersive Technologies. This review confirms the use of two main technologies—360-degree video and 3D computer-generated imagery—in the creation of immersive productions. However, new formats resulting from various forms of hybridization between these two technologies were also identified in recent studies, whose classification into one or the other category is difficult. The impact of the two types of technologies was largely similar, rendering their differentiation in this respect irrelevant. This is consistent with the findings of Canet and Sánchez-Castillo (2024).

Types of Immersive Experiences. This review identified five distinct types of immersive experiences. Notably, 360IW (Immersive Witnessing) and 3DIFPE (Immersive First-Person Experience) were the most frequently examined in the studies reviewed. All five types demonstrated statistically significant effect sizes, with no significant differences observed between them. However, 360IW showed the largest effect size, followed by 3DIFPE. This finding differs slightly from those reported by Canet and Sánchez-Castillo (2024), who, conversely, found a greater effect size for the IFPE group (which included both 3D and 360 productions) than for the 360IW group. Ma et al. (2023) distinguish between intra-diegetic (the participant is situated within the story world, assuming the role of a character) and extra-diegetic proposals (the participant observes the story), which could be compared to IFPE and IW, respectively. Given that Ma et al. limit their study to 360-degree video narratives, their extra-diegetic proposal aligns with the concept proposed here of 360IW, while their intra-diegetic proposal corresponds to 360IFPE. Based on this equivalence, their results align with the finding of the present study, as the extra-diegetic group also showed a greater effect size than the intra-diegetic group. Despite minor discrepancies between these three meta-analyses, no statistically significant differences were found between the two types of immersive experience. Hence, the results suggest that whether one witnesses another's reality or experiences it firsthand is not a determining factor in influencing prosocial responses.

However, given that empathy is the primary response evaluated in the 360IW group and attitude is

predominant in the 3DIFPE group—and that the former exhibited a greater effect than the latter—this may in part explain the observed higher impact of 360IW experiences compared to 3DIFPE. More importantly, the main difference between the two groups lies in the strong impact of 360IW—one of the highest in the dataset—compared to the very low impact of 3DIFPE—the lowest in the dataset—on intention. Nevertheless, this result regarding intention should be interpreted with caution due to the limited number of studies in these two groups (ten and six, respectively), as well as the considerable heterogeneity within the 360IW group.

Among these two types of immersive experiences, we identified two groups of highly similar studies that stand out for their strong impact and serve as representative examples of the defining features of each type. The first group consists of seven studies that evaluated the effect of 360IW on empathy toward refugee children. This group reported the second-highest effect size across the entire dataset. These findings suggest that witnessing the suffering of victims—especially children—in a non-fictional 360-degree environment strongly elicits affective responses toward them. The second group comprises five studies that assessed the effect of 3DIFPEs on implicit bias toward Black individuals, using the Implicit Association Test (IAT). In this case, the effect size ranked among the ten largest overall and was the highest among the attitude-related groups. This finding highlights the unique capacity of immersive experiences to facilitate first-person perspectives through embodied simulations of being others, thereby demonstrating their potential to reduce implicit biases toward outgroup members.

Experimental Design Models. The most common of the three experimental design models identified was the one aimed at assessing the impact of immersion level on prosocial responses (ILCM). However, the Immersive Experience Engagement Comparison Model (IEECM) group emerged as the most consistent and robust, whereas the Perspective-Taking Comparison Model (PTCM) group proved to be the least impactful. These findings suggest that the specific conditions under which immersive experiences are delivered—such as the nature of embodiment or the context of interaction—may be more influential than the distinction between immersive and non-immersive conditions. In particular, they raise questions about the comparative value of traditional perspective-taking methods versus their immersive counterparts.

Modality analysis. We conducted a modality analysis focused solely on studies explicitly designed to assess the impact of immersion level on prosocial responses. Comparing media content on a screen with the same content on HMD yields the strongest and most reliable effect, confirming the advantage that immersive environments have over traditional screen-based media. In contrast, although the difference was very close to statistical significance, the variation between consuming the same content on a screen with access to the full 360-degree view and through an HMD was not substantial enough to produce differences in prosocial responses. Furthermore, the difference between textual consumption and immersive exposure was even less statistically significant. In this case, a possible explanation—beyond the impact of outliers, as discussed in the previous section—may lie in the marked difference between the two media. While the earlier comparisons involved audiovisual formats with varying levels of immersion, in this instance the characteristics of the media differ so significantly that they may elicit different types of responses, potentially moderating the media effect. For example, in the textual version, imagination plays a more central role and may act as a moderator that helps explain the absence of differences in favour of the immersive experience. This interpretation aligns with the weaker results observed—recently discussed in the previous paragraph—among studies comparing traditional imagination-based perspective-taking methods with immersive first-person experiences.

Moreover, our findings suggest that when using phones with VR viewers (cardboard viewer group), the impact of immersive formats is not significantly different from that of the same content viewed in less immersive formats. This result calls into question the practical recommendation made by Ma et al. (2023), who advocated for the use of cardboard viewers for large audiences due to their low cost. It is worth noting in this respect that Ma et al. (2023) categorize studies using phone-based devices as HMD, in contrast to the approach taken in the present study (as discussed above). As a result, they included less immersive devices in the HMD category, potentially diluting the greater impact that HMD might otherwise demonstrate in comparison with the use of cardboard viewers.

Empathy Dimensions: A Focused Discussion. Although the difference between the two dimensions of empathy was not statistically significant, this study found that immersive experiences are more effective in eliciting emotional responses than in fostering cognitive ones, for which the effect size did not reach statistical significance. These findings align more closely with those of Martingano et al. (2021), which reported significant effects on emotional empathy but not on cognitive empathy, than they do with those of Ventura et al. (2020) or Lee et al. (2024), both of which found the opposite pattern. Both Lee et al. (2024) and Ventura and Martingano (2023) suggested that one possible explanation for this discrepancy lies in the type of immersive productions included in the meta-analysis by Martingano et al. (2021). However, as noted above, our meta-analyses only included immersive productions delivered via VR headsets. Moreover, our findings are not biased by the studies

included in Martingano et al.'s work, since— as previously reported—this meta-analysis contributed the lowest percentage of studies to the present review. Therefore, alternative explanations must be considered.

An important limitation of the meta-analysis conducted by Ventura et al. (2020) is that it included only three studies evaluating the cognitive dimension. One of these was the study by Raij et al. (2009), in which the impact on the cognitive dimension was not significantly greater than on the emotional dimension, as significant effects were found for both. Conversely, the other two studies (Van Loon et al., 2018; Wijma et al., 2017) reported a greater impact on the cognitive dimension than on the emotional one. However, both should be interpreted with caution. In the case of Van Loon et al. (2018), the difference between the two dimensions only appeared in the condition where participants embodied a character with whom they would later interact. Moreover, these characters were ingroup members—students from the same campus as the participants (which is why this study was not included in the present review, as noted above). These two factors seem particularly favourable for perspective-taking. Similarly, Wijma et al. (2017) was excluded from this review because the media experience in their study was embedded within a broader intervention program. For this reason, the effects cannot be specifically attributed to the immersive experience, a limitation that was acknowledged even by the authors themselves.

In contrast, the number of effect sizes included in the meta-analysis of the cognitive dimension is not a limitation in Lee et al. (2024), as sixteen were considered. Among these, the Jefferson Scale of Empathy (JSE; Hojat et al., 2009) was the most frequently used instrument to assess this dimension. This is problematic for two reasons. First, the JSE was specifically developed to measure empathy within a particular context—namely, health professions education and patient care—which may be more conducive to eliciting prosocial responses. Second, Lee et al. (2024) coded the JSE as a measure of cognitive empathy, despite exploratory and confirmatory factor analyses conducted by Hojat et al. (2018) identifying three distinct factors: "Perspective Taking," "Compassionate Care," and "Walking in the Patient's Shoes." Therefore, the JSE measures not only the cognitive but also the emotional dimension of empathy and, as such, should have been coded as a measure of general empathy rather than exclusively cognitive empathy. In our sample, two studies used the JSE to assess general empathy. In both cases, pre/post differences following exposure to immersive experiences were statistically significant, indicating enhanced empathy among participants. These findings may suggest a moderating effect of the JSE itself, potentially introducing a positive bias in the results reported by Lee et al. (2024).

Although our results do not align with those of Lee et al. (2024), we agree with their explanation in principle. Immersive technology does have the potential to generate first-person experiences and, in turn, to enhance cognitive empathy. The question, then, is why the IFPEs studied do not produce the expected outcomes in the cognitive dimension. In their analysis of some of the predictors of both dimensions, Bacca-Acosta et al. (2023) find that the lack of embodiment is the main reason why their model identifies less variance in cognitive empathy compared to emotional empathy. The argument that embodied experiences enhance the cognitive dimension is also supported by Ventura and Martingano (2023). By this argument, participants need to perceive themselves as having undergone an embodied experience. This may not occur if, due to technical limitations, the immersive experience does not reach the necessary threshold to give participants the sensation of being in someone else's place. It is worth noting that among the prosocial responses, the effects on the perception of self-other closeness were among the lowest. Another potential hindrance may be that the duration of the experience is too short for the perspective-taking task to produce the intended effect. As Martingano et al. (2021) suggest, cognitive empathy may not be significantly enhanced by a single immersive session.

Moreover, if the immersive experience fails to make participants feel like they are inside the virtual environment and sharing the space with its virtual inhabitants, it is unlikely that they will experience the sensation of embodiment. This feeling, which is known as the sense of presence, has been found to be the primary mediator of the effects of immersive experiences (Canet & Sánchez-Castillo, 2024). A higher level of immersion fosters a stronger sense of presence (Cummings & Bailenson, 2016; Ma et al., 2023). Thus, if the immersive version of a media production cannot give participants a stronger sense of presence than a traditional version of the same production, this would suggest that the two types of media experience are not sufficiently different to attribute any difference in their effects to the level of immersion.

In a media production, the specific technology used is not the only factor that matters, as the content presented also plays a significant role. In the case of the emotional dimension of empathy, it is reasonable to assume that the emotional intensity of the content is particularly important and perhaps even more decisive than the specific features of the technology used. This may also help explain why sometimes no differences are found between different modes of presenting the same content. Moreover, the way the content is presented may influence the emotional intensity of the response. In traditional media formats, for instance, close-up shots are used to convey characters' emotions more clearly. Such proximity, which may elicit a stronger emotional response,

is not as easily achieved in immersive media. Indeed, Liu et al. (2023) demonstrate that the omission from immersive experiences of key emotional stimuli—such as the victim in a bullying scenario—may weaken the participant's empathic response. Conversely, textual narratives—which rely on the participant's imagination to construct the emotional reality, as noted above—may compensate for such visual omissions and thereby maintain or even enhance emotional empathy.

In addition to its emotional intensity, the valence of the content may also play an important role. Stories of misfortune can trigger stronger emotional responses (Feshbach & Feshbach, 2011). The productions evaluated in the studies reviewed contain numerous narratives of suffering, many involving refugee children as underlined above. It cannot be overlooked that the victim's identity and situation may in fact be the key variable that triggers empathy. Various authors have highlighted the significance of the victim, referring to the "identifiable victim effect" (Kogut & Ritov, 2011) and "the tradition of the victim in documentary film" (Winston, 1988). Furthermore, as several studies have demonstrated (e.g., Banakou et al., 2020; Hasler et al., 2017; Patane et al., 2020), the prosocial effect is moderated by the social situation depicted in the virtual simulation. Specifically, negative situations can increase racial bias, while neutral and positive situations can reduce it. Patane et al. (2020) demonstrate that implicit bias decreases more in a cooperative situation than in a neutral one. These findings align with intergroup contact research, demonstrating that positive intergroup representation or interaction reduces prejudice (Pettigrew & Tropp, 2006).

In general terms, it seems clear that appropriate alignment between the content of the production and the specific expressive form of the media format used to present it is the ideal formula for enhancing its effect on participants. However, the early stages of any new media technology may pose challenges that hinder this alignment. In the case at hand, technological limitations, the immaturity of the expressive language, and the novelty of the new technology itself may impede the assimilation of the content and, consequently, its message, thereby reducing its persuasive effect. Several studies reviewed in this research (e.g., Marques et al., 2022; Van Damme et al., 2019) highlight the fact that participants' lack of previous experience with immersive media may lead them to focus more on the novelty of the experience than on the content. Moreover, although the content creators may attempt to guide their attention, the freedom that participants have to look wherever they choose at any given moment may mean that they end up missing important information—a problem that is less likely to occur in traditional media, where the viewing experience is much more controlled.

In short, these factors—which do not affect traditional media formats—may distract participants from the task of making sense of the content, thereby diminishing the impact of the immersive experience. In fact, one of the explanations offered by Ma et al. (2023) for the non-significant effects of immersion level on narrative transportation is the potential distraction associated with immersive experiences that may place more emphasis on the virtual environment than on the narrative content.

LIMITATIONS AND FUTURE RESEARCH

The inclusion criteria for this research narrowed the scope of the analysis, limiting the total number of studies considered from the six meta-analyses. The purpose of this approach was to ensure a higher level of comparability both within and across groups of studies. This review focused exclusively on studies of prosocial responses toward outgroup members who are often victims of exclusion, discrimination, or stigmatization. Research on prosocial responses toward non-stigmatized groups, such as ingroup members or regular patients, were therefore excluded, as were studies of responses to environmental or animal-related issues. This decision was based on the hypothesis that this diversity of groups and issues may elicit very different types of prosocial responses, a hypothesis that could be tested in future reviews.

The findings here suggest that gender dynamics should be more systematically explored in future immersive media research, as they may reveal differences in terms of susceptibilities to prosocial outcomes. Moreover, the predominance of female participants in the studies reviewed could have implications for the generalizability of the results, reflecting a need for more gender-balanced designs. The participants in most of the studies reviewed here were university students between the ages of 18 and 25. Future research could examine studies with more diverse participant samples in order to explore how factors such as age, background, and life experience may mediate prosocial responses to immersive media experiences. For example, future research could examine whether older participants are more reluctant to engage with new technologies or less proficient in their use, potentially diminishing the effectiveness of immersive experiences, as suggested by our results.

Given the common reliance on self-report measures, future research could incorporate alternative methods for assessing prosocial responses, such as brain imaging techniques or biosignals, thereby allowing for a

comparison between subjective and objective measures. Moreover, it has been found that the cognitive dimension has been assessed in far fewer studies, which limits our ability to evaluate it and, more importantly, to compare it with the much more widely studied emotional dimension. This research gap needs to be addressed in order to fully understand the nuanced emotional and cognitive mechanisms involved in immersive experiences. Recent studies have explored new types of productions created by blending different technologies to offer hybrid immersive experiences, as well as emerging forms of immersive media such as augmented reality and extended reality. As these new hybrid approaches were not considered here, future reviews could examine their effects on prosocial responses.

The considerable heterogeneity of group effect sizes—particularly when the number of studies within a group is relatively small—may be the result of a single study skewing the overall effect and the potential interpretation thereof, as the sensitivity of results to such outliers may impact perceptions of the strength and reliability of the prosocial effect. Several groups with substantial heterogeneity were identified in this review, underscoring the need for careful data scrutiny to detect outliers. This issue, which is also common in other meta-analyses with similar outcomes, necessitates cautious interpretation of the results for these groups. Due to space limitations, it was not possible to give full consideration to this question, which could be explored more fully in future research. Moreover, to enhance internal consistency, as well as the replicability and comparability of findings across studies, there is a need for more precise and consistent operational definitions of prosocial responses, more robust theoretical models, and more standardized research methods.

CONCLUSION

The review of the six previous meta-analyses considering the relationship between immersive media and prosociality provided valuable insights into the main trends characterizing research in this area. The overview presented here identifies homogeneous groups of studies, which have served as the foundation for the 68 meta-analyses conducted. This process has also served to refine the definition of prosociality—strictly as responses beneficial to other humans—and to limit the focus of study to immersive audiovisual experiences using VR headsets. Although modest, the overall effect size calculated in this review is consistent with previous research and falls within a range considered practically meaningful in the behavioural and social sciences, reinforcing the potential of immersive media as a valuable tool for promoting prosociality.

The analysis of the social groups depicted in immersive productions underscores the importance of understanding how moral judgments and social perceptions may influence prosocial responses to immersive media experiences. These findings highlight the need for more nuanced experimental designs capable of challenging biases and fostering prosocial responses toward less traditionally “sympathetic” groups. There is a need to examine the extent to which the attribution of responsibility for individuals’ circumstances—and, consequently, the belief that they are not deserving of sympathy—may mediate the prosocial effects of immersive media. Moreover, it is important to move beyond the conventional portrayal of vulnerable individuals solely as victims and to explore new approaches that feature alternative protagonists, such as those who provide help.

The results of this review suggest that the prosocial responses most susceptible to being influenced by exposure to immersive experiences are empathy and intention. As expected, behaviour has proven to be the most difficult prosocial response to influence, which may help explain why it has received the least scholarly attention. Immersive experiences have been found to be more effective at stimulating emotional responses than cognitive ones. As might be expected, the emotional dimension of empathy is more likely to be influenced by brief exposure to an immersive experience than the cognitive dimension. This suggests that the emotional dimension may function more as a situational and automatic response, and is therefore more likely to exhibit immediate changes following media exposure. In contrast, the cognitive dimension involves a slower, more deliberate process for which longer exposure is likely required. These findings thus support the dual-process model of empathy, which posits that certain dimensions of empathy require more time and effort to develop than others (Martingano, 2020; Martingano et al., 2021; Yu & Chou, 2018).

Although our findings do not provide statistical confirmation of the relationship proposed in the introduction between the type of prosocial response and the type of immersive experience, they suggest that witnessing another person’s lived experience in a non-fictional 360-degree environment has a stronger impact on affective responses and behavioural intentions than embodying that experience from a first-person perspective. Nevertheless, the former effect may be more attributable to the nature of the content depicted, while the latter may reflect technological and formal limitations inherent to new media. Thus, although the findings indicate that immersion can have a meaningful impact on prosocial responses, caution is warranted, as other variables may be responsible for moderating or mediating the observed variance in outcomes following the immersive experience. Mostly, we

cannot overlook the possibility that certain prosocial responses are more sensitive to content characteristics than to variations in communication format. Further research is therefore needed to identify the conditions under which confounding variables may influence the effects of immersive media. In other words, there is still much to learn about how immersive media can effectively promote prosociality.

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Appendix

Table 1. Distribution of Publications and Participants per Meta-Analysis

Meta-analysis	Publications	Articles	Percentage	Participants	Up to
Ventura et al	7	7	100%	335	2018
Martingano et al	43	32	72.42%	5,644	2018
Nikolaou et al	16	14	87.50%	1,878	2021
Ma et al	22	16	72.73%	2,608	2022 (July)
Canet and Sánchez-Castillo	37	37	100%	5,390	2022
Lee et al	49	41	83.67%	4,728	2023 (June)
Total	174	147		20,583	

Table 2. List and Details of the Publications Excluded from the Six Meta-Analyses

N	Authors	Year	Title	Reasons	Considered by
1	Cheng et al	2010	Enhancing empathy instruction using a collaborative virtual learning environment for children with autistic spectrum conditions	Participants: people with autism	Martingano et al
2	Kandalaft et al	2013	Virtual reality social cognition training for young adults with high functioning autism	Participants: people with autism	Martingano et al
3	Rice et al	2015	Computer-assisted face processing instruction improves emotion recognition, mentalizing, and social skills in students with ASD	Participants: people with autism	Martingano et al
4	Chen et al	2016	Augmented reality-based video- modeling storybook of nonverbal facial cues for children with autism spectrum disorder to improve their perceptions and judgments of facial expressions and emotions.	Participants: people with autism	Martingano et al
5	Yang et al	2018	Neural mechanisms of behavioral change in young adults with high-functioning autism receiving virtual reality social cognition training: A pilot study.	Participants: people with autism	Martingano et al
6	van Pelt et al.	2022	Dynamic Interactive Social Cognition Training in Virtual Reality (DiSCoVR) for adults with Autism Spectrum Disorder: A feasibility study	Participants: people with autism	Lee et al
7	Wilding et al.	2023	Virtual reality to foster empathy in disability workers: A feasibility study during COVID-19	Participants: disability workers	Lee et al
8	Ahn et al.	2016	Experiencing nature: Embodying animals in immersive virtual environments increases inclusion of nature in self and involvement with nature.	Production about animals	Martingano et al Nikolaou et al
9	Filter et al.	2020	Virtual Reality nature experiences involving wolves on YouTube: Presence, emotions, and attitudes in immersive and nonimmersive settings	Production about animals	Nikolaou et al
10	Kristofferson et al. [S3]	2022	Using virtual reality to increase charitable donations	Production about animals	Ma et al
11	Ahn et al.	2014	Short-and long-term effects of embodied experiences in immersive virtual environments on environmental locus of control and behavior	Production about environmental issues	Nikolaou et al
12	Breves & Hever	2020	Into the wild: The effects of 360 immersive nature videos on feelings of commitment to the environment	Production about environmental issues	Ma et al
13	Breves & Schramm	2021	Into the wild: The effects of 360 immersive nature videos on feelings of commitment to the environment	Production about environmental issues	Ma et al
14	Blythe et al	2021	Fostering ocean empathy through future scenarios	Production about environmental issues	Lee et al
15	Kandaurova & Lee [S2]	2019	The effects of virtual reality (VR) on charitable giving: The role of empathy, guilt, responsibility,	Production about environmental issues	Canet & Sánchez

			and social exclusion		Lee et al
16	Van Loon et al.	2018	Virtual reality perspective-taking increases cognitive empathy for specific others	Students take the perspective of another student from their own university (ingroup contact)	Martingano et al Ventura et al
17	Calvert & Abadia	2020	Impact of immersing university and high school students in educational linear narratives using virtual reality technology	Production about a historical moment in World War II	Lee et al
18	Cutello et al	2021	Evaluating an intervention to reduce risky driving behaviors: Taking the fear out of virtual reality	Production addressing road safety	Ma et al
19	Breves	2021	Biased by being there: The persuasive impact of spatial presence on cognitive processing	Production about fair trade	Ma et al
20	Pressgrove & Bowman	2020	From immersion to intention? Exploring advances in prosocial storytelling	Three productions of hope focused on people who helped with recovery after extreme flood damage in rural communities	Canet & Sánchez
21	Mado et al	2021	Effect of Virtual Reality Perspective-Taking on Related and Unrelated Contexts	Evaluate the extent to which immersive experiences can train skills applicable to unrelated social targets and contexts	Lee et al
22	Muravevskaia & Gardner-McCune	2023	Designing a Virtual Reality Empathy Game framework to create empathic experiences for children	Video game for children based on a traditional Russian fairy tale.	Lee et al
23	Nowak et al	2020	Using immersive virtual reality to improve the beliefs and intentions of influenza vaccine avoidant 18-to-49-year-olds: Considerations, effects, and lessons learned	Evaluation of the benefits of flu vaccination.	Nikolaou et al
24	Han et al	2022	Immersive virtual reality for increasing presence and empathy	Experience of emergency room situations, including evaluation, surgery, and recovery.	Lee et al
25	Hu & Lai	2022	Increasing empathy for children in dental students using virtual reality	Children's experiences during dental visits	Lee et al
26	Thng et al	2022	Combination of Teddy Bear Hospital and Virtual Reality Training increases empathy of medical students	Pediatric patients in general	Lee et al
27	Kim & Chun	2022	Effects of a Patient Experience? Based Virtual Reality Blended Learning Program on Nursing Students	Perioperative patients, referring to individuals in the period surrounding a surgical procedure	Lee et al
28	Ma et al	2021	Feasibility of a Computer Role-Playing Game to Promote Empathy in Nursing Students: The Role of Immersiveness and Perspective	Cancer patients	Lee et al
29	Raij et al	2009	Virtual experiences for social perspective-taking	Cancer patients	Ventura et al
30	Bunn & Terpstra	2009	Cultivating empathy for the mentally ill using simulated auditory hallucinations	Simulation of auditory experiences	Martingano et al
31	Chaffin & Adams	2016	Creating empathy through use of a hearing voices simulation.	Simulation of auditory experiences	Martingano et al
32	Skoy et al	2016	Use of an auditory hallucination simulation to increase student pharmacist empathy for patients with mental illness	Simulation of auditory experiences	Martingano et al

33	Haley et al	2017	Effects of using an advancing care excellence for seniors simulation scenario on nursing student empathy: A randomized controlled trial	Simulation of auditory experiences	Martingano et al
34	Roberts et al	2016	Promoting empathy through immersive learning	360º real space: Dome	Martingano et al
35	Wijma et al	2018	A virtual reality intervention to improve the understanding and empathy for people with dementia in informal caregivers: results of a pilot study	360º real space: experiencing dementia inside a caravan designed to simulate a kitchen	Lee et al Ventura et al
36	Bouchard et al	2016	Empathy toward virtual humans depicting a known or unknown person expressing pain	360º real space: used an immersive cube, where images were retro-projected onto its six faces (similar to CAVE, Cave Automatic Virtual Environment)	Ventura et al
37	Gehlbach et al.	2015	Many ways to walk a mile in another's moccasins: Type of social perspective taking and its effect on negotiation outcomes.	Using a web-browser interface	Martingano et al
38	Kleinsmith et al.	2015	Understanding empathy training with virtual patients	Using a web-browser interface	Martingano et al
39	Lee & Kim	2014	Empathetic video clip experience through timely multimodal interaction	Interactive video clip	Martingano et al
40	Deladisma et al.	2007	Do medical students respond empathetically to a virtual patient?	Interactions with patients through a wall screen	Martingano et al
41	Smith et al.	2017	Evaluation of two different poverty simulations with professional phase pharmacy students	Considered the immersive experience (IE) as a process involving two interventions	Martingano et al
42	Menzel et al.	2014	Effectiveness of a poverty simulation in Second Life: Changing nursing student attitudes toward poor people	Considered the IE as part of a curricular experience delivered three times over a one-year period	Martingano et al
43	Hess et al	2022	The impact and feasibility of a brief, virtual, educational intervention for home healthcare professionals on Parkinson's Disease and Related Disorders: pilot study of I SEE PD Home	Included the IE as part of a daylong event featuring focused lectures, discipline-specific breakout sessions, immersive virtual reality vignettes, and interactive panels.	Lee et al
44	Stargatt et al	2021	The Effects of Virtual Reality-Based Education on Empathy and Understanding of the Physical Environment for Dementia Care Workers in Australia: A Controlled Study	Evaluated the IE as part of a three-hour workshop	Lee et al
45	Sung et al	2022	Effects of a dementia virtual reality-based training with peer support for home care workers: A cluster randomized controlled trial	Incorporated the IE into a VR-based training program consisting of three-month dementia care e-book modules	Lee et al
46	Zare-Bidaki et al	2022	Evaluating the Effects of Experiencing Virtual Reality Simulation of Psychosis on Mental Illness Stigma	Assessed the media effect after a session of theoretical education	Lee et al
47	Lee et al	2023	The Auxiliary Role of Virtual Reality in	Evaluated textual	Lee et al

			Enhancing the Effects of Disaster News on Empathy and Fear: The Mediating Role of Presence	disaster news in combination with a 360-degree video	
48	Freina et al	2017	Evaluation of visuo-spatial perspective taking skills using a digital game with different levels of immersion	Analyzed the effects on visuo-spatial perspective-taking skills	Martingano et al
49	Vannini et al	2011	"FearNot!": A computer-based anti-bullying-programme designed to foster peer intervention	Evaluated prosocial responses, but not in relation to immersive experiences—instead, they examined peer intervention and the differences between new defenders and permanently non-involved students in bullying situations	Martingano et al
50	Seinfeld et al	2017	Offenders become the victim in virtual reality: Impact of changing perspective in domestic violence	Focused their research on the sensitivity index and the recognition of angry and fearful facial expressions	Martingano et al
51	Alvidrez & Peña	2020	Contact in VR: Testing Avatar Customisation and Common Ingroup Identity Cues on Outgroup Bias Reduction	The direct effect on prosocial response was not reported	Canet & Sánchez
52	Ingram et al	2019	Evaluation of a virtual reality enhanced bullying prevention curriculum pilot trial	No data collected immediately after the immersive experience	Martingano et al Lee et al

Table 3. List of the Publications Included from the Six Meta-Analyses

Authors	Year	Title
Adefila et al	2016	myShoes–the future of experiential dementia training?
Ahn et al [S1]	2013	The effect of embodied experiences on self-other merging, attitude, and helping behavior
Banakou et al	2020	Virtual body ownership and its consequences for implicit racial bias are dependent on social context: Body ownership and implicit racial bias
Barreda-Ángeles et al	2020	"An "empathy Machine" or a "just-for-the-Fun-of-It" Machine? Effects of Immersion in Nonfiction 360-Video Stories on Empathy and Enjoyment.
Barreda-Ángeles et al	2021	Development and experimental validation of a dataset of 360°-videos for facilitating school-based bullying prevention programs
Behm-Morawitz et al	2016	The effects of virtual racial embodiment in a gaming app on reducing prejudice
Breves, P	2020	Bringing people closer: The prosocial effects of immersive media on users' attitudes and behavior
Breves, P	2018	Reducing Outgroup Bias through Intergroup Contact with Non-Playable Video Game Characters in VR
Bujic et al	2020	"Empathy machine": how virtual reality affects human rights attitudes
Chen et al [S1] [S2]	2021a	Perspective-taking in virtual reality and reduction of biases against minorities
Chen et al	2021b	The Effect of VR Avatar Embodiment on Improving Attitudes and Closeness Toward Immigrants
Chowdhury et al	2021	VR disability simulation reduces Implicit bias towards Persons with disabilities
Christofi et al	2020	A Virtual Reality Simulation of Drug Users' Everyday Life: The Effect of Supported Sensorimotor Contingencies on Empathy
Cohen et al	2021	Exposure to social suffering in virtual reality boosts compassion and facial synchrony
Cummings et al	2021	Effects of immersive storytelling on affective, cognitive, and associative empathy: The mediating role of presence
D'Errico et al	2020	Prosocial virtual reality, empathy, and EEG measures: A pilot study aimed at monitoring emotional processes in intergroup helping behaviors

Everson et al	2015	Measuring the impact of a 3D simulation experience on nursing students' cultural empathy using a modified version of the Kiersma-Chen Empathy Scale
Formosa et al	2018	Testing the efficacy of a virtual reality-based simulation in enhancing users' knowledge, attitudes, and empathy relating to psychosis
Groom et al	2009	The influence of racial embodiment on racial bias in immersive virtual environments
Gutierrez et al	2013	Fair play: A video game designed to reduce implicit racial bias
Hamilton-Giachritsis et al	2018	Reducing risk and improving maternal perspective-taking and empathy using virtual embodiment.
Hasler et al	2017	Virtual race transformation reverses racial in- group bias
Hasler et al	2021	Virtual reality-based conflict resolution: The impact of immersive 360° video on changing view points and moral judgment in the context of violent intergroup conflict
Hasson et al [S1] [S2]	2019	The enemy's gaze: Immersive virtual environments enhance peace promoting attitudes and emotions in violent intergroup conflicts
Herrera et al [S1] [S2]	2018	Building long-term empathy: A large-scale comparison of traditional and virtual reality perspective-taking
Herrera & Bailenson	2021	Virtual reality perspective-taking at scale: Effect of avatar representation, choice, and head movement on prosocial behaviors
Kalyanaraman et al	2010	The virtual doppelganger: Effects of a virtual reality simulator on perceptions of schizophrenia
Kandaurova & Lee [S1] [S3]	2019	The effects of Virtual Reality (VR) on charitable giving: The role of empathy, guilt, responsibility, and social exclusion
Kristofferson et al [S1] [S2]	2022	Using virtual reality to increase charitable donations
Lesur et al	2020	How Does Embodying a Transgender Narrative Influence Social Bias? An Explorative Study in an Artistic Context
Li & Lee	2022	Emotional personalization in testimonies and modality on emotional valence, presence, empathy, and recall
Liu et al	2023	Using VR to investigate bystander behavior and the motivational factors in school bullying
Ma & Zytko	2021	Designing immersive stories for health: Choosing character perspective based on the viewer's modality
Ma, Z	2020	Effects of immersive stories on prosocial attitudes and willingness to help: testing psychological mechanisms
Ma, Z	2022	The use of immersive stories to influence college students' attitudes and intentions related to drinking and driving
Marques et al	2022	Impact of a Virtual Reality-Based Simulation on Empathy and Attitudes Toward Schizophrenia
Martingano et al	2022	The Limited Benefits of Using Virtual Reality 360° Videos to Promote Empathy and Charitable Giving
McCalla et al	2023	Feasibility of a Cinematic-Virtual Reality Training Program for Health Professional Students: A Single-Arm Pre-Post Study
Oh et al [S1] [S2]	2016	Virtually old: Embodied perspective taking and the reduction of ageism under threat.
Papadopoulos et al	2021	A visit with Viv: Empathising with a digital human character embodying the lived experiences of dementia
Patane et al	2020	Exploring the Effect of Cooperation in Reducing Implicit Racial Bias and Its Relationship with Dispositional Empathy and Political Attitudes
Peck et al	2013	Putting yourself in the skin of a black avatar reduces implicit racial bias
Peña et al	2021	Virtual Reality and Political Outgroup Contact: Can Avatar Customization and Common Ingroup Identity Reduce Social Distance?
Pimentel et al	2021	Voices of the unsung: The role of social presence and interactivity in building empathy in 360 video
Schutte & Stilinovic	2017	Facilitating empathy through virtual reality
Shin, D	2018	Empathy and embodied experience in virtual environment: To what extent can virtual reality stimulate empathy and embodied experience?
Steinfeld, N	2020	To be there when it happened: Immersive journalism, empathy, and opinion on sexual harassment
Sundar et al	2017	Being there in the midst of the story: How immersive journalism affects our perceptions and cognitions
Tassinari et al	2022	Investigating the Influence of Intergroup Contact in Virtual Reality on Empathy: An

		Exploratory Study Using AltspaceVR
Theriault et al	2021	Body swapping with a Black person boosts empathy: Using virtual reality to embody another
Tong et al	2020	Designing a Virtual Reality Game for Promoting Empathy Toward Patients With Chronic Pain: Feasibility and Usability Study
Tsao et al	2020	Design, development, and evaluation of a virtual aging simulation system
Van Damme et al	2019	360 video journalism: Experimental study on the effect of immersion
Ventura et al	2021	How Does It Feel to Be a Woman Victim of Sexual Harassment? The Effect of 360 Video-Based Virtual Reality on Empathy and Related Variables
Walewijns et al	2023	To give or not to give: Examining the prosocial effects of a 360◦ video endorsing a clean water charity
Wang et al	2022	Walk in my shoes: How perspective-taking and VR enhance telepresence and empathy in a public service announcement for people experiencing homelessness
Wu et al	2021	Immersive virtual reality news: A study of user experience and media effects
Yang & Zhang	2022	Presence and flow in the context of virtual reality storytelling: What influences enjoyment in virtual enviroments?
Yoo & Drumwright	2018	Nonprofit fundraising with virtual reality
Young et al	2021	Exploring virtual reality for quality immersive empathy building experiences

Table 4. Search Strings Conducted and Their Results

Search string	k
TI=((“virtual reality”) AND (empathy)) OR AB=((“virtual reality”) AND (empathy)) OR AK=((“virtual reality”) AND (empathy))	147
TI=(("immersive virtual environment" OR “virtual reality”) AND (empathy)) OR AB=(("immersive virtual environment" OR “virtual reality”) AND (empathy)) OR AK=(("immersive virtual environment" OR “virtual reality”) AND (empathy))	148
TI=(("360* video*" OR “virtual reality”) AND (empathy)) OR AB=(("360* video*" OR “virtual reality”) AND (empathy)) OR AK=(("360* video*" OR “virtual reality”) AND (empathy))	148
TI=(("immersive media" OR “virtual reality”) AND (empathy)) OR AB=(("immersive media" OR “virtual reality”) AND (empathy)) OR AK=(("immersive media" OR “virtual reality”) AND (empathy))	150
TI=(("immersive media" OR “virtual reality”) AND (prosocial* OR empathy)) OR AB=(("immersive media" OR “virtual reality”) AND (prosocial* OR empathy)) OR AK=(("immersive media" OR “virtual reality”) AND (prosocial* OR empathy))	165
TI=(("immersive media" OR “virtual reality”) AND (prosocial* OR “reduc* bias” OR “attitudinal change” OR “donation intention” OR “donation behavi*” OR charity OR “charitable giving” OR empathy)) OR AB=(("immersive media" OR “virtual reality”) AND (prosocial* OR “reduc* bias” OR “attitudinal change” OR “donation intention” OR “donation behavi*” OR charity OR “charitable giving” OR empathy)) OR AK=(("immersive media" OR “virtual reality”) AND (prosocial* OR “reduc* bias” OR “attitudinal change” OR “donation intention” OR “donation behavi*” OR charity OR “charitable giving” OR empathy))	171

Table 5. List and Details of the Publications Excluded from the Updating

N	Authors	Year	Title	Reasons
1	Adria, M	2024	How to Worship in the Metaverse: Religious Experience and the Affordances of a New Medium	No experimental design
2	Al Yahyaei, A	2024	Reserving the human touch in nursing education while integrating virtual reality and simulation	No experimental design
3	Aydi & Elleuch	2024	Design of Virtual Reality Based Game for Dual Enhancement of City Monuments and Brand Image	No experimental design
4	Bahng et al	2023	Designing immersive stories with novice VR creators: a study of autobiographical VR storytelling during the COVID-19 pandemic	No experimental design
5	Becker & Lago	2023	Immersive Journalistic Narratives (IJNS)	No

				experimental design
6	Bedard, P	2024	Making room for empathy in contemporary virtual reality cinema	No experimental design
7	Block et al	2023	Educational 360-video development for clinical practice improvement toward Deaf and Hard-of-Hearing Population	No experimental design
8	Chauvel et al	2023	Changes in the empathy of fourth-year French medical students following a mandatory module on doctor-patient relationships	No experimental design
9	Collier et al	2023	The Development and Feasibility of an Empathy Virtual Reality Scenario in Healthcare Education	No experimental design
10	Creed, C et al	2024	Inclusive Augmented and Virtual Reality: A Research Agenda	No experimental design
11	Creed, C et al	2024	Inclusive AR/VR: accessibility barriers for immersive technologies	No experimental design
12	de Jong, S	2023	Empathy and Embodiment in VR Experiences of Former Nazi Concentration and Extermination Camps	No experimental design
13	Farmer, H	2023	Reducing dehumanisation through virtual reality: prospects and pitfalls	No experimental design
14	Fawzy, RM	2024	VR as a metaleptic possible world of global citizenship embodiment: a cognitive stylistic approach	No experimental design
15	Fawzy & ElSamadoni	2024	An Umwelt-to-Umwelt Rhythmical Interaction: A Biosemiotic Reading of Cultural Embodiment in the Context of Humanitarian VR	No experimental design
16	Gaspich & Han	2024	Immersive media and its influences on design thinking	No experimental design
17	Gordon et al	2024	Moral enhancement and cheapened achievement: Psychedelics, virtual reality and AI	No experimental design
18	Hernandez-Rodriguez, JC	2023	Theoretical model for reality journalism research (MVRJR): the user's journey through an immersive news experience	No experimental design
19	Jeon et al	2024	Immersive virtual reality game for cognitive-empathy education: Implementation and formative evaluation	No experimental design
20	Kim et al	2024	Using immersive virtual reality in testing empathy type for adolescents	No experimental design
21	Kizhevska et al	2024	Protocol of the study for predicting empathy during VR sessions using sensor data and machine learning	No experimental design
22	Kurian & Hajir	2024	Should we stop talking about empathy?: Virtual reality, refugee children and the ethics of technology-mediated moral education	No experimental design
23	Lewis et al	2024	Writing research-based theatre on aged care: the ethnodrama, After Aleppo	No experimental design
24	Lin & Hsu	2023	The new ethical thinking in CGI immersive journalism	No experimental design

25	Lucifora et al	2023	Virtual reality supports perspective taking in cultural heritage interpretation	No experimental design
26	Manz & Long	2024	Internment, immersive technology and historical empathy: Natal's Fort Napier Camp (1914-1919) as a virtual reality experience	No experimental design
27	Mattsson et al	2024	Nursing Students' Experiences of Empathy in a Virtual Reality Simulation Game	No experimental design
28	Messeri, L	2024	Putting Big Tech in its place: A view of the virtual from Los Angeles	No experimental design
29	Murphy et al	2023	A human-centred systems manifesto for smart digital immersion in Industry 5.0: a case study of cultural heritage	No experimental design
30	Orduna et al	2023	Methodology to Assess Quality, Presence, Empathy, Attitude, and Attention in 360-degree Videos for Immersive Communications	No experimental design
31	Paudel et al	2024	A Survey on Identifying Empathic Expression in Remote Collaboration From Empathic Computing	No experimental design
32	Pérez et al	2024	User reviews of the impact of immersive media experiences: A qualitative content analysis of user comments about Traveling While Black	No experimental design
33	Pinto-Coelho et al	2023	Inclusion and adaptation beyond disability: Using virtual reality to foster empathy	No experimental design
34	Rambaree et al	2023	Enhancing Cultural Empathy in International Social Work Education through Virtual Reality	No experimental design
35	Reis, AB	2023	Immersive media and social change : The 'empathy machine' is dead, long live 'emotional geography'!	No experimental design
36	Roberts et al	2024	Stepping Up Psychosis: The Use of Virtual Reality in Pre-registration Mental Health Nursing Education	No experimental design
37	Ryu, S	2024	Facing, mirroring and echoing in human-avatar symbiosis	No experimental design
38	Szilak, I	2024	Exploring the Ethical Dimensions of Virtual Production: Lessons from Queerskins: Fly Angel Soul	No experimental design
39	Taguchi, N	2023	Using immersive virtual reality for the assessment of intercultural conflict mediation	No experimental design
40	Thomson et al	2024	Experiencing COVID-19 Through the Patient Lens to Promote Empathy: Pilot Testing a Virtual Reality Learning Opportunity	No experimental design
41	Torres et al	2024	Scientific virtual reality as a research tool in prehistoric archaeology: the case of Atxurra Cave (Northern Spain)	No experimental design
42	Trevena et al	2024	Could virtual reality training be effective for enhancing empathetic behaviours in disability support worker training	No experimental design
43	Turpin et al	2024	Towards a Co-Creative Immersive Digital Storytelling Methodology to Explore Experiences of Homelessness in Loughborough	No experimental design

44	Uhm et al	2024	First-Person Experience in Virtual Reality Sport Advertisements: Transportation of Embodied Empathy	No experimental design
45	Yekani et al	2024	Research Paper Introducing a New Method for Studying the Effects of Movement Synchrony in Virtual Reality	No experimental design
46	Zahiu et al	2023	Empathy training through virtual reality: moral enhancement with the freedom to fall?	No experimental design
47	Badger et al	2023	Developing a virtual reality environment for educational and therapeutic application to investigate psychological reactivity to bullying	No focused on prosocial outcome or immersive media
48	Dzardanova et al	2024	Exploring the impact of non-verbal cues on user experience in immersive virtual reality	No focused on prosocial outcome or immersive media
49	Guan et al	2024	From experience to empathy: An empathetic VR-based learning approach to improving EFL learners' empathy and writing performance	No focused on prosocial outcome or immersive media
50	Gupta et al	2024	CAEVR: Biosignals-Driven Context-Aware Empathy in Virtual Reality	No focused on prosocial outcome or immersive media
51	Hernández-Rodríguez & García-Perdomo	2023	I enjoy 360° video news more, but understand them less! Gratification gained in virtual reality journalism research	No focused on prosocial outcome or immersive media
52	Hoogesteyn et al	2023	Rapport-building: Chat versus in-person witness interviews	No focused on prosocial outcome or immersive media
53	Hou et al	2024	Harnessing Virtual Reality to Influence Attitudes Toward Beef Consumption: The Role of Empathy in Dietary Interventions	No focused on prosocial outcome or immersive media
54	Hsiung et al	2024	Metaverse in the Military: Using Virtual Reality to Enhance Awe Emotions and Prosocial Behaviors Among Cadets	No focused on prosocial outcome or immersive media
55	Hsu et al	2024	Bridging the Gap: Virtual Reality as a Tool for De-Escalation Training in Disability Support Settings	No focused on prosocial outcome or immersive media
56	Jin et al	2024	Observing heroic behavior and its influencing factors in immersive virtual environments	No focused on prosocial outcome or immersive media
57	Jin et al	2024	Comparative Study of HMD-based Virtual and Augmented Realities for Immersive Museums: User Acceptance, Medium, and	No focused on prosocial outcome or

			Learning	immersive media
58	Jin et al	2024	Evaluating User Engagement and Preference in Virtual Reality and Augmented Virtuality for Interactive Storytelling	No focused on prosocial outcome or immersive media
59	Kiuchi et al	2024	An Exploratory Study of the Potential of Online Counseling for University Students by a Human-Operated Avatar Counselor	No focused on prosocial outcome or immersive media
60	Li et al	2024	The Impact of Cue-Interaction Stimulation on Impulse Buying Intention on Virtual Reality Tourism E-commerce Platforms	No focused on prosocial outcome or immersive media
61	Lin et al	2024	Can virtual reality technology be used for empathy education in medical students: a randomized case-control study	No focused on prosocial outcome or immersive media
62	Lin et al	2024	Helping others and improving myself: The effects of natural- and supernatural-based awe in virtual reality	No focused on prosocial outcome or immersive media
63	Mahling et al	2023	Virtual Reality for Emergency Medicine Training in Medical School: Prospective, Large-Cohort Implementation Study	No focused on prosocial outcome or immersive media
64	Moreno et al	2023	Diminished vagally mediated heart rate variability in a compassion-eliciting task in intimate partner violence offenders	No focused on prosocial outcome or immersive media
65	Naqvi et al	2024	The Dual Importance of Virtual Reality Usability in Rehabilitation: A Focus on Therapists and Patients	No focused on prosocial outcome or immersive media
66	Qin & Guo	2024	Classifying and Validating Metahuman Service Quality Dimensions: A Mixed-Method Study	No focused on prosocial outcome or immersive media
67	Ramchandani et al	2024	Effects of bimanual vs unimanual motor actions on consumer behavior intention and attitude	No focused on prosocial outcome or immersive media
68	Ryu & Yu	2023	Virtual Reality Simulation for Advanced Infection Control Education in Neonatal Intensive Care Units: Focusing on the Prevention of Central Line-Associated Bloodstream Infections and Ventilator-Associated Infections	No focused on prosocial outcome or immersive media
69	Sakuma et al	2023	Immersive role-playing with avatars leads to adoption of others' personalities	No focused on prosocial outcome or immersive

				media
70	Salehi et al	2024	A Theoretical and Empirical Analysis of 2D and 3D Virtual Environments in Training for Child Interview Skills	No focused on prosocial outcome or immersive media
71	Szita et al	2024	Going to the movies in VR: Virtual reality cinemas as alternatives to in-person co-viewing	No focused on prosocial outcome or immersive media
72	Tsekhmister et al	2023	Virtual Reality in EU Healthcare: Empowering Patients and Enhancing Rehabilitation	No focused on prosocial outcome or immersive media
73	Villmore et al	2024	Teaching empathy: comparison of a virtual reality experience using head-mounted display versus group streaming	No focused on prosocial outcome or immersive media
74	Williams et al	2024	Virtual reality training for crisis communication: Fostering empathy, confidence, and de-escalation skills in library and information science graduate students	No focused on prosocial outcome or immersive media
75	Yang et al	2023	Cognitive and motor skill competence are different: Results from a prospective randomized trial using virtual reality simulator and educational video in laparoscopic cholecystectomy	No focused on prosocial outcome or immersive media
76	Yang et al	2023	Virtual Fitting Room Effect: Moderating Role of Body Mass Index	No focused on prosocial outcome or immersive media
77	Yang, SR	2023	Sentiment and Storytelling: What Affect User Experience and Communication Effectiveness in Virtual Environments?	No focused on prosocial outcome or immersive media
78	Yang et al	2024	Exploring sex differences in collaborative virtual environments for participation equality and user experience	No focused on prosocial outcome or immersive media
79	Abrams et al	2024	Virtual Reality-Based Simulated Hallucinations to Enhance Empathy Toward Individuals With Schizophrenia	Part of a program or intervention
80	Cheung et al	2024	Effect of narrative videos and mini-VR games in nursing smoking cessation training on empathy and self-efficacy of smoking cessation counseling: A randomized controlled trial	Part of a program or intervention
81	Festari et al	2024	Virtual Reality Combined With Psychoeducation to Improve Emotional Well-Being in Informal Caregivers of Alzheimer's Disease Patients: Rationale and Study Design of a Randomized Controlled Trial	Part of a program or intervention
82	Festari et al	2024	Does virtual reality increase the emotional well-being benefits of online	Part of a program or

			psychoeducation? Preliminary results in informal caregivers of people with Alzheimer's disease	intervention
83	Garza et al	2024	Assessing the effectiveness of virtual reality to promote empathy for patients through a mixed-methods study	Part of a program or intervention
84	Green et al	2024	Understanding Expressions of Self-Determination Theory in the Evaluation of IDEA-Themed VR Storytelling	Part of a program or intervention
85	Liu et al	2024	The Effects of Immersive Virtual Reality-Assisted Experiential Learning on Enhancing Empathy in Undergraduate Health Care Students Toward Older Adults With Cognitive Impairment: Multiple-Methods Study	Part of a program or intervention
86	Morganti et al	2024	Virtual Reality-Based Psychoeducation for Dementia Caregivers: The Link between Caregivers' Characteristics and Their Sense of Presence	Part of a program or intervention
87	Wu et al	2024	Effects of a dementia educational programme using virtual reality on nurses in an acute care hospital: A pre-post comparative study	Part of a program or intervention
88	Hall & Walmsley	2023	Technology-enhanced learning in orthopaedics Virtual reality and multi-modality educational workshops may be effective in the training of surgeons and operating department staff	Part of a program or intervention
89	Wardian et al	2023	Creating Patient Context: Empathy and Attitudes Toward Diabetes Following Virtual Immersion	Part of a program or intervention
90	Lee et al	2023	The Auxiliary Role of Virtual Reality in Enhancing the Effects of Disaster News on Empathy and Fear: The Mediating Role of Presence	Part of a program or intervention
91	Lee & Kang	2024	The interplay of virtual reality and narrative story in disaster journalism through empathy, transportation, and identification	Part of a program or intervention
92	Huang & Macgilchrist	2024	From physical feelings to empathy: An immersive virtual reality approach to facilitate physical empathy	Part of a program or intervention
93	Rehl et al	2024	Feasibility of a cinematic-virtual reality training program about opioid use disorder for osteopathic medical students: a single-arm pre-post study	2D videos
94	Salazar et al	2023	Study protocol for a randomized controlled trial of RealConsent2.0: a web-based intervention to promote prosocial alcohol-involved bystander behavior in young men	Web-based intervention
95	Venkatesan & Wang	2023	Feeling Connected: The Role of Haptic Feedback in VR Concerts and the Impact of Haptic Music Players on the Music Listening Experience	Auditory experience
96	Dinh et al	2023	Perceptions About Augmented Reality in Remote Medical Care: Interview Study of Emergency Telemedicine Providers	Augmented reality
97	Girginova et al	2024	Augmented Landscapes of Empathy: Community Voices in Augmented Reality Campaigns	Augmented reality
98	Huang et al	2024	The effects of augmented reality on prosocial behavior intentions in the	Augmented reality

			disaster news context: The mediating role of physical presence and empathy	
99	Laska-Lesniewicz et al	2023	Working on empathy with the use of extended reality scenarios: the Mr. UD project	Extended reality
100	Alqallaf et al	2024	Empathy, Education, and Awareness: A VR Hackathon's Approach to Tackling Climate Change	Environmental issues
101	Fauville et al	2024	Underwater virtual reality for marine education and ocean literacy: technological and psychological potentials	Environmental issues
102	Hegde, A	2024	Digital Nations and the Future of the Climate Crisis	Environmental issues
103	Shin & Lee	2024	Harnessing 360-Degree Video to Prompt Users to Think Along With Pro-Environmental Campaign Messages	Environmental issues
104	Xie & Yang	2024	Use of immersive virtual reality in environmental education: effects on environmental empathy, skill transfer, and attitudes	Environmental issues
105	Kim et al	2023	Constructing a Mixed Simulation With 360° Virtual Reality and a High-Fidelity Simulator Usability and Feasibility Assessment	Health field not related to vulnerable people
106	Sansoni et al	2023	Looking Through Your Eyes: Using Immersive Virtual Reality to Promote Well-Being among Cancer Survivors and Their Partners	Health field not related to vulnerable people
107	Scandola et al	2024	Topographic mapping of the sensorimotor qualities of empathic reactivity: A psychophysiological study in people with spinal cord injuries	Non-regular participants (People with paraplegia)
108	Abellán et al	2024	Immersive documentary journalism: exploring the impact of 360° virtual reality compared with a 2D screen display on the responses of people toward undocumented young migrants to Spain	Not report valid data for meta-analysis
109	Dario & Saginor	2024	Exploration of a virtual reality exercise to help train police with responding to mental health crises in the community	Not report valid data for meta-analysis
110	Raposo et al	2023	Incresing awareness and empathy among university students through immersive experiences-Testing of the virtual reality application: a pilot study	Not report valid data for meta-analysis
111	Trudeau et al	2024	The Power of Storyliving: A Study of Adolescent Students' Responses to Cinematic Virtual Reality in a School Library Setting	Not report valid data for meta-analysis

Table 6. Years of Publication of the Final Pool of Studies

Year	k
2009	1
2010	1
2013	2
2015	1
2016	3
2017	3
2018	6
2019	4
2020	12

2021	16
2022	7
2023	9
2024	13
Total	78

Table 7. List of the Publications Included from the Updating

Authors	Year	Title
Alieldin et al	2024	Effectiveness of immersive virtual reality in teaching empathy to medical students: a mixed methods study
Anderson et al	2024	Virtual reality education on myalgic encephalomyelitis for medical students and healthcare professionals: a pilot study
Bacca-Acosta et al	2023	Insights into the Predictors of Empathy in Virtual Reality Environments
Borah et al	2024	Political ideology and the intention to donate in the case of the Syrian refugee crisis
Branham, L	2024	Virtual Immersive Contact: A Field Experiment to Reduce Prejudice and Discrimination in Central African Republic
Chen & Ibasco	2023	All it takes is empathy: how virtual reality perspective-taking influences intergroup attitudes and stereotype
Dunivan et al [S1][S2]	2024	Expanding the empirical study of virtual reality beyond empathy to compassion, moral reasoning, and moral foundations
Gugenishvili & Nyström	2024	Virtual Reality and Charitable Giving: The Influence of Space, Presence, and Attention
Heap et al	2024	Experiencing Virtual Reality for Perspective-Taking of Blind and Visually Impaired Learners
Lee & Li	2023	So far yet so near: Exploring the effects of immersion, presence, and psychological distance on empathy and prosocial behavior
Lem et al	2024	Exploring the impact of immersive virtual reality on depression knowledge and stigma reduction: a cross-over RCT fMRI study
Li et al	2024	How Virtual Reality Can Increase Effectiveness of Prosocial Advertising Put Yourself in the Donee's Shoes: The Effect of Virtual Reality on Charitable Donations
Martínez, FJ	2024	The Stigma Machine: A Study of the Prosocial Impact of Immersive VR Narratives on Youth in Spain and Canada
Mason & Westhead	2023	Senua's psychosis in virtual reality: effects on mental health stigma
Phillips et al	2024	A study of virtual reality and the empathetic experience in Australian secondary students
Quay & Ramakrishnan	2023	Innovative Use of Virtual Reality to Facilitate Empathy Toward Older Adults in Nursing Education
Schlagowski et al	2024	The feeling of being classified: raising empathy and awareness for AI bias through perspective-taking in VR
Veloso et al	2024	Using Immersive Environments in E-Mental Health Rehabilitation Programs Directed to Future Health Professionals to Promote Empathy and Health Literacy about Schizophrenia.

Table 8. Summary of Results from the Reviewed Meta-Analyses

Meta-analysis	k	Effect size	CI	I2
Martingano et al	51	0.43	0.31-0.55	86.81%
Nikolaou et al	24	0.21	0.08-0.34	45.00%
Canet and Sánchez-Castillo	43	0.33	0.27-0.39	76.56%
Lee et al	49	0.46	0.33-0.59	75.9%

Table 9. Gender of Participants

Authors	Year	Gender (Female)
Ventura et al	2021	0%
Tong et al.	2020	22%
Chowdhury et al	2021	34%
Lem et al	2024	41%
Li & Lee	2019	41%

Schlagowski et al	2024	41%
Branham, L	2024	45%
Young et al	2021	45%
Phillips et al	2024	45%
Herrera & Bailenson	2021	45%
Kristofferson et al [S2]	2022	46%
Dunivan et al [S1]	2024	46%
Chen et al [S1]	2021a	46%
Christofi et al	2020	48%
D'Errico et al	2020	48%
Liu et al	2023	48%
Kristofferson et al [S1]	2022	48%
Ma & Zytko	2021	50%
Breves	2018	50%
Ahn et al [S1]	2013	50%
Bacca-Acosta et al	2023	50%
Shin	2018	50%
Tsao et al	2020	50%
Yoo & Drumwright	2018	50%
Yang & Zhang	2022	50%
Barreda-Ángeles et al	2021	51%
Martingano et al	2022	53%
Alieldin et al	2024	53%
Van Damme et al	2019	53%
Chen et al [S2]	2021a	53%
Barreda-Ángeles et al	2020	54%
Gugenishvili & Nyström	2024	54%
Li et al	2024	54%
Lee & Li	2023	55%
Ma	2020	55%
Oh et al [S2]	2016	55%
Kalyanaraman et al	2010	56%
Formosa et al	2018	56%
Herrera et al [S2]	2018	57%
Ma	2022	57%
Kandaurova & Lee [S1]	2019	58%
Lesur et al	2020	58%
Wu et al	2021	58%
Schutte & Stilinović	2017	58%
Chen et al	2021b	59%
Groom et al	2009	60%
Chen & Ibasco	2023	61%
Papadopoulos et al	2021	61%
Heap et al	2024	62%
Behm-Morawitz et al	2016	63%
Steinfeld	2020	64%
Herrera et al [S1]	2018	64%
Oh et al [S1]	2016	64%
Bujic et al	2020	67%
Anderson et al	2024	67%
Patane et al	2020	68%
Dunivan e al [S2]	2024	68%
Borah et al	2024	69%

Hasler et al	2021	71%
Hasson et al [S2]	2019	71%
Stavroulia & Lanitis	2023	71%
Theriault et al	2021	71%
Wang et al	2022	72%
Kandaurova & Lee [S3]	2019	73%
Walewijns et al	2023	75%
Breves	2020	75%
Hasson et al [S1]	2019	77%
Veloso et al	2024	77%
Sundar et al	2017	78%
Marques et al	2022	80%
Pimentel et al	2021	82%
McCalla et al.	2023	83%
Cummings et al	2021	84%
Everson et al	2015	88%
Quay & Ramakrishnan	2023	93%
Banakou et al	2020	100%
Hamilton-Giachritsis et al	2018	100%
Peña et al	2021	100%
Cohen et al	2021	100%
Mason & Westhead	2023	100%
Hasler et al	2017	100%
Peck et al	2013	100%
Adefila et al	2016	ns
Martínez	2024	ns
Tassinari et al	2022	ns

Table 10. Meta-Analysis Results: Gender of Participants

Gender	k (total)	k (meta-analysis group)	k (update group)	Effect size	p	I2
40-59%	42	32	10	0.36	0,000005	85.00
>60%	30	23	7	0.48	0,000003	85.95
100% female	7	6	1	0.46	0,004759	48.86

Table 11. Age of Participants

Authors	Year	Participants	Age	Reasons
Dunivan et al [S1]	2024	Students	18,8	
Ma	2022	Students	19,1	
Kristofferson et al [S2]	2022	Students	19,3	
Ma	2020	Students	19,4	
Schutte & Stilinović	2017	Students	19,9	
Pimentel et al	2021	Students	19,9	
Dunivan e al [S2]	2024	Students	20,0	
Chowdhury et al	2021	Students	20,3	
Peña et al	2021	Students	20,3	
Kandaurova & Lee [S3]	2019	Students	20,4	
Sundar et al	2017	Students	20,4	
Wang et al	2022	Students	20,5	
Kandaurova & Lee [S1]	2019	Students	20,6	
Cummings et al	2021	Students	20,8	

Authors	Year	Participants	Age	Reasons
Li et al	2024	Students	20,9	
Breves	2018	Students	21,0	
Behm-Morawitz et al	2016	Students	21,0	
Oh et al [S1]	2016	Students	21,0	
McCalla et al.	2023	Students	21,1	
Marques et al	2022	Students	21,2	
Kristofferson et al [S1]	2022	Students	21,2	
Veloso et al	2024	Students	21,2	
Breves	2020	Students	21,7	
Alieldin et al	2024	Students	22,0	
Ma & Zytko	2021	Students	22,1	
Kalyanaraman et al	2010	Students	22,3	
Chen et al	2021b	Students	22,4	
Ahn et al [S1]	2013	Students	22,6	
Lee & Li	2023	Students	22,6	
Li & Lee	2019	Students	22,8	
Herrera et al [S1]	2018	Students	22,9	
Schlagowski et al	2024	Students	23,3	
Cohen et al	2021	Students	23,6	
D'Errico et al	2020	Students	23,8	
Hasson et al [S2]	2019	Students	23,9	
Hasson et al [S1]	2019	Students	23,9	
Steinfeld	2020	Students	24,0	
Lem et al	2024	Students	24,2	
Chen et al [S1]	2021a	Students	24,3	
Chen et al [S2]	2021a	Students	24,5	
Tong et al.	2020	Students	24,8	
Mason & Westhead	2023	Students	25,7	
Bacca-Acosta et al	2023	Students	18-25	
Gugenishvili & Nyström	2024	Students	26,0	
Quay & Ramakrishnan	2023	Students	26,0	
Bujic et al	2020	Students	26,4	
Everson et al	2015	Students	27,5	
Herrera et al [S2]	2018	Students	29,2	
Shin	2018	Students	31,2	
Heap et al	2024	Students	33,7	
Martingano et al	2022	Students	34,7	
Tassinari et al	2022	Young adults	18,5	
Walewijns et al	2023	Young adults	21,2	
Patane et al	2020	Young adults	25,8	
Yoo & Drumwright	2018	Young adults	27,1	
Martínez	2024	Young adults	18-25	
Banakou et al	2020	General public/University	21,8	
Theriault et al	2021	General public	22,2	
Hasler et al	2021	General public	24,3	
Barreda-Ángeles et al	2020	General public/University	24,5	
Wu et al	2021	General public	28,1	
Van Damme et al	2019	General public/University	29,9	

Authors	Year	Participants	Age	Reasons
Young et al	2021	General public	34,1	
Lesur et al	2020	General public/University/Museum	34,1	
Formosa et al	2018	General public	34,9	
Tsao et al	2020	Students	18-35	These studies identified their participants as students under the age of 35, thus potentially including individuals from both age groups coded above.
Hasler et al	2017	Students	19-31	
Chen & Ibasco	2023	Students	19-33	
Oh et al [S2]	2016	Students	<35	
Groom et al	2009	Students	ns	These studies described their participants as students but did not report their age.
Anderson et al	2024	Students	ns	
Borah et al	2024	Students	ns	
Peck et al	2013	Students	ns	
Adefila et al	2016	Students	ns	
Christofi et al	2020	General Public	Majority between 18-24	These studies did not report the mean age, and the age range was very broad.
Papadopoulos et al	2021	General Public	Majority between 18-24	
Herrera & Bailenson	2021	General Public/Museum	15-above65	
Yang & Zhang	2022	General public/University	Under 20 and over 35	
Stavroulia & Lanitis	2023	Teachers	18-59	These final seven studies were not included because of their unique conditions.
Branham, L	2024	Christians from Bangui	25,3	
Ventura et al	2021	Male	26,2	
Hamilton-Giachritsis et al	2018	Mothers	39,3	
Barreda-Ángeles et al	2021	School	10,6	
Liu et al	2023	School	15,3	
Phillips et al	2024	Teenagers	13-15	

Table 12. Meta-Analysis Results: Age of Participants

Age	k (total)	k (meta-analysis group)	k (update group)	Effect size	p	I2
Students18-25	43	33	10	0.42	0,000000	82.78
Students>25	8	5	3	0.33	0,017030	82.63
Young Adults	5	4	1	0.89	0,020563	87.62
General Public	9	9	0	0.29	0,230806	86.07
General Public>25	5	5	0	0.33	0,326521	86.83
General Public<25	4	4	0	0.26	0,536274	88.00

Table 13. Topics and Social Groups

Authors	Year	Topic	Social group
Dunivan et al [S2]	2024	Refugee	Children
Dunivan et al [S1]	2024	Refugee	Children
Gugenishvili & Nyström	2024	Refugee	Children
Martingano et al	2022	Refugee	Children
Shin	2018	Refugee	Children
Sundar et al	2017	Refugee	Children
Yang & Zhang	2022	Refugee	Children

Authors	Year	Topic	Social group
Breves	2020	Refugee	Children (with Malaria)
Ma	2020	Refugee	Children (with Malaria)
Borah et al	2024	Refugee	Children (Syrian)
Bujic et al	2020	Refugee	Children (Syrian)
Phillips et al	2024	Refugee	Children (Syrian)
Schutte & Stilinović	2017	Refugee	Children (Syrian)
Yoo & Drumwright	2018	Refugee	Refugee (Syrian)
Van Damme et al	2019	Refugee	Workers (Syrian)
Pimentel et al	2021	Refugee	Refugee (displaced due to climate change)
Cummings et al	2021	Refugee	Refugee
Banakou et al	2020	Racism	Black People
Behm-Morawitz et al	2016	Racism	Black People
Breves	2018	Racism	Black People
D'Errico et al	2020	Racism	Black People
Groom et al	2009	Racism	Black People
Hasler et al	2017	Racism	Black People
Patane et al	2020	Racism	Black People
Peck et al	2013	Racism	Black People
Tassinari et al	2022	Racism	Black People
Theriault et al	2021	Racism	Black People
Young et al	2021	Racism	Black People
Bacca-Acosta et al	2023	Migration	Migrants
Chen & Ibasco	2023	Migration	Migrants
Chen et al	2021b	Migration	Migrants
Chen et al [S1]	2021a	Migration	Migrants (Ethnic minority)
Chen et al [S2]	2021a	Migration	Migrants (Ethnic minority)
Peña et al	2021	Migration	Children
Barreda-Ángeles et al	2021	Abuse	Children (victims of bullying/harassment)
Liu et al	2023	Abuse	Children (victims of bullying)
Martínez	2024	Abuse	Children (victims of bullying)
Hamilton-Giachritsis et al	2018	Abuse	Children (victims of parental maltreatment)
Kandaurova & Lee [S3]	2019	Hardships	Children (Africa/Water scarcity)
Walewijns et al	2023	Hardships	Children (Africa/Water scarcity)
Kristofferson et al [S1]	2022	Hardship	Children (India/Cleft lip)
Kristofferson et al [S2]	2022	Disability (Autism)	Children (with autism)
Li et al	2024	Disability (Autism)	Children (with autism)
Heap et al	2024	Disability	Blind People
Young et al	2021	Disability	Blind People
Ahn et al [S1]	2013	Disability	Colourblind People
Chowdhury et al	2021	Disability	Wheelchair
Marques et al	2022	Mental illness (Healthcare context)	Schizophrenic People
Kalyanaraman et al	2010	Mental illness (Healthcare context)	Schizophrenic People
Veloso et al	2024	Mental illness (Healthcare	Schizophrenic People

Authors	Year	Topic	Social group
		context)	
Formosa et al	2018	Mental illness	Schizophrenic People
Mason & Westhead	2023	Mental illness	Schizophrenic People
Alieldin et al	2024	Ageism (Healthcare context)	Old people (with diabetes)
McCalla et al.	2023	Ageism (Healthcare context)	Old people (with diabetes)
Quay & Ramakrishnan	2023	Ageism (Healthcare context)	Old people
Adefila et al	2016	Ageism/Mental illness (Healthcare context)	Old people (with dementia)
Papadopoulos et al	2021	Ageism/Mental illness	Old people (with dementia)
Oh et al [S1]	2016	Ageism	Old People
Oh et al [S2]	2016	Ageism	Old People
Tsao et al	2020	Ageism	Old People
Tong et al.	2020	Ageism	Old People (with chronic pain)
Anderson et al	2024	Healthcare context	Patients (Myalgic encephalomyelitis/chronic fatigue syndrome)
Everson et al	2015	Healthcare context	Patients (Culturally and linguistically diverse)
Lem et al	2024	Mental illness	People with depression
Wu et al	2021	Health issues	Patients (with severe acute respiratory syndrome/epidemic)
Herrera et al [S1]	2018	Stigmatization	Homeless People
Herrera et al [S2]	2018	Stigmatization	Homeless People
Herrera & Bailenson	2021	Stigmatization	Homeless People
Wang et al	2022	Stigmatization	Homeless People
Cummings et al	2021	Stigmatization	Homeless People
Ma & Zytko	2021	Stigmatization	Binge drinkers
Ma	2022	Stigmatization	Binge drinkers
Christofi et al	2020	Stigmatization	Drug Users
Lesur et al	2020	Stigmatization	Transgender People
Cohen et al	2021	Hardships	A woman with a painful past and history of social suffering
Schlagowski et al	2024	Hardships	Unprivileged People
Lee & Li	2023	Hardships	Victims of wars
Stavroulia & Lanitis	2023	Hardships	Isolation/Distancing/bullying (Disability/Refugee)
Li & Lee	2019	Hardships	African People (Spread of Ebola in Congo)
Branham, L	2024	Hardships	African People (Minority groups in areas of violent conflict)
Steinfeld	2020	Abuse/Harassment	Victim of sexual harassment at workplace
Ventura et al	2021	Abuse/Harassment	Victim of sexual harassment at workplace
Barreda-Ángeles et al	2020	Different social issues	General
Kandaurova & Lee [S1]	2019	Different social issues	General
Hasson et al [S1]	2019	Intergroup conflict	Palestinians (Israel-Palestinian Conflict)
Hasson et al [S2]	2019	Intergroup conflict	Palestinians (Israel-Palestinian Conflict)

Authors	Year	Topic	Social group
Hasler et al	2021	Intergroup conflict	Palestinians (Israel-Palestinian Conflict)

Table 14. Meta-Analysis Results: Topics and Social Groups

Topic and social groups	k (total)	k (meta-analysis group)	k (update group)	Effect size	p	I2
MigrationRacismRefugees	34	27	7	0.53	0,000000	83.69
Refugees	17	12	5	0.56	0,001443	91.27
RacismBlackPeople	11	11	0	0.52	0,000009	44.74
Migration	6	4	2	0.50	0,001015	70.73
Children	23	16	8	0.46	0,000250	89.15
HealthcareContext	9	5	4	0.42	0,027316	91.95
Schizophrenia	5	3	2	0.52	0,063500	85.58
Ageism	9	7	2	0.25	0,040030	57.38
Disabilities	6	4	2	0.28	0,364295	91.30
Stigmatization	9	9	0	0.09	0,104735	0

Table 15. Prosocial Responses

Authors	Year	Outcome	Subcategory	Scale
Christofi et al	2020	Empathy	Emotional	Batson et al (1997) scale
Cohen et al	2021	Empathy	Emotional	Batson et al (1997) scale
D'Errico et al	2020	Empathy	Emotional	Batson et al (1997) scale
Gugenishvili & Nyström	2024	Empathy	Emotional	Batson et al (1997) scale
Hasler et al	2021	Empathy	Emotional	Batson et al (1997) scale
Herrera et al [S1]	2018	Empathy	Emotional	Batson et al (1997) scale
Herrera et al [S2]	2018	Empathy	Emotional	Batson et al (1997) scale
Kalyanaraman et al	2010	Empathy	Emotional	Batson et al (1997) scale
Li & Lee	2019	Empathy	Emotional	Batson et al (1997) scale
Tassinari et al	2022	Empathy	Emotional	Batson et al (1997) scale
Bacca-Acosta et al	2023	Empathy	Emotional	IRI (Empathy Concern subscale)
Barreda-Ángeles et al	2020	Empathy	Emotional	IRI (Empathy Concern subscale)
Branham, L	2024	Empathy	Emotional	IRI (Empathy Concern subscale)
Chen & Ibasco	2023	Empathy	Emotional	IRI (Empathy Concern subscale)
Martínez	2024	Empathy	Emotional	IRI (Empathy Concern subscale)
Martingano et al	2022	Empathy	Emotional	IRI (Empathy Concern subscale)
Schutte & Stilinović	2017	Empathy	Emotional	IRI (Empathy Concern subscale)
Theriault et al	2021	Empathy	Emotional	IRI (Empathy Concern subscale)
Ventura et al	2021	Empathy	Emotional	Ad hoc self-report
Breves	2020	Empathy	Emotional	Affective subdimensions empathy and emotional contagion

Authors	Year	Outcome	Subcategory	Scale
				of the parasocial interaction (PSI) (Schramm & Hartmann, 2008)
Martínez	2024	Empathy	Emotional	Basic empathy scale (BES; Jolliffe & Farrington, 2006)
Martingano et al	2022	Empathy	Emotional	Empathic Adjective Task
Sundar et al	2017	Empathy	Emotional	Empathy Adjective Scale
Tong et al.	2020	Empathy	Emotional	Empathy Scale (Pommier Compassion Scale)
Pimentel et al	2021	Empathy	Emotional	Level of agreement with various adjectives describing their feelings toward the collective.
Phillips et al	2024	Empathy	Emotional	Measure of Empathy and Sympathy (AMES) Survey
Everson et al	2015	Empathy	Emotional	Modified Kiersma-Chen Empathy Scale (MKCES) (Affective Empathy Subscale)
Marques et al	2022	Empathy	Emotional	Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011; Queirós et al., 2018)
Theriault et al	2021	Empathy	Emotional	Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011; Queirós et al., 2018)
Cummings et al	2021	Empathy	Emotional	Shen (2010) scale
Bacca-Acosta et al	2023	Empathy	Cognitive	IRI (Perspective-taking subscale)
Barreda-Ángeles et al	2020	Empathy	Cognitive	IRI (Perspective-taking subscale)
Martínez	2024	Empathy	Cognitive	IRI (Perspective-taking subscale)
Martingano et al	2022	Empathy	Cognitive	IRI (Perspective-taking subscale)
Schutte & Stilinović	2017	Empathy	Cognitive	IRI (Perspective-taking subscale)
Theriault et al	2021	Empathy	Cognitive	IRI (Perspective-taking subscale)
Ventura et al	2021	Empathy	Cognitive	Ad hoc self-report
Martínez	2024	Empathy	Cognitive	Basic empathy scale (BES; Jolliffe & Farrington, 2006)
Martingano et al	2022	Empathy	Cognitive	Empathic Accuracy Task (EAT)
Phillips et al	2024	Empathy	Cognitive	Measure of Empathy and Sympathy (AMES) Survey

Authors	Year	Outcome	Subcategory	Scale
Everson et al	2015	Empathy	Cognitive	Modified Kiersma-Chen Empathy Scale (MKCES)/Perspective Taking Subscale
Marques et al	2022	Empathy	Cognitive	Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011; Queirós et al., 2018)
Theriault et al	2021	Empathy	Cognitive	Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011; Queirós et al., 2018)
Cummings et al	2021	Empathy	Cognitive	Shen (2010) scale
Martingano et al	2022	Empathy	Cognitive	UC Davis set of emotion expressions (UCDSEE)
Hasler et al	2021	Empathy	Cognitive	Using three items (No scale specified)
Papadopoulos et al	2021	Empathy	General	Comprehensive state empathy scale (CSES) Levett-Jones et al., 2017
Van Damme et al	2019	Empathy	General	Distant suffering´s subscale (empathy dimension) (Huibert & Joye, 2018)
Liu et al	2023	Empathy	General	Eight emotion adjectives were used to measure the subjects' emotional reactions (Empathy was one of them)
Oh et al [S2]	2016	Empathy	General	Empathic listening task: motivation to empathize with the speaker (Schumann, Zaki, & Dweck, 2014)
Kandaurova & Lee [S3]	2019	Empathy	General	Escalas and Stern (2003)
Kandaurova & Lee [S1]	2019	Empathy	General	Escalas and Stern (2003)
Wang et al	2022	Empathy	General	Escalas and Stern (2003)
Hasson et al [S2]	2019	Empathy	General	Following Porat et al (2016)
Hasson et al [S1]	2019	Empathy	General	Following Porat et al (2016)
Anderson et al	2024	Empathy	General	Hannans et al. (2021) empathy scale
Dunivan e al [S2]	2024	Empathy	General	IRI
Young et al	2021	Empathy	General	IRI
Lee & Li	2023	Empathy	General	IRI and Schutte and Stilinović (2017)
Stavroulia & Lanitis	2023	Empathy	General	IRI and Toronto Empathy Questionnaire

Authors	Year	Outcome	Subcategory	Scale
				(Spreng et al., 2009)
Quay & Ramakrishnan	2023	Empathy	General	Kiersma Chen Empathy Scale (KCES, Kiersma et al., 2013)
Borah et al	2024	Empathy	General	Measured by averaging five items adapted from past studies (i.e.Bae et al., 2014)
Everson et al	2015	Empathy	General	Modified Kiersma-Chen Empathy Scale (MKCES)
Walewijns et al	2023	Empathy	General	Parasocial Interaction (PSI) Process Scales (Schramm & Hartmann, 2008)
Schlagowski et al	2024	Empathy	General	Schutte and Stilinović (2017)
Shin	2018	Empathy	General	Shin and Biocca (2017)
Heap et al	2024	Empathy	General	Toronto Empathy Questionnaire (Spreng et al., 2009)
Wu et al	2021	Empathy	General	Toronto Empathy Questionnaire (Spreng et al., 2009)
Yang & Zhang	2022	Empathy	General	ns
Adefila et al	2016	Empathy	Healthcare context (emotional)	Empathy toward dementia patients
Alieldin et al	2024	Empathy	Healthcare context	Jefferson Scale of Empathy (JSE, Hojat et al., 2009)
Marques et al	2022	Empathy	Healthcare context	Empathic Feelings for People Suffering from Schizophrenia questionnaire (Kalyanaraman et al., 2010)
Mason & Westhead	2023	Empathy		Empathic Feelings for People Suffering from Schizophrenia questionnaire (Kalyanaraman et al., 2010)
McCalla et al.	2023	Empathy	Healthcare context	Jefferson Scale of Empathy (JSE, Hojat et al., 2009)
Formosa et al	2018	Empathy	Clinical empathy	Empathetic Understanding: Clinical empathy.
Hamilton-Giachritsis et al	2018	Empathy	Parenting empathy	Parenting empathy: Adult Adolescent Parenting Inventory (AAPI/empathy subscale)
Barreda-Ángeles et al	2021	Empathy	Empathy toward bullying	Empathy towards victims during bullying episodes

Authors	Year	Outcome	Subcategory	Scale
				(Kärnä et al., 2011; Pöyhönen, Kärnä, & Salmivalli, 2008)
Cummings et al	2021	Empathy	Associative	Shen (2010) scale
Banakou et al	2020	Attitude	Implicit	IAT
Breves	2018	Attitude	Implicit	IAT
Chowdhury et al	2021	Attitude	Implicit	IAT
Groom et al	2009	Attitude	Implicit	IAT
Hasler et al	2017	Attitude	Implicit	IAT
Lesur et al	2020	Attitude	Implicit	IAT
Patane et al	2020	Attitude	Implicit	IAT
Peck et al	2013	Attitude	Implicit	IAT
Theriault et al	2021	Attitude	Implicit	IAT
Banakou et al	2020	Attitude	Explicit	Attitudes Toward Blacks (ATB) scale (Brigham, 1993)
Oh et al [S1]	2016	Attitude	Explicit	Kogan's Attitudes towards Older People Scale (KOP, Kogan, 1961)
Tsao et al	2020	Attitude	Explicit	Kogan's Attitudes towards Older People Scale (KOP, Kogan, 1961)
Breves	2018	Attitude	Explicit	Pettigrew and Meertens (1995)
Theriault et al	2021	Attitude	Explicit	Symbolic Racism Scale (Henry & Sears, 2002; Sears & Henry, 2005)
Lesur et al	2020	Attitude	Explicit	Toward Transgender Men and Women questionnaire (Billard, 2018)
Chen & Ibasco	2023	Attitude		A series of semantic differential items (Osgood et al., 1975).
Oh et al [S2]	2016	Attitude		Affect Misattribution Procedure (AMP)
Chen & Ibasco	2023	Attitude		Affective feeling thermometer scale (Alwin, 1997).
Mason & Westhead	2023	Attitude	Attitudes towards schizophrenia	Attitudes towards schizophrenia (Adapted from Kalyanaraman et al., 2010)
Kalyanaraman et al	2010	Attitude		Batson et al. (1997) scale
Herrera et al [S1]	2018	Attitude	Attitudes toward the homeless	Batson et al. (1997) scale
Herrera & Bailenson	2021	Attitude	Attitudes toward the homeless	Batson et al. (1997) scale
Christofi et al	2020	Attitude	Attitudes toward drug users	Batson et al. (1997), adapted from the questionnaire used by Herrera et al. (2018)

Authors	Year	Outcome	Subcategory	Scale
Papadopoulos et al	2021	Attitude	Emotional distance	Change in emotional distance scale (CEDS)
McCalla et al.	2023	Attitude		Diabetes Attitude Scale-3 (DAS-3)
Chen et al	2021b	Attitude		Feeling thermometer attitudes
Chen et al [S1]	2021a	Attitude		Feeling thermometer attitudes
Chen et al [S2]	2021a	Attitude		Feeling thermometer attitudes
Branham, L	2024	Attitude		Feeling thermometer attitudes
Heap et al	2024	Attitude	Attitudes toward learning and working with BVI individuals	McDonnall's (2014) Productivity Subscale questions
Groom et al	2009	Attitude		Modern Racism (MRS) scale (McConahay, 1986)
Formosa et al	2018	Attitude	Attitudinal change	Reavley and Jorm (2011) and the United Kingdom Department of Health's (2013) scales
Kalyanaraman et al	2010	Attitude	Social distance	Social Distance Scale
Peña et al	2021	Attitude	Social distance	Social Distance Scale
Herrera et al [S1]	2018	Attitude	Dehumanization	The Ascent of Man measure of Dehumanization
Herrera et al [S2]	2018	Attitude	Dehumanization	The Ascent of Man measure of Dehumanization
Mason & Westhead	2023	Attitude	Social distance	The Desire for Social Distance measure (Adapted from Kalyanaraman et al., 2010)
Young et al	2021	Attitude		Toward Disabled Persons Survey (ATDPS) (Adapted)
Ahn et al [S1]	2013	Attitude		Toward Disabled Persons Survey (Yuker, Block, & Younng, 1966)
Wang et al	2022	Attitude	Tolerance	Toward people experiencing homelessness (Phelan et al. (1995)
Marques et al	2022	Attitude	Toward People Suffering from Schizophrenia	Toward People with Schizophrenia questionnaire (Kalyanaraman et al., 2010)
Veloso et al	2024	Attitude	Toward People Suffering from Schizophrenia	Virtual Doppelganger Questionnaire: Attitudes toward people with schizophrenia.
Veloso et al	2024	Attitude	Social distance	Virtual Doppelganger

Authors	Year	Outcome	Subcategory	Scale
				Questionnaire: Social Distance Scale.
Steinfeld	2020	Attitude	Decreasing stereotypical views of sexual harassment	
Hasson et al [S2]	2019	Attitude	Dehumanization	
Bujic et al	2020	Attitude	Human rights attitudes	
Hasson et al [S2]	2019	Attitude	Perceived threat	
Hasson et al [S1]	2019	Attitude	Positive appraisals	
Behm-Morawitz et al	2016	Attitude	Race-related policy beliefs	
Kandaurova & Lee [S3]	2019	Attitude	Responsibility about a social cause	
Kandaurova & Lee [S1]	2019	Attitude	Responsibility about a social cause	
Ma	2022	Attitude	Toward alternatives to drinking and driving	
Ma & Zytko	2021	Attitude	Toward binge drinking	
Ma	2020	Attitude	Toward helping people	
Pimentel et al	2021	Attitude	Toward the video	
Ventura et al	2021	Attitude	Violent attitude	
Borah et al	2024	Intention	Donation (Money)	Measured by averaging six items adapted from past studies (i.e. Ranganathan and Henley, 2008; Smith and McSweeney, 2007)
Branham, L	2024	Intention	Donation (Money)	A single-item donation challenge
Lee & Li	2023	Intention	Donation (Money)	
Martingano et al	2022	Intention	Donation (Money)	
Walewijns et al	2023	Intention	Donation (Money)	
Yoo & Drumwright	2018	Intention	Donation (Money)	
Herrera et al [S1]	2018	Intention	Donation (Money)	
Herrera et al [S2]	2018	Intention	Donation (Money)	
Lee & Li	2023	Intention	Donation (Time)	
Kandaurova & Lee [S3]	2019	Intention	Donation (Time)	
Liu et al	2023	Intention	Bystander behaviour tendency	Student Bystander Behavior Survey (SBBS, Thornberg & Jungert, 2013)
Liu et al	2023	Intention	Defender Self-Efficacy	Defender Self-Efficacy Scale (Thornberg & Jungert, 2013)
Oh et al [S1]	2016	Intention	Future Communication	
Oh et al [S2]	2016	Intention	Future Communication	
Walewijns et al	2023	Intention	Involvement regarding water	

Authors	Year	Outcome	Subcategory	Scale
			scarcity issues	
Breves	2020	Intention	Perceived issue involvement	
Pimentel et al	2021	Intention	Share media post	
Pimentel et al	2021	Intention	Signing a petition	
Sundar et al	2017	Intention	Story sharing	
Hasson et al [S1]	2019	Intention	Support for compensation	
Herrera et al [S1]	2018	Intention	Support for a real proposition: increasing affordable housing for vulnerable populations	
Herrera et al [S2]	2018	Intention	Support for a real proposition: increasing affordable housing for vulnerable populations	
Pimentel et al	2021	Intention	To donate toward relief efforts	
Pimentel et al	2021	Intention	To follow social media pages supporting Newtok relief efforts	
Pimentel et al	2021	Intention	To volunteer	
Ma	2020	Intention	Willingness to help	
Tong et al.	2020	Intention	Willingness to help	Willingness to Help Scale
Lem et al	2024	Intention	Stigma reduction was evaluated through respondents' future behavioural intentions toward patients with depression.	Intended Behavior subscale of the Reported and Intended Behavior Scale (RIBS; Evans-Lacko et al., 2011) (Japanese version)
Ahn et al [S1]	2013	Self–other closeness		IOS
Chen et al	2021b	Self–other closeness		IOS
Chen et al [S1]	2021a	Self–other closeness		IOS
Chen et al [S2]	2021a	Self–other closeness		IOS
Christofi et al	2020	Self–other closeness		IOS
Herrera et al [S1]	2018	Self–other closeness		IOS
Herrera et al [S2]	2018	Self–other closeness		IOS
Lee & Li	2023	Self–other closeness		IOS
Oh et al [S1]	2016	Self–other closeness		IOS
Oh et al [S2]	2016	Self–other closeness		IOS
Theriault et al	2021	Self–other closeness		IOS
Ventura et al	2021	Self–other closeness		IOS
Young et al	2021	Self–other closeness		IOS
Kristofferson et al [S1]	2022	Behaviour	Donation	
Dunivan et al [S1]	2024	Behaviour	Donation (Money)	
Martingano et al	2022	Behaviour	Donation (Money)	
Pimentel et al	2021	Behaviour	Donation (Money)	

Authors	Year	Outcome	Subcategory	Scale
Li et al	2024	Behaviour	Donation (Money)	
Kristofferson et al [S2]	2022	Behaviour	Donation (Money)	
Ahn et al [S1]	2013	Behaviour	Helping	
Chen et al [S2]	2021a	Behaviour	Helping	
Herrera & Bailenson	2021	Behaviour	Signing a petition	
Herrera et al [S1]	2018	Behaviour	Signing the petition in support of a proposition	
Herrera et al [S2]	2018	Behaviour	Signing the petition in support of a proposition	

Table 16. Meta-Analysis Results: Prosocial Responses

Topic and social groups	k (total)	k (meta-analysis group)	k (update group)	Effect size	p	I2
Empathy	57	41	16	0.48	0,000061	94.16
Attitude	45	40	5	0.38	0,000000	68.18
Intention	21	17	4	0.47	0,009747	94.86
IOS	13	12	1	0.28	0,006553	64.99
Behaviour	9	7	2	0.14	0,017856	22.32
EmpathyEmotional	28	22	6	0.45	0,000030	86.12
EmpathyCognitive	12	9	3	0.20	0,168945	82.43
EmpathyEmotionalBatson	10	9	1	0.34	0,000002	22.75
EmpathyEmotionalIRI	8	4	4	0.47	0,097920	90.57
AttitudeImplicit	9	9	0	0.53	0,001004	67.15
AttitudeEmplicit	6	6	0	0.30	0,158958	75.58

Table 17. Type of Immersive Technology and Type of Immersive Experience

Authors	Year	Format	Modality	Media production	Topic	Target
Dunivan et al [S1]	2024	360	IW	The Displaced	Refugee	Children
Dunivan e al [S2]	2024	360	IW	The Displaced	Refugee	Children
Gugenishvili & Nyström	2024	360	IW	The Displaced	Refugee	Children
Martingano et al	2022	360	IW	The Displaced	Refugee	Children
Shin	2018	360	IW	The Displaced	Refugee	Children
Sundar et al	2017	360	IW	The Displaced/The click effect	Refugee	Children
Yang & Zhang	2022	360	IW	The Displaced/Under a Cracked Sky	Refugee	Children
Borah et al	2024	360	IW	Clouds Over Sidra	Refugee	Children (Syrian)
Phillips et al	2024	360	IW	Clouds Over Sidra	Refugee	Children (Syrian)
Schutte & Stilinović	2017	360	IW	Clouds Over Sidra	Refugee	Children (Syrian)
Bujic et al	2020	360(Animation)	IW	See Player	Refugee	Children (Syrian)
Breves	2020	360	IW	Under the net	Refugee	Children (with Malaria)
Ma	2020	360	IW	Under the net	Refugee	Children (with

Authors	Year	Format	Modality	Media production	Topic	Target
						Malaria)
Van Damme et al	2019	360	IW	Ryad's War Oil	Refugee	Workers (Syrian)
Yoo & Drumwright	2018	360	IW	Syrian Refugee Camp: A 360VR Experience (UNICEF Korea)	Refugee	Refugee (Syrian)
Pimentel et al	2021	360	IW	Ad-hoc	Refugee	Refugee (displaced due to climate change)
Cummings et al	2021	360	IW	The Road to Nowhere/Sleeping on Denver´s Bitter Cold Streets	Refugee/Homeless	Refugee/Homeless
Cohen et al	2021	360	IW	Ad-hoc	Hardships	A woman with a painful past and history of social suffering
Branham, L	2024	360	IW/ISIC	Even in the Rain (Branham, 2018)	Hardships	African People people (Minority groups in areas of violent conflict)
Li & Lee	2019	360	IW	Congo: War and Disease	Hardships	African People people (Spread of Ebola in Congo)
Kandaurova & Lee [S3]	2019	360	IW	The source	Hardships	Children (Africa/Water scarcity)
Walewijns et al	2023	360	IW	The source	Hardships	Children (Africa/Water scarcity)
Kristofferson et al [S1]	2022	360	IW	Ad-hoc	Hardship	Children (India/Cleft lip)
Young et al	2021	360	IW	Travelling while Black	Racism	Black People
McCalla et al.	2023	360	IW	Ad_hoc	Ageism (Healthcare context)	Old people (with diabetes)
Anderson et al	2024	360(Animation)	IW	Ad-hoc (Discover ME)	Healthcare context	Patients (Myalgic encephalomyelitis/chronic fatigue syndrome)
Barreda-Ángeles et al	2020	360	IW	8 Youtube videos	Different social issues	General
Kandaurova &	2019	360	IW	Global Citizen	Different	General

Authors	Year	Format	Modality	Media production	Topic	Target
Lee [S1]					social issues	
Barreda-Ángeles et al	2021	360	IFPE	Ad-hoc	Abuse	Children (victims of bullying/harassment)
Steinfeld	2020	360	IFPE	Ad-hoc	Abuse/Harassment	Victim of sexual harassment at workplace
Ventura et al	2021	360	IFPE	Ad-hoc	Abuse/Harassment	Victim of sexual harassment at workplace
Kristofferson et al [S2]	2022	360	IFPE	Too much Information (National Autistic Society of Great Britain)	Disability (Autism)	Children (with autism)
Li et al	2024	360	IFPE	Too much Information (National Autistic Society of Great Britain)	Disability (Autism)	Children (with autism)
Veloso et al	2024	360	IFPE	Ad-hoc	Mental illness (Healthcare context)	Schizophrenic People
Theriault et al	2021	360	IFPE	The Machine to be Another	Racism	Black People
Lesur et al	2020	360 (180)	IFPE	Ad-hoc	Stigmatized	Transgender People
Ma & Zytko	2021	360	IFPE	Diageo DRINKiQ (Greg´s perspective and Steph´s perspective)	Stigmatized	Binge drinkers
Wang et al	2022	360	IFPE	Ad-hoc (Video produced by YouMatter studio)	Stigmatized	Homeless People
Alieldin et al	2024	360	IFPE	Ad-hoc (The Frank Lab) (Embodied Lab)	Ageism (Healthcare context)	Old people
Hamilton-Giachritsis et al	2018	3D	IFPE	Ad-hoc	Abuse	Children (victims of parental maltreatment)
Oh et al [S1]	2016	3D	IFPE	Ad-hoc	Ageism	Old People
Oh et al [S2]	2016	3D	IFPE	Ad-hoc	Ageism	Old People
Tsao et al	2020	3D	IFPE	Ad-hoc	Ageism	Old People
Tong et al.	2020	3D	IFPE/Exposure	Ad-hoc: AS IF (UnityD)	Ageism	Old People (with chronic pain)
Adefila et al	2016	3D	IFPE	Ad-hoc: myShoes project	Ageism/Mental illness (Healthcare	Old people (with dementia)

Authors	Year	Format	Modality	Media production	Topic	Target
					context)	
Heap et al	2024	3D	IFPE	Notes of Blindness	Disability	Blind People
Young et al	2021	3D	IFPE	Notes on Blindness	Disability	Blind People
Ahn et al [S1]	2013	3D	IFPE	Ad-hoc	Disability	Colorblind People
Chowdhury et al	2021	3D	IFPE	Ad-hoc (Unity 5)	Disability	Wheelchair
Schlagowski et al	2024	3D	IFPE	Ad-hoc	Hardships	Unprivileged People
Lee & Li	2023	3D	IFPE/Exposure	Ad-hoc	Hardships	Victims of wars
Stavroulia & Lanitis	2023	3D	IFPE/Exposure	Ad-hoc (Unity 3D)	Hardships	Isolation/Distancing/bullying (Disability/Refugee)
Formosa et al	2018	3D	IFPE	Ad-hoc	Mental illness	Schizophrenic People
Lem et al	2024	3D	IFPE	Ad-hoc	Mental illness	People with depression
Kalyanaraman et al	2010	3D	IFPE	Ad-hoc	Mental illness (Healthcare context)	Schizophrenic People
Marques et al	2022	3D	IFPE	Ad-hoc	Mental illness (Healthcare context)	Schizophrenic People
Veloso et al	2024	3D	IFPE	Ad-hoc	Mental illness (Healthcare context)	Schizophrenic People
Chen & Ibasco	2023	3D	IFPE	Ad-hoc	Migration	Migrants
Chen et al	2021b	3D	IFPE	Ad-hoc	Migration	Migrants
Chen et al [S1]	2021a	3D	IFPE	Ad-hoc (Unity)	Migration	Migrants (Ethnic minority)
Banakou et al	2020	3D	IFPE	Ad-hoc	Racism	Black People
Groom et al	2009	3D	IFPE	Ad-hoc	Racism	Black People
Hasler et al	2017	3D	IFPE	Ad-hoc	Racism	Black People
Patane et al	2020	3D	IFPE	Ad-hoc (Unity 5.5.1)	Racism	Black People
Peck et al	2013	3D	IFPE	Ad-hoc	Racism	Black People
Christofi et al	2020	3D	IFPE	Ad-hoc (Unity)	Stigmatized	Drug Users
Herrera et al [S1]	2018	3D	IFPE	Ad-hoc	Stigmatized	Homeless People
Herrera et al [S2]	2018	3D	IFPE	Ad-hoc	Stigmatized	Homeless People
Herrera & Bailenson	2021	3D	IFPE	Ad-hoc	Stigmatized	Homeless People
Ma	2022	360	ITPE	Decisions: a 360 virtual reality drunk driving experience	Stigmatized	Binge drinkers

Authors	Year	Format	Modality	Media production	Topic	Target
Everson et al	2015	360	ITPE	Ad-hoc	Healthcare context	Patients (Culturally and linguistically diverse)
Hasler et al	2021	360	ITPE	Ad-hoc	Intergroup conflict	Palestinians (Israel-Palestinian Conflict)
Hasson et al [S1]	2019	360	ITPE	Ad-hoc	Intergroup conflict	Palestinians (Israel-Palestinian Conflict)
Hasson et al [S2]	2019	360	ITPE	Ad-hoc	Intergroup conflict	Palestinians (Israel-Palestinian Conflict)
Chen et al [S2]	2021a	3D	ITPE	Ad-hoc	Migration	Migrants (Ethnic minority)
Mason & Westhead	2023	3D	ISIC	Video game: Hellblade: Senua's Sacrifice	Mental illness	Schizophrenic People
Peña et al	2021	3D	ISIC	vTime	Migration	Children
Behm-Morawitz et al	2016	3D	ISIC	The Sims Social: Digital gaming app	Racism	Black People
Breves	2018	3D	ISIC	Skyrim: Video game	Racism	Black People
Tassinari et al	2022	3D	ISIC	AltspaceVR	Racism	Black People
D'Errico et al	2020	360	ISIC	Ad-hoc	Racism	Black People
Liu et al	2023	3D	IW	Ad-hoc (Unity)	Abuse	Children (victims of bullying)
Papadopoulos et al	2021	3D	IW	Ad-hoc: The visit	Ageism/Mental illness	Old people (with dementia)
Wu et al	2021	3D	IW	Beijing: blocking action on severe acute respiratory syndrome (Unity)	Health issues	Patients (with severe acute respiratory syndrome/epidemic)
Bacca-Acosta et al	2023	3D/2DVideo	IW	Ad-hoc (Unity)	Migration	Migrants
Martínez	2024	3D/Volum.Video	IFPE	Ad-hoc: The Stigma Machine	Abuse	Children (victims of bullying)
Quay & Ramakrishnan	2023	ns	IFPE/ITPE	Ad-hoc	Ageism (Healthcare context)	Old people

Table 18. Meta-Analysis Results: Type of Immersive Technology

Type of immersive technology	k (total)	k (meta-analysis group)	k (update group)	Effect size	p	I2
360-degree video	45	35	10	0.47	0,000000	86.42
3DCG	39	32	7	0.39	0,000006	81.97

Table 19. Meta-Analysis Results: Type of Immersive Experiences

Type of immersive experience	k (total)	k (meta-analysis group)	k (update group)	Effect size	p	I2
360IW	28	21	7	0.53	0,000036	90.32
3DIFPE	30	24	6	0.40	0,000660	86.89
360IFPE	11	8	3	0.36	0,000010	35.32
ITPE	6	6	0	0.31	0,000001	0
ISIC	6	5	1	0.34	0,000594	10.03
360IWEmpathy	23	17	6	0.67	0,000648	94.51
360IWIntention	10	8	2	0.72	0,034990	96.37
360IWAttitude	8	7	1	0.31	0,000006	0
360IWBehavior	4	2	2	0.16	0,086412	13.20
360IWEmpathyEmotional	12	9	3	0.50	0,013113	89.88
360IWEmpathyCognitive	5	4	1	0.04	0,893620	87.91
360IWEmpathyRefugeeChildren	7	6	1	0.81	0,000333	86.68
3DIFPEAttitude	24	20	4	0.37	0,000299	80.52
3DIFPEEmpathy	17	12	5	0.59	0,000739	89.18
3DIFPEIntention	6	5	1	0.01	0,941180	47.11
3DIFPEBehavior	4	3	1	0.31	0,414948	95.75
3DIFPEIOS	11	10	1	0.19	0,021877	43.06
3DIFPEEmpathyEmotional	7	6	1	0.46	0,024747	84.90
3DIFPEAttitudeImplicitBlackPeople	5	5	0	0.67	0,000283	40.62
360IFPEAttitude	7	6	1	0.24	0,089252	62.77
360IFPEEmpathy	6	4	2	0.54	0,000115	35.58
ITPEAttitude	4	4	0	0.60	0,020181	83.96
ITPEEmpathy	4	4	0	0.31	0,000020	0
ISICAttitude	4	3	1	0.24	0,020563	0

Table 20. List of Studies of Two Significant Groups

360IW empathy toward refugee children		3DIFPE implicit racial bias (IAT) toward Black individuals	
Breves	2020		
Martingano et al	2022	Banakou et al	2020
Phillips et al	2024	Groom et al	2009
Schutte & Stilinovic	2017	Hasler et al	2017
Shin	2018	Patane et al	2020
Sundar et al	2017	Peck et al	2013
Yang & Zhang	2022		

Table 21. List of Studies that Evaluated the Dimensions of Empathy

	Emotional Empathy		Cognitive Empathy			
360IW	Barreda-Ángeles et al	2020	Barreda-Ángeles et al	2020	Schlagowski et al. 2024 Alieldin et al. 2024 These two studies addressed both dimensions of empathy; however, they either did not report suitable values for inclusion in the meta-analysis or focused solely on the total empathy score.	
	Branham, L	2024	Cummings et al	2021		
	Breves	2020	Martingano et al	2022		
	Cohen et al	2021	Schutte & Stilinovic	2017		
	Cummings et al	2021	Phillips et al	2024		
	Gugenishvili & Nyström	2024				
	Li&Lee	2019				
	Martingano et al	2022				
	Phillips et al	2024				
	Pimentel et al	2021				
	Schutte & Stilinovic	2017				
	Sundar et al	2017				
3DIFPE	Chen & Ibasco	2023	Marques et al	2022		
	Christofi et al	2020				
	Herrera et al [S1]	2018				

Herrera et al [S2]	2018
Kalyanaraman et al	2010
Marques et al	2022
Tong et al.	2020

Table 22. List of Studies Experimental Design Models

Authors	Year	Design	Factors and Conditions	Modality
Cohen et al	2021	ILCM	(2) between-subjects	ScreenHMD
Gugenishvili & Nyström	2024	ILCM	(2) between-subjects	ScreenHMD
Hasler et al	2021	ILCM	(2) between-subjects	ScreenHMD
Kandaurova & Lee [S1]	2019	ILCM	(2) between-subjects	ScreenHMD
Li et al	2024	ILCM	(2) between-subjects	ScreenHMD
Marques et al	2022	ILCM	(2) between-subjects	ScreenHMD
Papadopoulos et al	2021	ILCM	(2) between-subjects	ScreenHMD
Phillips et al	2024	ILCM	(2) between-subjects	ScreenHMD
Schutte & Stilinović	2017	ILCM	(2) between-subjects	ScreenHMD
Lem et al	2024	ILCM	(2) within-subjects	ScreenHMD
Martínez	2024	ILCM	(2) within-subjects	ScreenHMD
Kandaurova & Lee [S3]	2019	ILCM	(2X2) between-subjects (Modality/Social belonging)	ScreenHMD
Shin	2018	ILCM	(2X2) between-subjects (Modality/Two personality traits)	ScreenHMD
Chowdhury et al	2021	ILCM	(2X2) between-subjects (Modality/Type of interface)	ScreenHMD
Barreda-Ángeles et al	2021	ILCM	(2X2) between-subjects (Modality/Video content)	ScreenHMD
Breves	2018	ILCM	(3) between-subjects (ScreenWPC/Screen PC/HMDPC)	ScreenHMD
Borah et al	2024	ILCM	(2) between-subjects	Screen360HMD
Christofi et al	2020	ILCM	(2) between-subjects	Screen360HMD
Kristofferson et al [S1]	2022	ILCM	(2) between-subjects	Screen360HMD
Kristofferson et al [S2]	2022	ILCM	(2) between-subjects	Screen360HMD
Barreda-Ángeles et al	2020	ILCM	(2) within-subjects	Screen360HMD
Yoo & Drumwright	2018	ILCM	(2X2) between-subjects (Modality/ Level of sensation-seeking)	Screen360HMD
Li & Lee	2019	ILCM	(2X2) between-subjects (Modality/Emotional personalization)	Screen360HMD
Walewijns et al	2023	ILCM	(3) between-subjects	ScreenScreen360HMD

Authors	Year	Design	Factors and Conditions	Modality
Liu et al	2023	ILCM	(2X2X2) between-subjects (Modality/Participant sex/Actor sex)	TextHMD
Wang et al	2022	ILCM	(3) between-subjects (TextObjective/TextFP/HMDFP)	TextHMD
Kalyanaraman et al	2010	ILCM	(4) between-subjects (Control/TextEmpathy/HMD/HMDEmpathy)	TextHMD
Ventura et al	2021	ILCM	Mixed design	TextHMD
Steinfeld	2020	ILCM	(3) between-subjects	TextScreenHMD
Cummings et al	2021	ILCM	(3) between-subjects	Text&ImagenesScreen360HMD
Sundar et al	2017	ILCM	Mixed design	Text&ImagenesScreen360Cardboard
Bujic et al	2020	ILCM	(3) between-subjects	TextScreenCardboard
Ma	2020	ILCM	(2) between-subjects	Screen360Cardboard
Ma	2022	ILCM	(2) between-subjects	Screen360Cardboard
Ma & Zytko	2021	ILCM	(2X2) between-subjects (Modality/Character perspective)	Screen360Cardboard
Yang & Zhang	2022	ILCM	(3) between-subjects	ScreenScreen360Cardboard
Van Damme et al	2019	ILCM	(4) between-subjects	ScreenScreen360CardboardHMD
Breves	2020	ILCM	(3) between-subjects	ScreenCardboardHMD
Martingano et al	2022	ILCM	(4) between-subjects (Audiobook/Waiting Room/HMDClassic/HMDBoost)	AudiobookHMD
Lee & Li	2023	ILCM	(3) between-subjects	Screen360HMD/HMD(Interactive)
Wu et al	2021	ILCM	(3) between-subjects	ScreenHMD/HMD(Interactive)
Veloso et al	2024		(2) between-subjects	360HMD/3DHMD
Veloso et al was not included in the meta-analysis, as it did not compare different levels of immersion but rather different types of immersive technologies				
Oh et al [S1]	2016	PTCM	(2X3) between-subjects (Modality/Level of threat)	Control/TraditionalPT/ImmersivePT
Theriault et al	2021	PTCM	(3) between-subjects	Control/TraditionalPT/ImmersivePT
Hasson et al [S1]	2019	PTCM	(3) between-subjects	Control/TraditionalPT/ImmersivePT
Herrera et al [S2]	2018	PTCM	(4) between-subjects	Control/TraditionalPT/Screen360/ImmersivePT
Schlagowski et al	2024	PTCM	(2) within-subjects	TraditionalPT/ImmersivePT
Ahn et al [S1]	2013	PTCM	(2) between-subjects	TraditionalPT/ImmersivePT
Oh et al [S2]	2016	PTCM	(2X2) between-subjects	TraditionalPT/ImmersivePT

Authors	Year	Design	Factors and Conditions	Modality
			(Modality/Level of threat)	
Herrera et al [S1]	2018	PTCM	(2) between-subjects	TraditionalPT/ImmersivePT
Peña et al	2021	IEECM	(2X2) between-subjects (Avatar customization/Priming a common ingroup identity)	Avatar customization
Chen et al	2021b	IEECM	(2X2) between-subjects (Embodiment order/Number of embodiment scenarios)	Embodiment
Chen & Ibasco	2023	IEECM	(2) between-subjects	Ingroup/Outgroup
Groom et al	2009	IEECM	(2X2X2) between-subjects (Participant race/Model race/Model representation)	Model race (White avatar/Black avatar)
Behm-Morawitz et al	2016	IEECM	(2) between-subjects	Model race (White avatar/Black avatar)
Banakou et al	2020	IEECM	(2X3) between-subjects (Body type/Valence)	Model race (White avatar/Black avatar)
Hasler et al	2017	IEECM	Mixed design	Model race (White avatar/Black avatar)
Peck et al	2013	IEECM	(4) between-subjects (Embodied-light skinned/Embodied-dark skinned/Non-embodied-dark/Embodied-alien skinned)	Model race (White avatar/Black avatar)
Tsao et al	2020	IEECM	(2X3) between-subjects (Environment/Feedback valence)	Type of environment
Herrera & Bailenson	2021	IEECM	(4) between-subjects (Control/VR No Hands/ VR Chosen Hands/VR Random Hands)	Type of hands
Pimentel et al	2021	IEECM	(2X2) between-subjects (Interaction/Social presence)	Type of interaction
Hamilton-Giachritsis et al	2018	IEECM	(2) within-groups counter-balanced	Type of interaction (Interaction with negative mother/Interaction with positive mother)
Patane et al	2020	IEECM	(2) between-subjects	Type of interaction (Non-cooperative/Cooperative)
D'Errico et al	2020	IEECM	(3X2) between-subjects (Social appearance	Type of interlocutor

Authors	Year	Design	Factors and Conditions	Modality
			confederate/Ethnicity of the passerby)	
Tassinari et al	2022	IEECM	Mixed design	Type of interlocutor (Participants played with avatars (Caucasian ethnicity)/Participants interacted with an avatar (African ethnic background)
Hasson et al [S2]	2019	IEECM	(2) between-subjects	Type of perspective (Ingroup/Outgroup)
Stavroulia & Lanitis	2023	IEECM	(3) between-subjects	Type of perspective (Teacher perspective/Teacher-Student with a prosthetic leg/Teacher-Student Refugee-Student prosthetic leg)
Chen et al [S1]	2021a	IEECM	Mixed design	Type of reactions
Chen et al [S2]	2021a	IEECM	Mixed design	Type of reactions
Lesur et al	2020	IEECM	(2) within-factor	Type of stimulation (Conventional/Sensorimotor)
Adefila et al	2016	PRE/POST	Impact of consumption	
Alieldin et al	2024	PRE/POST	Impact of consumption	
Anderson et al	2024	PRE/POST	Impact of consumption	
Bacca-Acosta et al	2023	PRE/POST	Impact of consumption	
Dunivan e al [S2]	2024	PRE/POST	Impact of consumption	
Everson et al	2015	PRE/POST	Impact of consumption	
Formosa et al	2018	PRE/POST	Impact of consumption	
Heap et al	2024	PRE/POST	Impact of consumption	
Mason & Westhead	2023	PRE/POST	Impact of consumption	
McCalla et al.	2023	PRE/POST	Impact of consumption	
Quay & Ramakrishnan	2023	PRE/POST	Impact of consumption	
Tong et al.	2020	PRE/POST	Impact of consumption	
Young et al	2021	PRE/POST	Impact of consumption	
Branham, L	2024	PRE/POST	(2) between-subjects (Content Comparation: Social/Neutral Content)	
Dunivan et al [S1]	2024	PRE/POST	(2) between-subjects (Content Comparation:	

Authors	Year	Design	Factors and Conditions	Modality
			Social/Neutral Content)	

Table 23. Meta-Analysis Results: Experimental Design Models

Design model	k (total)	k (meta-analysis group)	k (update group)	Effect size	p	I2
ILCM	41	34	7	0.41	0,000006	87.78
PTCM	8	7	1	0.31	0,150004	87.48
IEECM	20	19	1	0.48	0,000000	43.71

Table 24. Studies Not Included in the Modality Analysis

Studies that did not report the values of the condition combinations separately	
Steinfeld 2020	Text/Screen/HMD
Cummings et al 2021	Text&Images/Screen360/HDM
Lee & Li 2023	Screen/HDM/HDM(Interactive)
Oh et al [S1, S2] 2016	They designed a study with two independent variables (Level of threat (low/high) X Modality (Control/MS/IVE), but the data for each variable were not presented separately; only the combined data were reported
Studies with conditions that assessed variables beyond the level of immersion	
Martingano et al 2021	In one condition, the immersive experience was combined with a perspective-taking task

Table 25. Modality Analysis

Screen/HMD	Screen360/HMD	Text/HMD	Text/Cardboard	Screen/Carboard	Screen360/ Cardboard	Audiobook/HMD	HMD/HMD(I)
Barreda-Ángeles et al (2021)	Barreda-Ángeles et al (2020)	Cummings et al	Bujic et al	Breves (2020)	Ma (2020)	Martingano et al	Lee&Li
Breves (2018)	Borah et al (pilot study)	Kalyanaraman et al	Sundar et al	Bujic et al	Ma (2022)		Wu et al
Breves (2020)	Christofi et al	Liu et al		Van Damme et al	Ma&Zytko		
Chowdhury et al	Cummings et al	Steinfeld		Yang & Zhang	Sundar et al		
Cohen et al	Kristofferson et al [S1]	Ventura et al			Van Damme et al		
Gugenishvili & Nyström	Kristofferson et al [S2]	Wang et al			Yang & Zhang		
Hasler et al	Lee & Li						
Kandaurova & Lee [S1]	Li & Lee						
Kandaurova & Lee [S3]	Van Damme et al						
Lem et al	Walewijns et al						
Li et al (2024)	Yoo & Drumwright						
Marques et al							
Martinez							
Papadopoulos et al							
Phillips et al							
Schutte & Stilinovic							

Screen/HMD	Screen360/HMD	Text/HMD	Text/Cardboard	Screen/Carboard	Screen360/Cardboard	Audiobook/HMD	HMD/HMD(I)
Shin							
Steinfeld							
Van Damme et al							
Walewijns et al							
Wu et al							

Table 26. Meta-Analysis Results: Modality Analysis

Modality	k (effect sizes)	Effect size	p	I2
ScreenHMD	31	0.53	0,007985	96.06
Screen360HMD	14	0.28	0,081829	86.82
TextHMD	10	0.45	0,430147	98.02
ScreenORScreen360Cardboard	13	0.15	0,177894	74.93
ScreenORScreen360HMD	45	0.44	0,002649	95.08
TextHMDNOLiu	9	0.85	0,047494	95.89
TextHMDNOLiuKalyanaraman	7	0.30	0,009129	34.62

Supplementary Material

Computation of Effect Sizes and the Statistical Analyses Conducted

The studies reported different types of statistical data: (a) group means, their standard deviations, and group sizes or the total sample size; (b) t-value and group sizes or total sample size; (c) F-value and group sizes or overall sample size; (d) mean difference between groups, pooled standard deviation, and total sample size. A few studies reported less suitable measures: (e) Chi² and total sample size; (f) the Z-value from the non-parametric Wilcoxon test and total sample size; finally, (g) some studies reported regression beta coefficients and group sizes.

In cases where a study reported more than one of the options listed above, we followed the order proposed in this list. For example, if a study—such as Pimentel et al. (2021)—provided both (a) and (c), we used the data from (a). Although it is possible to approximate a correlation from a beta coefficient (when the absolute value is less than or equal to 0.5), this is not a recommended practice (Lenhard & Lenhard, 2022). Nevertheless, we performed the conversion from regression beta to r, and then from r to d, using the online calculator available at: https://www.psychometrica.de/effect_size.html (Lenhard & Lenhard, 2022).

All effect size measures were converted into standardized mean change scores using Hedges' g, as it is a less biased estimate than Cohen's d for small sample sizes (Borenstein, 2009; Nikolaou, 2022; Viechtbauer, 2010). The conversion from Cohen's d to Hedges' g, as well as the calculation of the variance for both statistics, was carried out using Workbook 3 of Meta-Essentials (Van Rhee et al., 2018). It was confirmed that the resulting values matched those obtained using the metafor package in R, through the escalc procedure and the SMD option, where the standardized mean difference is automatically corrected for its positive bias based on the Hedges and Olkin method (Viechtbauer, 2010).

For studies with a pretest-posttest design, effect sizes were calculated using the following website: https://www.psychometrica.de/effect_size.html (Lenhard & Lenhard, 2022). In these cases, the pretest-posttest correlation value is required. When this value was not reported, we assumed a correlation of 0.5. This decision is considered the most conservative approach (Morris & DeShon, 2002; Van Rhee et al., 2018; Lenhard & Lenhard, 2022).

The analyses were conducted using the metafor package in R, version 4.6-0 (Viechtbauer, 2010). In all cases, we assumed random-effects models, allowing for generalizations beyond the specific populations from which the data were drawn (Ma et al., 2023; Borenstein, 2019; Van Rhee et al., 2018). We used the weighted variance method to estimate the confidence interval of the combined effect size. Simulations have shown that weighted variance confidence intervals outperform other methods regardless of the estimator used, the value of τ^2, the number of studies, or the sample size (Sánchez-Meca & Marín-Martínez, 2008; Van Rhee et al., 2018).

For each meta-analysis, a pooled standardized Hedges' g was calculated, along with its 95% confidence interval, 95% prediction interval, and 95% credibility interval (Borenstein et al., 2019; Brannick et al., 2021; Kepes et al., 2024). Additionally, statistical significance was tested using a Z-test. The results are presented in a forest plot. Effect sizes were interpreted as follows: 0.2 = small effect, 0.5 = moderate effect, and 0.8 = large effect.

To estimate the heterogeneity variance, we used the Hedges method, as it is less biased than the Hunter and Smith (2004) method when there is high heterogeneity across studies, and also less biased than the Restricted Maximum Likelihood (REML) method—which is the default in metafor and a widely used iterative approach—when sample sizes are not large (Van Rhee et al., 2018). We tested for heterogeneity using Cochran's Q statistic and its associated p-value. We interpreted I^2 values as follows: 0–25% = low heterogeneity; 25–50% = moderate heterogeneity; 50–75% = substantial heterogeneity; and 75–100% = considerable heterogeneity.

Lastly, statistically significant differences between groups were calculated using the p-value of the Qbetween statistic (Sierra-Morán, 2024; Borenstein, 2009), as provided in the output of metafor.

Studies in which prosocial responses were not included in the meta-analyses because the data were either not reported or did not allow for the calculation of effect size

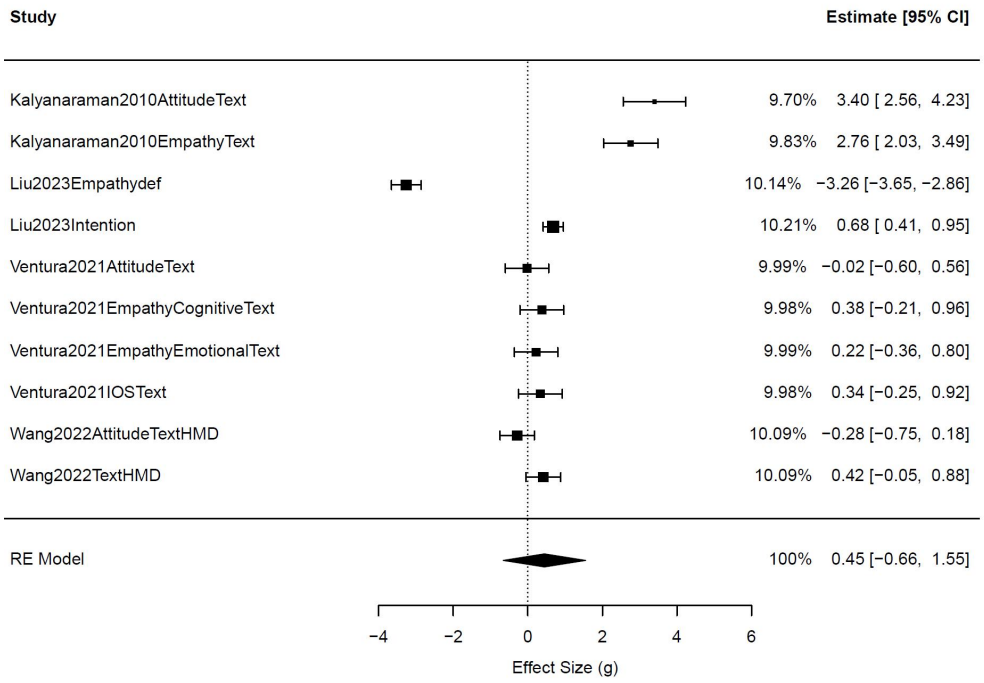
Kandaurova & Lee [S3] 2019	Intention/donation money	No data was reported because the effect was not significant
Gugenishvili & Nyström 2024	Intention/donation money	There is no standard deviation for the groups
Walewijns et al 2023	Intention/donation money	There is no standard deviation for the groups
Branham 2024	Attitude	Beta is greater than 0.5
Branham 2024	Intention/donation money	Beta is greater than 0.5
Tong et al 2020	Emotional empathy	Wheel of emotion is measured as a percentage
Tong et al 2020	Cognitive empathy	Other in the Self Scale is measured as a

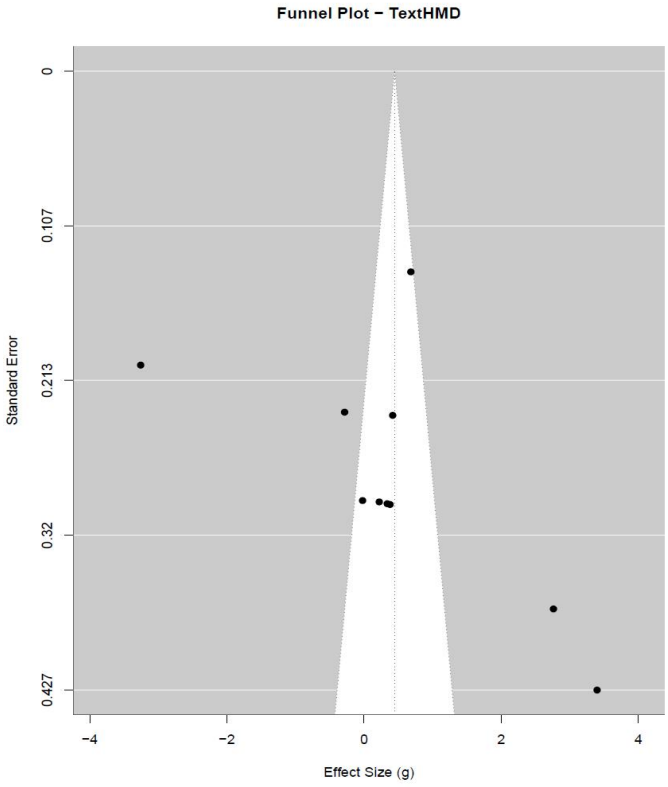
Studies in which prosocial responses were not included in the meta-analyses because the data were either not reported or did not allow for the calculation of effect size

			percentage
Martínez	2024	Self-other closeness (IOS)	IOS is mentioned but ultimately no data was reported
Steinfeld	2020	Empathy	No data were reported because the effect of the experimental condition was not statistically significant

Modality Analysis: TextHMD

The most notable outlier was found in the study by Liu et al. (2023), which reported a negative effect with substantial relative weight (g = -3.26). In this study, the authors found that empathic responses were higher among participants in the textual mode than among those in the immersive experience, although the measures related to intention showed more favorable results for the immersive experience. The authors themselves offered a convincing explanation for the surprising findings regarding empathy, noting that their immersive experience did not allow participants to see the victim of the bullying, who was confined inside one of the stalls in a school bathroom. Since the study did not explicitly specify whether the emotional or the cognitive dimension of empathy was assessed, its evaluation was categorized as general, although the measurement was more closely aligned with the emotional dimension as the adjectives used aimed to identify feelings of sadness about the situation and sympathy for the victim. Thus, the absence of the victim in the immersive experience may have undermined the aim of eliciting an emotionally driven empathic response. The victim's absence is perhaps less problematic in the textual version, as it relies more heavily on the participant's imagination to envision the actions and reactions of the story's characters. Moreover, since this was a 3D immersive witnessing experience, the 3D reenactment of the bullying scenario may have affected its realism, thereby limiting the emotional impact.





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Detailed results of the separate meta-analyses conducted

Group	k	g	SE	CI_lower	CI_upper	PI_lower	PI_upper	CrdI_lower	CrdI_upper	Z_value	p_value	Q_stat	Q_pval	tau2	I2
Overall	66	0,4445	0,0621	0,3227	0,5662	-0,4318	1,3208	-0,4234	1,3123	7,1557	0,000000	273,1856	0,000000	0,1961	82,5673
OverallUpdate	19	0,3633	0,1356	0,0975	0,6290	-0,7192	1,4457	-0,6861	1,4126	2,6791	0,007382	89,6273	0,000000	0,2866	86,3521
Gender 40perc-59perc	42	0,3590	0,0788	0,2047	0,5134	-0,5425	1,2606	-0,5292	1,2473	4,5591	0,000005	180,7853	0,000000	0,2054	84,9982
Gender +60perc	30	0,4843	0,1040	0,2806	0,6881	-0,5558	1,5245	-0,5357	1,5043	4,6588	0,000003	142,6490	0,000000	0,2708	85,9468
Gender 100perc	7	0,4564	0,1617	0,1395	0,7732	-0,1927	1,1054	-0,1101	1,0229	2,8229	0,004759	10,9622	0,089552	0,0835	48,8626
AgeStudents18-25	43	0,4202	0,0766	0,2700	0,5703	-0,4641	1,3044	-0,4513	1,2916	5,4855	0,000000	137,9623	0,000000	0,1977	82,7819
AgeStudents+25	8	0,3299	0,1383	0,0589	0,6009	-0,4028	1,0627	-0,3509	1,0107	2,3861	0,017030	38,7922	0,000002	0,1207	82,6320
AgeYoungAdults	5	0,8879	0,3394	0,2226	1,5532	-0,6519	2,4277	-0,5008	2,2766	2,6157	0,008904	33,3317	0,000001	0,5020	87,6159
AgePublicGeneral	9	0,2912	0,2430	-0,1851	0,7675	-1,0989	1,6813	-1,0148	1,5972	1,1983	0,230806	36,9421	0,000012	0,4440	86,0690
AgePublicGeneral+25	5	0,3250	0,3313	-0,3243	0,9743	-1,1623	1,8124	-1,0131	1,6632	0,9811	0,326521	22,8815	0,000134	0,4661	86,8268
AgePublicGeneral-25	4	0,2561	0,4140	-0,5554	1,0675	-1,4551	1,9673	-1,2505	1,7626	0,6185	0,536274	14,0537	0,002833	0,5908	87,9925
MigrationRacismRefugees	34	0,5329	0,0968	0,3433	0,7226	-0,4745	1,5403	-0,4565	1,5223	5,5071	0,000000	165,4646	0,000000	0,2548	83,6896
Refugees	17	0,5566	0,1747	0,2142	0,8989	-0,8204	1,9335	-0,7772	1,8903	3,1860	0,001443	134,6135	0,000000	0,4631	91,2722
RacismBlackPeople	11	0,5164	0,1165	0,2882	0,7447	-0,0285	1,0614	0,0216	1,0113	4,4347	0,000009	13,4640	0,198871	0,0637	44,7449
Migration	6	0,4968	0,1512	0,2005	0,7932	-0,1759	1,1696	-0,1072	1,1009	3,2865	0,001015	16,6530	0,005207	0,0950	70,7307
Children	23	0,4577	0,1250	0,2127	0,7026	-0,6516	1,5669	-0,6242	1,5396	3,6622	0,000250	121,6960	0,000000	0,3047	89,1500
Healthcare	9	0,4233	0,1918	0,0474	0,7992	-0,6999	1,5465	-0,6351	1,4817	2,2070	0,027316	54,2546	0,000000	0,2916	91,9489
Schizophrenia	5	0,5239	0,2823	-0,0294	1,0773	-0,7360	1,7838	-0,6080	1,6558	1,8557	0,063500	16,7193	0,002191	0,3335	85,5770
Ageism	9	0,2500	0,1217	0,0114	0,4886	-0,3317	0,8317	-0,2805	0,7805	2,0534	0,040030	23,9264	0,002358	0,0733	57,3828
Disabilities	6	0,2773	0,3056	-0,3218	0,8763	-1,2127	1,7672	-1,0870	1,6415	0,9072	0,364295	22,1754	0,000485	0,4845	91,2999
Stigmatized	9	0,0892	0,0550	-0,0186	0,1970	-0,0186	0,1970	0,0892	0,0892	1,6223	0,104735	7,5417	0,479464	0,0000	0,0000
Empathy	57	0,4818	0,1202	0,2463	0,7174	-1,2369	2,2005	-1,2207	2,1844	4,0095	0,000061	666,9202	0,000000	0,7545	94,1617
Attitude	45	0,3797	0,0572	0,2676	0,4917	-0,2273	0,9866	-0,2168	0,9762	6,6421	0,000000	107,2883	0,000000	0,0926	68,1800
Intention	21	0,4652	0,1800	0,1124	0,8179	-1,1335	2,0638	-1,0941	2,0244	2,5847	0,009747	218,0785	0,000000	0,6329	94,8636
IOS	13	0,2729	0,1004	0,0762	0,4697	-0,3086	0,8544	-0,2743	0,8201	2,7187	0,006553	31,9321	0,001418	0,0779	64,9921
Behaviour	9	0,1436	0,0606	0,0248	0,2624	-0,0602	0,3473	-0,0219	0,3091	2,3686	0,017857	11,7703	0,161753	0,0071	22,3160
EmpathyEmotional	28	0,4508	0,1080	0,2391	0,6624	-0,5844	1,4859	-0,5625	1,4640	4,1734	0,000030	138,8251	0,000000	0,2673	86,1228
EmpathyCognitive	12	0,1965	0,1429	-0,0835	0,4765	-0,6974	1,0905	-0,6525	1,0455	1,3756	0,168945	40,3879	0,000031	0,1876	82,4273
EmpathyEmotionalBatson	10	0,3440	0,0724	0,2021	0,4859	0,0894	0,5986	0,1326	0,5554	4,7512	0,000002	11,2370	0,259812	0,0116	22,7525
EmpathyEmotionalIRI	8	0,4670	0,2822	-0,0860	1,0201	-1,1050	2,0390	-1,0046	1,9386	1,6550	0,097920	72,4355	0,000000	0,5637	90,5741
AttitudeImplicitIAT	9	0,5310	0,1614	0,2146	0,8474	-0,2942	1,3562	-0,2311	1,2931	3,2893	0,001004	22,8542	0,003557	0,1512	67,1459
AttitudeExplicit	6	0,3026	0,2148	-0,1185	0,7237	-0,6749	1,2801	-0,5796	1,1848	1,4086	0,158958	11,5211	0,041972	0,2026	75,5813
360-degree video	45	0,4683	0,0822	0,3072	0,6294	-0,5256	1,4622	-0,5125	1,4490	5,6967	0,000000	208,6105	0,000000	0,2504	86,4170
3DCG	39	0,3855	0,0855	0,2180	0,5530	-0,5376	1,3087	-0,5223	1,2934	4,5112	0,000006	134,0455	0,000000	0,2146	81,9689
360IW	28	0,5276	0,1276	0,2775	0,7777	-0,7368	1,7920	-0,7118	1,7670	4,1341	0,000036	190,2983	0,000000	0,3999	90,3187
3DIFPE	30	0,3981	0,1169	0,1690	0,6273	-0,7505	1,5468	-0,7275	1,5238	3,4057	0,000660	138,8081	0,000000	0,3298	86,8939
360IFPE	11	0,3572	0,0808	0,1987	0,5156	0,0164	0,6979	0,0555	0,6588	4,4177	0,000010	10,0540	0,435770	0,0237	35,3202
ITPE	6	0,3133	0,0651	0,1857	0,4409	0,1857	0,4409	0,3133	0,3133	4,8132	0,000001	2,8122	0,728910	0,0000	0,0000
ISIC	6	0,3418	0,0995	0,1467	0,5368	0,0939	0,5897	0,1887	0,4948	3,4344	0,000594	7,0543	0,216636	0,0061	10,0314
360IWEmpathy	23	0,6688	0,1961	0,2845	1,0531	-1,1470	2,4846	-1,1059	2,4435	3,4108	0,000648	200,4869	0,000000	0,8199	94,5058
360IWIntention	10	0,7153	0,3392	0,0504	1,3801	-1,4429	2,8734	-1,3380	2,7685	2,1085	0,034990	154,3477	0,000000	1,0974	96,3705
360IWAttitude	8	0,3142	0,0695	0,1780	0,4505	0,1780	0,4505	0,3142	0,3142	4,5192	0,000006	5,2195	0,633192	0,0000	0,0000
360IWBehaviour	4	0,1639	0,0956	-0,0234	0,3512	-0,0687	0,3965	0,0259	0,3018	1,7146	0,086412	3,3804	0,336604	0,0050	13,1950
360IWEmpathyEmotional	12	0,5002	0,2017	0,1050	0,8955	-0,8391	1,8396	-0,7795	1,7800	2,4807	0,013113	81,7493	0,000000	0,4263	89,8788
360IWEmpathyCognitive	5	0,0401	0,2997	-0,5474	0,6275	-1,3011	1,3812	-1,1656	1,2457	0,1337	0,893620	26,1114	0,000030	0,3784	87,9123
360IWEmpathyRefugeeChildren	7	0,8098	0,2257	0,3674	1,2521	-0,3446	1,9642	-0,2565	1,8761	3,5879	0,000333	31,4505	0,000021	0,2960	86,6763
3DIFPEAttitude	24	0,3749	0,1037	0,1717	0,5781	-0,5042	1,2540	-0,4804	1,2302	3,6162	0,000299	74,1668	0,000000	0,1904	80,5246
3DIFPEEmpathy	17	0,5926	0,1756	0,2484	0,9368	-0,7519	1,9370	-0,7071	1,8923	3,3747	0,000739	81,4265	0,000000	0,4397	89,1808
3DIFPEIntention	6	0,0075	0,1019	-0,1923	0,2073	-0,3769	0,3919	-0,3209	0,3359	0,0738	0,941180	8,2553	0,142715	0,0281	47,1089
3DIFPEIOS	11	0,1869	0,0815	0,0271	0,3466	-0,1839	0,5576	-0,1477	0,5215	2,2925	0,021877	21,6575	0,016948	0,0291	43,0644
3DIFPEBehaviour	4	0,3134	0,3845	-0,4401	1,0669	-1,3262	1,9530	-1,1428	1,7696	0,8152	0,414948	46,4924	0,000000	0,5520	95,7483
3DIFPEEmpathyEmotional	7	0,4614	0,2055	0,0586	0,8641	-0,5838	1,5066	-0,5031	1,4259	2,2453	0,024747	32,4344	0,000013	0,2422	84,9004
3DIFPEAttitudeImplicitIATRacismBP	5	0,6755	0,1861	0,3108	1,0402	0,0444	1,3066	0,1604	1,1905	3,6300	0,000283	4,4361	0,350194	0,0691	40,6214
360IFPEAttitude	7	0,2433	0,1432	-0,0373	0,5239	-0,4026	0,8892	-0,3385	0,8251	1,6994	0,089252	12,0163	0,061606	0,0881	62,7655
360IFPEEmpathy	6	0,5429	0,1408	0,2669	0,8189	0,0562	1,0296	0,1420	0,9438	3,8557	0,000115	7,1897	0,206907	0,0418	35,5832
ITPEAttitude	4	0,6033	0,2597	0,0943	1,1123	-0,4571	1,6636	-0,3269	1,5335	2,3230	0,020181	13,5697	0,003553	0,2252	83,9581
ITPEEmphaty	4	0,3082	0,0722	0,1666	0,4498	0,1666	0,4498	0,3082	0,3082	4,2667	0,000020	2,8548	0,414563	0,0000	0,0000
ISICAttitude	4	0,2440	0,1054	0,0375	0,4506	0,0375	0,4506	0,2440	0,2440	2,3159	0,020563	2,7175	0,437269	0,0000	0,0000
ILMC	41	0,4092	0,0901	0,2326	0,5858	-0,6450	1,4633	-0,6301	1,4484	4,5415	0,000006	222,7565	0,000000	0,2811	87,7786
PTCM	8	0,3121	0,2168	-0,1128	0,7370	-0,8633	1,4875	-0,7838	1,4080	1,4395	0,150004	14,6045	0,041417	0,3126	87,4806
IEECM	20	0,4800	0,0708	0,3412	0,6188	0,0712	0,8888	0,0954	0,8645	6,7759	0,000000	49,1718	0,000173	0,0385	43,7103
ScreenHMD	31	0,5253	0,1980	0,1372	0,9134	-1,6124	2,6629	-1,5769	2,6275	2,6527	0,007985	212,8866	0,000000	1,1503	96,0552
Screen360HMD	14	0,2761	0,1587	-0,0349	0,5871	-0,8328	1,3850	-0,7883	1,3405	1,7402	0,081829	70,8236	0,000000	0,2949	86,8154
TextHMD	10	0,4451	0,5642	-0,6606	1,5508	-3,1779	4,0681	-3,0052	3,8953	0,7889	0,430147	408,8805	0,000000	3,0988	98,0171
ScreenORScreen360Cardboard	13	0,1463	0,1086	-0,0665	0,3592	-0,5407	0,8334	-0,5069	0,7996	1,3473	0,177894	50,7562	0,000001	0,1111	74,9332
ScreenORScreen360HMD	45	0,4375	0,1456	0,1522	0,7228	-1,4338	2,3089	-1,4120	2,2870	3,0058	0,002649	283,8935	0,000000	0,8904	95,0835
TextHMDNoLiu	9	0,8506	0,4292	0,0094	1,6919	-1,7451	3,4464	-1,6051	3,3064	1,9819	0,047494	99,3516	0,000000	1,5698	95,8878
TextHMDNoLiuKalyanaraman	7	0,2973	0,1140	0,0738	0,5209	-0,1116	0,7063	-0,0451	0,6398	2,6072	0,009129	14,8678	0,021310	0,0305	34,6236

Detailed results of the comparison between groups

Grupo1	Grupo2	Q_between	p_between	Q_within	df_within	p_within	Q_total	df_total	p_total
Gender 40perc-59perc	Gender +60perc	1,083054	0,298015	323,434258	70	0,000000	324,517313	71	0,000000
Gender 40perc-59perc	Gender 100perc	0,390432	0,532072	191,747472	47	0,000000	192,137904	48	0,000000
Gender +60perc	Gender 100perc	0,002377	0,961117	153,611142	35	0,000000	153,613519	36	0,000000
AgeStudents18-25	AgeStudents+25	0,261416	0,609149	176,754546	49	0,000000	177,015961	50	0,000000
AgeStudents18-25	AgeYoungAdults	4,926323	0,026451	171,294001	46	0,000000	176,220323	47	0,000000
AgeStudents18-25	AgePublicGeneral	0,757812	0,384014	174,904421	50	0,000000	175,662233	51	0,000000
AgeStudents18-25	AgePublicGeneral+25	0,295490	0,586724	160,843826	46	0,000000	161,139316	47	0,000000
AgeStudents18-25	AgePublicGeneral-25	0,647801	0,420900	152,016029	45	0,000000	152,663830	46	0,000000
AgeStudents+25	AgeYoungAdults	3,327205	0,068143	72,123913	11	0,000000	75,451118	12	0,000000
AgeStudents+25	AgePublicGeneral	0,049978	0,823102	75,734333	15	0,000000	75,784311	16	0,000000
AgeStudents+25	AgePublicGeneral+25	0,007845	0,929421	61,673738	11	0,000000	61,681583	12	0,000000
AgeStudents+25	AgePublicGeneral-25	0,123025	0,725777	52,845941	10	0,000000	52,968966	11	0,000000
AgeYoungAdults	AgePublicGeneral	2,289802	0,130227	70,273788	12	0,000000	72,563590	13	0,000000
AgeYoungAdults	AgePublicGeneral+25	1,438690	0,230352	56,213193	8	0,000000	57,651883	9	0,000000
AgeYoungAdults	AgePublicGeneral-25	1,542451	0,214253	47,385396	7	0,000000	48,927847	8	0,000000
AgePublicGeneral	AgePublicGeneral+25	0,007329	0,931779	59,823614	12	0,000000	59,830942	13	0,000000
AgePublicGeneral	AgePublicGeneral+25	0,007329	0,931779	59,823614	12	0,000000	59,830942	13	0,000000
AgePublicGeneral+25	AgePublicGeneral-25	0,022961	0,879559	36,935222	7	0,000005	36,958182	8	0,000012
Migration_Racism_Refugees	Refugees	0,007492	0,931025	300,078142	49	0,000000	300,085634	50	0,000000
Migration_Racism_Refugees	RacismBlackPeople	0,003191	0,954950	178,928644	43	0,000000	178,931836	44	0,000000
Migration_Racism_Refugees	Migration	0,006791	0,934322	182,117628	38	0,000000	182,124419	39	0,000000
Migration_Racism_Refugees	Children	0,292195	0,588817	287,160568	55	0,000000	287,452763	56	0,000000
Migration_Racism_Refugees	Healthcare	0,321528	0,570691	219,719173	41	0,000000	220,040700	42	0,000000
Migration_Racism_Refugees	Schizophrenia	0,003853	0,950505	182,183902	37	0,000000	182,187755	38	0,000000
Migration_Racism_Refugees	Ageism	1,809502	0,178568	189,390997	41	0,000000	191,200499	42	0,000000
Migration_Racism_Refugees	Disabilities	0,847887	0,357151	187,640020	38	0,000000	188,487907	39	0,000000
Migration_Racism_Refugees	Stigmatized	6,169014	0,013001	173,006342	41	0,000000	179,175355	42	0,000000
Refugees	RacismBlackPeople	0,016261	0,898529	148,077565	26	0,000000	148,093827	27	0,000000
Refugees	Migration	0,013230	0,908429	151,266549	21	0,000000	151,279779	22	0,000000
Refugees	Children	0,219252	0,639611	256,309489	38	0,000000	256,528741	39	0,000000
Refugees	Healthcare	0,225355	0,634989	188,868094	24	0,000000	189,093449	25	0,000000
Refugees	Schizophrenia	0,006173	0,937376	151,332823	20	0,000000	151,338996	21	0,000000
Refugees	Ageism	1,179282	0,277502	158,539918	24	0,000000	159,719200	25	0,000000
Refugees	Disabilities	0,681668	0,409013	156,788941	21	0,000000	157,470609	22	0,000000
Refugees	Stigmatized	3,945611	0,046994	142,155263	24	0,000000	146,100874	25	0,000000
RacismBlackPeople	Migration	0,035158	0,851265	30,117052	15	0,011506	30,152209	16	0,017229
RacismBlackPeople	Children	0,142857	0,705457	135,159992	32	0,000000	135,302849	33	0,000000
RacismBlackPeople	Healthcare	0,273570	0,600947	67,718596	18	0,000000	67,992166	19	0,000000
RacismBlackPeople	Schizophrenia	0,022763	0,880076	30,183326	14	0,007200	30,206088	15	0,011200
RacismBlackPeople	Ageism	2,623374	0,105300	37,390420	18	0,004660	40,013795	19	0,003259
RacismBlackPeople	Disabilities	0,708192	0,400045	35,639444	15	0,001992	36,347636	16	0,002588
RacismBlackPeople	Stigmatized	17,674420	0,000026	21,005766	18	0,279122	38,680186	19	0,004857
Migration	Children	0,069628	0,791880	138,348975	27	0,000000	138,418603	28	0,000000
Migration	Healthcare	0,138064	0,710214	70,907580	13	0,000000	71,045643	14	0,000000
Migration	Schizophrenia	0,000106	0,991788	33,372309	9	0,000115	33,372415	10	0,000236
Migration	Ageism	1,422769	0,232948	40,579404	13	0,000111	42,002173	14	0,000124
Migration	Disabilities	0,472499	0,491840	38,828427	10	0,000027	39,300927	11	0,000047
Migration	Stigmatized	7,015749	0,008080	24,194749	13	0,029385	31,210498	14	0,005179
Children	Healthcare	0,024164	0,876469	175,950520	30	0,000000	175,974684	31	0,000000
Children	Schizophrenia	0,052684	0,818456	138,415249	26	0,000000	138,467934	27	0,000000
Children	Ageism	0,773253	0,379213	145,622344	30	0,000000	146,395597	31	0,000000
Children	Disabilities	0,338016	0,560976	143,871368	27	0,000000	144,209384	28	0,000000
Children	Stigmatized	3,811200	0,050911	129,237689	30	0,000000	133,048889	31	0,000000
Healthcare	Schizophrenia	0,094552	0,758469	70,973854	12	0,000000	71,068406	13	0,000000
Healthcare	Ageism	0,399655	0,527267	78,180949	16	0,000000	78,580604	17	0,000000
Healthcare	Disabilities	0,162998	0,686411	76,429972	13	0,000000	76,592970	14	0,000000
Healthcare	Stigmatized	2,659722	0,102919	61,796294	16	0,000000	64,456016	17	0,000000
Schizophrenia	Ageism	0,905850	0,341218	40,645678	12	0,000056	41,551528	13	0,000078
Schizophrenia	Disabilities	0,377205	0,539103	38,894702	9	0,000012	39,271906	10	0,000023
Schizophrenia	Stigmatized	5,369824	0,020488	24,261023	12	0,018740	29,630848	13	0,005322
Ageism	Disabilities	0,056091	0,812784	46,101796	13	0,000014	46,157887	14	0,000026
Ageism	Stigmatized	0,974134	0,323651	31,468118	16	0,011719	32,442252	17	0,013252
Disabilities	Stigmatized	3,202756	0,073514	29,717141	13	0,005172	32,919897	14	0,002959
Empathy	Attitude	0,243409	0,621755	774,208591	100	0,000000	774,451999	101	0,000000
Empathy	Intention	0,003900	0,950205	884,998746	76	0,000000	885,002645	77	0,000000
Empathy	IOS	0,553910	0,456724	698,852392	68	0,000000	699,406302	69	0,000000
Attitude	Intention	0,086393	0,768814	325,366838	64	0,000000	325,453231	65	0,000000
Attitude	IOS	0,884949	0,346850	139,220484	56	0,000000	140,105433	57	0,000000
Intention	IOS	0,493446	0,482394	250,010639	32	0,000000	250,504085	33	0,000000
EmpathyEmotional	EmpathyCognitive	1,982837	0,159092	179,213053	38	0,000000	181,195889	39	0,000000
EmpathyEmotional_Batson	EmpathyEmotional_IRI	0,170830	0,679375	83,672570	16	0,000000	83,843400	17	0,000000
AttitudeImplicit_IAT	AttitudeExplicit	1,041429	0,307489	34,375358	13	0,001055	35,416787	14	0,001275
360-degree video	3DCG	0,615483	0,432731	342,656043	82	0,000000	343,271526	83	0,000000
360IW	3DIFPE	0,641418	0,423198	329,106370	56	0,000000	329,747788	57	0,000000
360IW	360IFPE	0,464283	0,495629	200,352296	37	0,000000	200,816579	38	0,000000
360IW	ITPE	0,395281	0,529536	193,110522	32	0,000000	193,505803	33	0,000000
360IW	ISIC	0,265103	0,606636	197,352567	32	0,000000	197,617670	33	0,000000
3DIFPE	360IFPE	0,000000	0,999705	148,862045	39	0,000000	148,862045	40	0,000000
3DIFPE	ITPE	0,012681	0,910341	141,620271	34	0,000000	141,632952	35	0,000000
3DIFPE	ISIC	0,000342	0,985242	145,862316	34	0,000000	145,862658	35	0,000000
360IFPE	ITPE	0,106088	0,744642	12,866197	15	0,612632	12,972285	16	0,674783
360IFPE	ISIC	0,007669	0,930214	17,108242	15	0,312435	17,115911	16	0,378135
ITPE	ISIC	0,022388	0,881059	9,866468	10	0,452286	9,888856	11	0,540412
360IW_EmpathyEmotional	360IW_EmpathyCognitive	1,680297	0,194885	107,860697	15	0,000000	109,540995	16	0,000000
ILMC	PTCM	0,292941	0,588342	237,361022	47	0,000000	237,653963	48	0,000000
ILMC	IEECM	0,804897	0,369633	271,928378	59	0,000000	272,733275	60	0,000000
PTCM	IEECM	3,153992	0,075741	63,776307	26	0,000051	66,930299	27	0,000030