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VR content and its prosocial impact: predictors, moderators, and mediators of media effects. A systematic literature review

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The main purpose of this paper is to explore the prosocial impact of virtual reality (VR) audiovisual content based on a systematic literature review of empirical research on immersive VR media's potential to elicit prosocial behaviors. The illusion of place, verisimilitude, and virtual corporeality are the main elements that underpin the creation of immersive experiences that can turn the user into an active subject of the narrative, engaging with the audiovisual content and feeling the emotions it elicits. A virtual reality system that can offer these three elements provides the means to transform not only the user's sensation of space and reality, but even the users themselves. The question this paper seeks to answer is whether audiovisual VR content can influence an individual's thoughts and feelings about otherness, thereby eliciting prosocial behaviors rooted in a sense of social justice, equality and fairness. To this end, it presents a systematic literature review in accordance with the guidelines of the PRISMA statement, applying a self-deductive coding system based on the Differential Susceptibility to Media Effects Model. The review identifies trends in research on the prosocial potential of VR content, among which perspective taking stands out as one of the most common strategies. In addition, predictors, moderators, mediators, effects, and their correlations are identified in the research reviewed.

KEYWORDS

virtual reality, prosocial impact, media effects, DSMM model, PRISMA statement, systematic literature review

1. Introduction

Since the earliest days of virtual reality (VR), from Robert Barker's panorama-building designs in 1787 (Otto, 2007) to the *Sensorama* of the mid-1950s (Heilig, 1957; patent from 1962) and Sutherland's head mounted display (HMD) in 1968, virtual immersive media has eluded standardization in favor of diverse experimentation. However, since the beginning of the 21st century, the field of audiovisual immersive media has been expanding slowly but surely. VR creators, designers, and researchers are working to shed light on conventions, languages, affordances, and strategies with the aim of defining VR's impact on audiences. As Bolter and Grusin (1996) suggest, new media forms remediate and refashion the conventions of previous forms, until they develop a unique voice sufficient to their affordances. In this sense, with the advent of the metaverse, VR has climbed Gartner's "slope of enlightenment" and reached the "plateau of productivity," integrated into new use-cases with creative and useful applications (Panetta, 2017).

1.1. Conceptualizing VR

Throughout the second half of the 20th century, research focused on the technological wonders of virtual reality, while neglecting the user experience and its possible applications (Stanković, 2015). For instance, in 1965 Sutherland depicted immersive media systems as rooms that would include "interactive graphics, force-feedback, sound, smell and taste" (Sutherland, 1965; Mandal, 2013, p. 304). The fascination with new media often led to disillusionment due to excessively high expectations, as researchers explored the technological possibilities without considering the emotions they may elicit.

It was for this reason that Steuer (1992) criticized definitions of VR that took an exclusively "device-driven" perspective. Moving beyond this perspective, Coates (2003) describes an electronic apparatus composed of a head-mounted display (HMD) and wired clothing to interact in a 3D situational environment. Greenbaum (1992) added movement tracking in an "alternate world" of computer imaging. Cruz-Neira (1993) and Gigante (1993) included the "synthetic environment" into the concept of the immersive multi-sensory experience and combined the technological capabilities of the devices (for example, the HMD should offer a stereoscopic display, head movement, and position tracking, facilitating a deeper connection between the content and the user).

Apart from the technological perspective, although we consider her "viewer-centered" approach to be the most important aspect of Cruz-Neira's contribution, she anticipates "three common features of VR: immersion, presence, and interaction" as highlighted by Biocca (1997), Heeter (2000), Biocca et al. (2001a,b), Bailenson et al. (2006), Slater (2009), Mandal (2013), Lopreiato et al. (2016), and Cipresso et al. (2018). Blascovich et al. (2002) emphasize a definition of VR based on its purpose: to deceive the senses into perceiving a representation of reality through synthetic sensory information as if it were not synthetic. Yoh (2001) identifies the imprecision of the term, as it changes its meaning depending on the context, while Bown et al. (2017, p. 255) describe VR as a simulation perceived as being real, mediated by "presence as the effect caused by perceiving an essential copy," following physical transcendence. Zhou and Deng (2009) classify the definitions of VR in two blocks: technology-based and immersion-based. Finally, Kardong-Edgren et al. (2019) critique the "lack of standardization," reviewing all previous definitions and suggesting that the concept should take levels of immersion into account, to which end they propose three: low, medium, and high, based on Slater and Wilbur (1997).

Although cinema and books are technologies at least a century old, every time a person laughs, cries or feels immersed while watching a film or reading an engaging novel is having a virtual experience. Today's broad conception of VR is mainly based on immersion and user interaction. Other features that build a more specific type of immersive media could be telepresence, simulation, and full-body immersion (Heim, 1998). For our purposes, taking into account both technological and experiential perspectives, the definition of VR can be narrowed down to the use of advanced hardware and software capabilities to create user-centered high-fidelity emotional experiences that go beyond the two-dimensional screen. Thus, in the high-level (Kardong-Edgren et al., 2019) immersive system (Cipresso et al., 2018), the human senses are substituted with computer signals and the user's movements are tracked and mirrored.

Finally, the four key features for user engagement are immersion, presence, interaction (Biocca, 1997; Lombard and Ditton, 1997; Loomis et al., 1999; Heeter, 2000; Biocca et al., 2001a,b; Bailenson et al., 2006; Skalski and Tamborini, 2007; Andersen and Thorpe, 2009; Slater, 2009; Sundar et al., 2010; Cipresso et al., 2018), and embodiment, through which the user takes part in realistic events. Mind perception plays a paramount role for the user to feel present in any environment. The degree of flow (Zhou and Deng, 2009) thus mediates the feeling of being involved and present in an alternate possible reality. Immersion therefore depends on the level of presence, understood as how real the VR experience feels, and the degree of vividness (Steuer, 1992; Levis, 2006). Embodiment mediates the level of presence and hence the immersion. Technically, VR immersion depends on "tracking, rendering and display" (Bailenson, 2018), and if these three components are all well-balanced, users will feel like they are in the shoes of another person, opening up the possibility to create perspective-taking experiences. These ideas are central to the definition of VR and the investigation of its prosocial impact on audiences in order to shed light on the trends, features, and effects of immersive media.

1.2. VR, empathy, and prosocial behavior

Although in other disciplines VR is used for training professionals or as a form of treatment for certain "phobias and psychological disorders" (Riva et al., 2019), in the field of communication studies it is used to create new audiovisual immersive and interactive discourses that focus on emotion, storytelling, and ludic engagement. In some of these explorations, new storytelling strategies are using this technology with the aim of instilling values of justice, fairness, and equity in the spectator, thereby contributing to the betterment of contemporary societies. While grandiose claims such as Milk's (2015) that VR is "the ultimate empathy machine" have been questioned (Robertson, 2017) due to the lack of empirical evidence to support the empathy-model and the lack of a corpus of studies concerning the impact of VR cinematic experiences (Sora-Domenjó, 2022), this paper considers creators and researchers who are interested in the media effects of VR and summarizes the main findings of their research on VR's prosocial impact.

Empathy is defined as the ability to share someone else's emotions (Herrera et al., 2018) and may involve both perspective-taking and feelings-based connections. *Prosocial behavior* has generally been described as "voluntary, intentional behavior that results in benefits for another" (Staub, 1978; Eisenberg, 1982). González Portal (1992) defines *prosocial behavior* as every positive social act with or without altruistic motivations. It is thus a type of moral behavior related to the notions of justice and fairness. The study of prosocial behavior can contribute to the prevention of antisocial behavior such as aggression, violence, indifference to the problems of others, sexism, xenophobia, and environmental neglect. Prosocial behavior could be fostered through the development of media representations that model

prosocial skills (Moñivas, 1996). In the context of VR, prosocial media experiences are those that have a positive impact on the user. In short, they are immersive experiences designed to place the viewer in a space for reflection, to subvert prejudices and to impart values that can challenge implicit or explicit biases.

New developments in audiovisual activism take advantage of the immersive power and presence factor of VR to create narratives that place users inside the scenes (Martínez-Cano et al., 2020). The illusion of place, plausibility (or verisimilitude with a sense-of-presence) and virtual corporeality (or appropriation of the virtual body) are the main elements that underpin the creation of immersive experiences. Through these, VR storytelling is capable of immersing the user as an active subject of the narrative, who engages with the audiovisual content and the feelings it elicits. A virtual reality system able to offer these three elements provides the means to transform not only the user's sensation of space and reality, but even the users themselves (Peña et al., 2010).

Illusion of place helps to create the effect of presence. It works as a mirage that maintains the consistency of the VR space around the user. Together with verisimilitude and corporeality, it can produce an even deeper sense of real presence in a close-to-reality experience. Verisimilitude can be understood as the process whereby users voluntarily set aside their critical sense when judging the realism of what they are seeing (Bates, 1992), while corporeality, also known as embodiment, is the effect that enables users to feel the virtual representation of their body as their own (Kilteni et al., 2012). All three of these elements contribute to inserting users into a virtual fictional situation that can help them to empathize in a direct way with their avatar, thus promoting empathetic behaviors toward the people involved in the conflict depicted in the VR experience (Martínez-Cano, 2020, p. 608). As Bucher (2017, p. 6) suggests, the combination of film techniques with immersive strategies "creates an even greater sense of an unmediated experience and more immediate meanings for the viewer." On this specific point, Kalyanaraman and Bailenson (2019, p. 404) argue that the key difference between VR and traditional media is the increasingly blurred "line between what constitutes 'real' and what constitutes 'mediated'." Moreover, in their survey of the use of virtual reality to foster empathy, Christofi and Michael-Grigoriou (2017, p. 6) find "preliminary support for the use of VR to successfully induce empathy in people and reduce their prejudices toward stigmatized groups".

According to McRoberts (2018, p. 2), nonfiction VR cinema "can be distinguished from other forms of VR by dint of the fact that it aims to immerse users within real-world stories," where the sense of presence is intended to generate empathic engagement as a catalyst for social transformation. In the same vein, Brautović et al. (2017) assert that creators of audiovisual products are demonstrating that VR content is a good way to engage audiences and promote empathic behaviors. Nash (2018) suggests that it is possible for VR to foster an empathic response to the other, but that this is not guaranteed by the mere fact of building the media discourse with this technology; rather, it depends on the way the virtual experience is designed.

Research by Archer and Finger (2018) on the generation of empathy in users of immersive audiovisual products concludes that immersive formats result in stronger empathic responses than traditional media, resulting in a higher probability that these subjects will take part in political or social actions. Similarly, research conducted by the sociology department at Oxford University comparing the prosocial impact of conventional and immersive media finds that target-specific perspective-taking VR formats have a bigger influence on users (Van Loon et al., 2018). Overall, recent research unequivocally confirms the importance of audiovisual media as a social agent and demonstrates VR's powerful influence on audiences, which is found to be greater than that of traditional media. However, levels of immersion and media effect in the medium and long term still need to be measured and tested.

2. Methods

This article presents a systematic literature review (SLR) of research on VR's capacity to positively influence the values and behaviors of users. The studies considered constitute pioneers in the application of immersive technologies as prosocial tools, establishing a foundation for this line of research. This is research that proposes a wide range of experimental designs that consider the question from both conceptual and technological perspectives.

For the development of this systematic review, the guidelines of the PRISMA statement (Moher et al., 2009) were followed (Figure 1). Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was inspired by the QUORUM statement, which was developed in 1999 as a standard for publishing meta-analyses of randomized controlled trials. PRISMA was updated in 2009 and 2020 to incorporate several advances in the field of systematic reviews (Page et al., 2021). Although systematic reviews and meta-analyses are increasingly important in the health sciences, the field for which this guideline was originally developed, they have since been applied to a wide range of fields of study to help researchers to standardize the process and improve the presentation of research methodologies. In addition, the software Atlas.it was used for the coding and qualitative content analysis of the papers and studies included in the screening phase. The coding was completed by three independent researchers in order to avoid the risk of bias. The review process was separated into four different phases: scoping, searching, screening, coding, and qualitative content analysis. For this last stage, a self-developed deductive coding system was applied (Figure 4), based on the Differential Susceptibility to Media Effects Model (DSMM; Valkenburg and Peter, 2013).

2.1. Scope

The focus of this review is on audiovisual VR content's potential to influence individuals' thoughts and feelings about otherness, thereby eliciting prosocial behaviors rooted in a sense of social justice, equality, and fairness. The main goal is thus to provide a narrative overview of the scientific literature related to empirical research on the potential of immersive VR media to induce prosocial behaviors. Based on the DSMM model (Valkenburg and Peter, 2013), this SLR aims to identify predictors, moderators, mediators, and effects and their transactionality in VR mediated experiences. The sample consists of experimental studies that focus

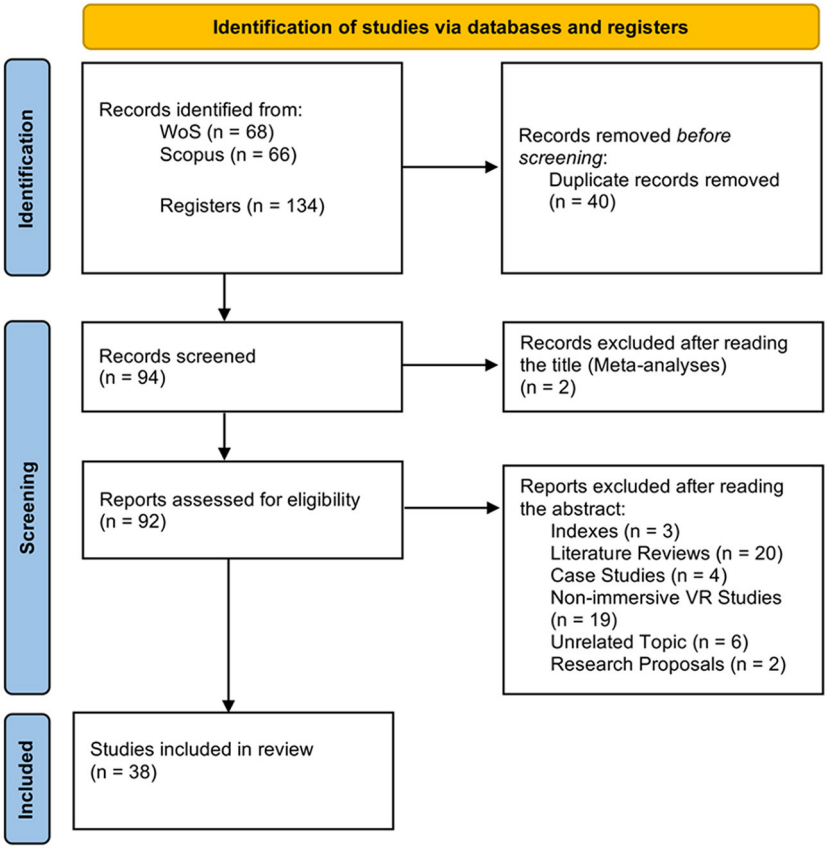

FIGURE 1
PRISMA 2020 flow diagram for new systematic reviews. Source: Authors, based on the PRISMA statement (http://www.prisma-statement.org/).

on clarifying the complex process of mediating a prosocial response through VR. In relation to this process, key questions to be answered include:

- Are there any trends identifiable in studies analyzing prosocial media effects of virtual reality audiovisual content?
- Does VR have validity as a tool for researching media effects?
- Are there any standardized methodologies for the study of VR narratives' prosocial impact?
- Is there enough evidence to assert that VR content is capable of eliciting positive attitudinal changes in audiences?
- What are the factors involved in achieving an effective prosocial outcome by experiencing VR content? How do they interact?
- Does virtual media intergroup contact work like actual intergroup contact?

2.2. Systematic search

The first searches were conducted in January 2021, using the terms "virtual reality" and "prosocial" in Web of Science (WoS) and Scopus, as these are the main databases used for social and human sciences research, and WoS is specifically recommended for media and communication studies (Hansen and Machin, 2018). Although a systematic review of the field of study published in 2017, *Immersive Environments and Virtual Reality: Systematic Review and Advances in Communication, Interaction and Simulation* (Rubio-Tamayo et al., 2017), the searches were not limited by year, as there is no systematic review to date focusing on the prosocial impact of virtual reality audiovisual content. No limitations were specified on the type of research document either, so articles, book chapters, conference papers, and books were all included in the search results. A systematic search of both databases was again at the end of August 2021, with the aim of identifying new publications. The combination of terms used in WoS was TS=(("virtual reality" OR "VR") AND ("prosocial")), yielding 55 results. In Scopus, the search string was TITLE-ABS-KEY (("virtual reality" OR "VR") AND ("prosocial")), obtaining 47 results. A final search using the same terms was conducted on January 25, 2023, with the aim of including the latest research published up to December 31, 2022 (68 results from WoS and 66 from Scopus). Eventually, a total of 134 research works were submitted to the next phase. Before determining the articles to be selected, inclusion and exclusion criteria were defined.

2.2.1. Inclusion criteria

Documents meeting any of the following criteria were included:

- Empirical research focusing on the impacts of VR on the audience and not reviews or case studies.

- Studies using virtual reality technology to test its potential to induce prosocial behavior or how it can positively alter users' behavior.
- Studies proposing an experimental design and including some method of measuring the effects of the mediated experience.
- Studies exploring mediated experiences that deal with a social conflict and/or with a helping situation.

2.2.2. Exclusion criteria

Documents meeting any of the following criteria were eliminated:

- Literature reviews, systematic reviews and meta-analyses.
- Studies that do not provide an experimental design or a proposal.
- Studies that do not include some method of measuring the effects of the mediated experience.
- Studies that approach the term "virtual" from an online perspective but not with reference to immersive virtual reality environments.
- Studies dealing with an area of knowledge or subject matter unrelated to either prosocial or VR mediated experiences.
- Papers that only present a pilot study proposal.

2.2.3. Selection of databases and potential risks of bias

The use of WoS and Scopus provides an interface that allows quality control of the most relevant results related to the study subject and access to publications (Morris et al., 2009), in contrast to other approaches, such as Google Scholar (GS), which lack advanced search capabilities (Harzing and Alakangas, 2016). Both WoS and Scopus are continually developing their features and growing their data collections. Among other sources, both databases include material from conference proceedings published by ACSM, Springer, and IEEE. Its open access and extensive coverage give GS a significant advantage over WoS and Scopus. However, these features also make it less trustworthy as a source of bibliographic data (Pranckute, 2021). Citations from the same conference or publication appear replicated in different formats in the GS list of documents, whereas they are more consistently formatted and organized in WoS and Scopus. Due to these limitations, GS occasionally provides search results of questionable accuracy or quality (Falagas et al., 2008; Clermont and Dyckhoff, 2012; Harzing and Alakangas, 2016) and has limitations in terms of information retrieval and organization (Meho and Yang, 2007). The main shortcomings of the GS system include the lack of transparency in its coverage (Wouters and Costas, 2012), the inability to export data, and the possibility of data manipulation (López-Cózar et al., 2014).

Additional data sources that are more current than WoS and Scopus are also available, such as Microsoft Academic, CrossRef, and Dimensions. According to Harzing (2019), these sources provide different levels of citation coverage along with essentially similar publication coverage. CrossRef and Dimensions could serve as good alternatives to Scopus and WoS (Thelwall, 2018; Harzing, 2019). However, these data sources include preprint articles that have not yet undergone peer review, which might be a drawback when conducting literature reviews (Harzing, 2019; Singh et al., 2021). In addition, Scopus and WoS outperform Dimensions and Microsoft Academic in terms of the quality of the citation links (Visser et al., 2021). Other databases, such as PubMed, Engineering Source, Business Source Premier, ERIC, and Compendix, are quite specialized and therefore may not be suitable for more interdisciplinary content needs.

The selection of WoS and Scopus was based on the fact that they are historically the two most established databases (Delgado and Repiso, 2013; Singh et al., 2021). Their use does not require justification, whereas other sources such as GS are not immune to criticism (Harzing and Alakangas, 2016, p. 5). WoS and Scopus are two reliable sources of bibliographic data for comprehensive reviews and scientometric analyses (Archambault et al., 2009; Pranckute, 2021). They also facilitate replication through a systematic search process (Suárez et al., 2022). Furthermore, considering the multidisciplinary nature of their coverage (Archambault et al., 2006), both databases offer significant advantages for this SLR.

Publication bias is endemic (Copas and Shi, 2001). Over the past two decades, bias in research has been a significant concern (Sun and Pan, 2020). The selection of databases is a crucial step in systematic reviews, yet the optimal number of databases required for accurate extraction of relevant literature is still a largely unexplored question (Green et al., 2006; Wanyama et al., 2022). Reviewers such as Daigneault et al. (2014) recommend conducting searches across multiple databases, while Green et al. (2006, p. 107) suggest using at least two. Although WoS and Scopus are widely regarded as two of the largest and most comprehensive sources of publication metadata and impact indicators (Mongeon and Paul-Hus, 2016; Pranckute, 2021, p. 48; Singh et al., 2021), as "referential databases," and as two of the most important sources of bibliographic data (Etxebarria and Gomez-Uranga, 2010; Harzing and Alakangas, 2016), there is still a potential risk of bias. Firstly, it is important to note that these databases are subscription-based commercial products, and they serve as the primary data sources for internationally recognized university ranking organizations. Secondly, journal rankings can be misleading. The quality of a publication is assessed on the basis of its bibliometric impact, as the scientific rating system is designed to evaluate scientific output. Therefore, studies that contribute to the research topic but have not been published in internationally recognized journals with high impact factors may not be included (Egger and Smith, 1998). This is why some authors suggest that "journal rankings may be considered, but with caution" (Wanyama et al., 2022, p. 11).

Even if a study is conducted according to the highest standards, risks of bias may still exist. In the case of this SLR, we have identified some potential biases associated with using WoS and Scopus as the primary data sources. The most relevant issue might be location bias, which concerns the accessibility of research "based on variable indexing in electronic databases" (Sterne et al., 2008, p. 305). The selection of databases to be searched may introduce bias into the records included in the systematic review and therefore affect the results. As mentioned above, some studies published in low- or non-impact factor journals may not be indexed in these databases. Another bias to consider is regional or country bias, as well as

language coverage. Some authors suggest that studies published in certain countries may have a greater chance of being indexed in electronic databases (Archambault et al., 2006; Mongeon and Paul-Hus, 2016). This occurs more frequently in the field of social sciences because their topics often focus on specific regions, and their intended audience is usually limited to a single nation or region (Archambault et al., 2009). Moreover, the ideas and issues addressed in the social sciences can often only be expressed and understood within the cultural context in which they are developed. As a result, social science scholars tend to write more in their native language and publish in journals with limited distribution (Gingras, 1984; Line, 2000). Similarly, bias toward English-language journals may penalize papers written in other languages due to the use of databases that include only a small proportion of non-English publications (Mela et al., 1999), as is the case with WoS and Scopus (Mongeon and Paul-Hus, 2016). There is also a risk of citation bias, as positive studies may be easier to identify and therefore more likely to be included, which could influence the results (Carter et al., 2006). Finally, search results in databases can vary depending on the extent to which they cover different subject areas. In this regard, Dimensions provides better coverage of the social sciences and humanities, to the benefit of these fields. Although WoS and Scopus are biased toward the natural sciences, engineering, and biomedical research (Mongeon and Paul-Hus, 2016), both databases provide more comprehensive coverage across various disciplines (Singh et al., 2021).

2.3. Screening

Based on these criteria and by reading the titles alone, 92 articles were considered suitable (after eliminating 40 duplicates between the two databases and two meta-analyses). In the next step, after reading the abstracts, 54 were discarded, because they were indexes of conference proceedings ($n = 3$), systematic and other types of reviews of the scientific literature ($n = 20$), case studies ($n = 4$), studies that do not deal with immersive virtual reality environments ($n = 19$); studies dealing with topics unrelated to virtual reality-mediated experiences and prosocial responses ($n = 6$); or studies that do not involve an empirical study but only propose a pilot experimental design without testing it ($n = 2$), the proportions of included and excluded materials are shown in Figure 2.

Following this screening process, 38 articles met the inclusion criteria and were selected for the systematic review (Figure 1). All addressed VR-mediated experiences and tested their power to alter viewer behaviors by applying behavioral, physiological or self-reporting measures. In addition, they all proposed an experimental design that in all cases maintained the following basic scheme: initial data collection from the user prior to the VR media experience, followed by a second round of data collection after the experience. Some studies differed in that they incorporated the collection of physiological data from the viewer during the consumption of the VR content, or collected medium- and long-term behavioral data. Despite these differences, it was decided to include these studies as their approaches are similar and their results are comparable with each other and with the other studies, facilitating a classification of the different types of empirical studies carried out to date to test the media impact of immersive VR.

Most of the studies use immersive 3D interactive virtual environments (IVE) with synthetic images as a means to introduce the user to the manipulated experience ($n = 19$), but there are also studies that use 360-degree video ($n = 13$) as the type of immersive media to be tested. Only four of the studies focusing on interactive virtual reality with synthetic images define their content or refer to it as a video game ($n = 4$) and one uses an online virtual social network platform (Altspace VR; $n = 1$). All the others treat the narrative and interactive content as a mediated experience ($n = 34$). There is also a group of studies that compare the effect of a traditional medium or dynamic with its virtual reality analog ($n = 14$). Of all the research reviewed, only three conducted medium- and long-term studies. The rest focus only on immediate short-term impact ($n = 35$).

2.4. Coding and qualitative content analysis

Any mediated experience and its effects could be objectively analyzed using the Differential Susceptibility to Media Effects Model (DSMM) (Valkenburg and Peter, 2013) (Figure 3). The coding and qualitative analysis of the studies included in this review is based on this model. DSMM is a model designed to facilitate a better understanding of media effects, based on media effects theories. "It distinguishes three types of susceptibility to media effects: dispositional, developmental, and social susceptibility" and it works as a "mixing console" proposing "three media response states that mediate media effects: cognitive, emotional, and excitative" (Valkenburg and Peter, 2013, p. 221). This model is based on four propositions. The first is that media effects are considered to be conditional, depending on three types of variables: dispositional, developmental, and social. These are defined as differential-susceptibility variables. Dispositional susceptibility refers to "all person dimensions" including "gender, temperament, personality, cognitions, values, attitudes, beliefs, motivations and moods" (Valkenburg and Peter, 2013, p. 221). Developmental susceptibility refers to how the cognitive, emotional, and social development of all individuals predetermines the type of media they want to consume and how. Finally, social susceptibility is identified as all social and environmental elements that may affect the type of media consumed and how. Media effects therefore depend on differential-susceptibility variables.

Proposition 2 establishes that media effects are indirect and there are three media response states that mediate the connection between media effects and how media are consumed and used: the cognitive response state, or the way users actively choose and try to comprehend media content; the emotional response state, understood as all the affective reactions to media content; and the excitative response state, or the extent to which a person experiences physiological changes as a media response. Proposition 3 defines the two roles of the differential-susceptibility variables "as predictors of media use and as moderators of the effect of media use on media response states" (Valkenburg and Peter, 2013, p. 231). Therefore, the variables that influence media use also moderate the effects on the response states resulting from media consumption.

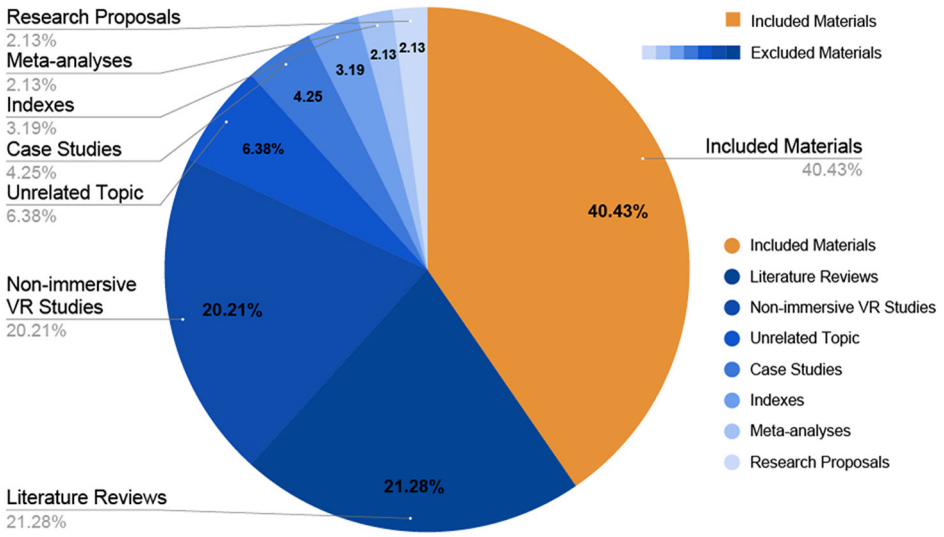

FIGURE 2
Proportions of included and excluded materials. Source: Martínez-Cano, Lachman and Canet.

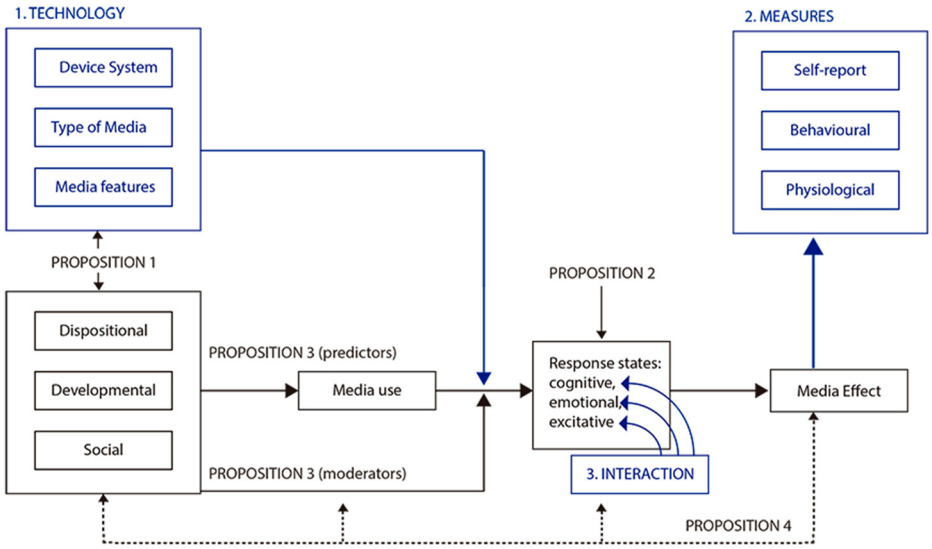

FIGURE 3
DSMM Model (Valkenburg and Peter, 2013) and the three categories added. Source: Original DSMM model shown in black (Valkenburg and Peter, 2013); proposed extension of the model shown in blue (based on Canet and Pérez-Escolar, 2022).

Finally, proposition 4 identifies the transactionality of media effects, meaning that they can in turn function as media response states and as predictors and moderators, as indicated by the dotted line in Figure 3. Our analysis is based on this last proposition, identifying the different roles and their transactionality of media effects, differential susceptibility variables, and response states.

Moreover, based on the extension of the DSMM (Canet and Pérez-Escolar, 2022), as the original model only includes the user's differential susceptibility variables, and with the aim of taking into account the role of technological features in media effects, three more variables are added to proposition 1 as technological differential variables: device system, type of media and media features. As measures of media effects should also be considered, three types of measures are included to evaluate media effects: self-reporting, behavioral, and physiological. Finally, given that all response states depend on the type of media interaction, this dimension has been added to proposition 2.

Using the structure shown in Figure 3, this paper offers an outline of the main commonalities in the research selected in relation to establishing the key moderators and mediators for prosocial effects. It also explores their interconnections, based on the idea that the media effects of the DSMM model are transactional

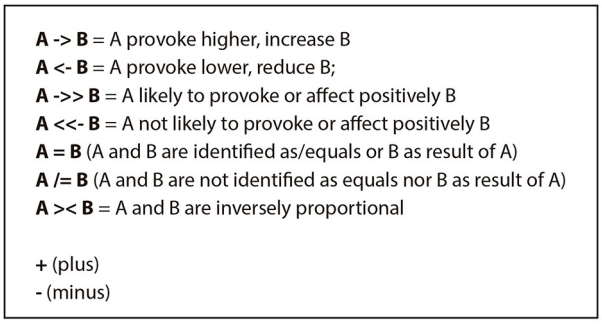

FIGURE 4
Operators used in the coding system. Source: Martínez-Cano, Lachman and Canet.

(Valkenburg and Peter, 2013, p. 7). This means that the outcomes of media influence can lead to media use. The model also extends this conception through media response states (mediators) and with differential susceptibility variables (predictors). We interpret this as meaning that the same instance can function as a predictor and at the same time can also act as a mediator, moderator, response or effect of a mediated experience (and vice versa).

The coding for the analysis of the selected studies included the new differential variables related to the media apparatus from proposition 1. These are transactional as media effects, which means they also work as predictors, moderators, and mediators, along with the measures that mirror and register media effects. The different measures of media effects have also been taken into account while coding, in order to identify the methodological approaches of the studies conducted in the period established for this SLR. With the aim of finding the correlations between DSMM categories in the results of the studies included in this SLR, a coding system was applied based on nine operators (Figure 4), each of which establishes the relation between moderators, mediators, and effects in the mediated experiences studied.

Finally, the analysis of the methodologies applied in the studies reviewed was carried out on the basis of the following variables: temporality of effect (measurement of immediate, medium-, short- and long-term impact), sample, narrative content and subject matter, data collection and experimental design, and data processing.

3. Results

This overview applies this model to an analysis of the results presented in the 38 studies reviewed, which are summarized in Table 1. The analysis adheres to the structure described above, based on the classification of the studies reviewed, which have been grouped by type of content into two blocks. The first is made up of research that focuses on interactive immersive VR experiences generated by computer graphics and video game engines using head mounted displays (HMDs). The second contains all the approaches to the prosocial effects of virtual reality 360-degree video on immersive HMD support for consumption. Despite this classification based on the two different types of content for virtual reality devices, most of the studies seem to suggest that the immersive capabilities (moderators) of this type of content consumed using these technologies, along with the cognitive, emotional and excitatory stimuli and responses (mediators), foster empathy and awareness of the other in their users.

3.1. Overall results

There are 11 studies (28.94% of the sample) that explore the impact of perspective-taking strategies on VR and how they could use embodying experiences to influence user behavior (studies 1, 2, 3, 6, 7, 9, 11, 16, 18, 20, and 22), thereby increasing empathy for a specific outgroup or "otherness." Among the included papers, 13 studies (31.57%) examine immersive 360-degree video using VR devices, 12 studies compare them with traditional media (26–38), five studies (13.15%) test the impact of immersive video game experiences, and 20 (52.63%) focus on VR experiences (1–19, and 23).

The immersive (moderating) capabilities of the content consumed through these technologies and the set of cognitive, emotional and excitatory (mediating) stimuli and responses generate empathic effects and awareness of the other in the audience. The results related to how they operate according to the coding system in Figure 4 are shown in Table 2, including the transactional instances of the media effects model of analysis that are revealed in the studies reviewed, featured as predictors, moderators, mediators and effects.

Regarding the correlations between the DSMM model categories, in accordance with preposition 4, some trends have been identified in this SLR. Presence is found as a mediator in eight of the studies (9, 21, 22, 23, 26, 29, 31, and 35) and as a moderator in only two (5, 33), and only one study considers presence as a media effect (30). Empathy is mostly identified as a mediator, in nine studies (1, 2, 6, 14, 20, 22, 32, 33, and 34). On the other hand, five studies characterize empathy as a predictor (9, 10, 16, 31 and 32), three as a media effect (8, 23 and 24), and only one as a moderator (18). Surprisingly, immersion is only identified as a moderator in three studies (18, 31, and 37), and as a mediator in just one (20). Perspective-taking tasks are understood as moderators in eight of the 11 studies that test their media effects (2, 6, 7, 9, 16, 18, 20, and 22). Embodiment is viewed as a moderator in four of the studies (1, 11, 18, and 22) and as a mediator in two (16, 28). Two of the studies offer an analysis of eudaimonic content and its impact on presence, thus mediating prosocial outcomes through different variables such as elevation and catharsis (35 and 37).

The studies reviewed reflect a standardized methodological structure focusing on media exposure to VR narrative content and the temporal measurement of impact with the intention of measuring immediate, short-term (2 weeks later), medium-term (4 weeks later) and long-term (8 weeks later) effects. The temporal structure consists of a pre-exposure phase, an exposure phase and a final post-exposure phase that may also have several sub-phases depending on the timing of the measurement. With this basic structure, the methodological strategies analyzed display similarities in terms of the types of measurement used and the research designs adopted.

TABLE 1 List of studies reviewed and relevant information.

	Authors	Sample	Type of media	Objective/Hypothesis	Results
1	Kilteni et al. (2012)	128 participants, (66 F) Age: 22.6. University students	IVE (VR experience; 3D synthetic image)	The efficacy of perspective taking in VR can be explained by the sense of embodiment that links the self and the avatar	Through the strategy of embodying another person (moderator), empathy is elicited and works as a mediator for prosocial behavior (effect) (altruism, donating your organs). Conversely, the strategy of embodying oneself increases (moderator) personal distress (mediator), eliciting egoistic motivation (money donations and voluntary work) (effect)
2	Herrera et al. (2018)	Study 1: 117 participants (40 M, 75 F, 2 O) Age: 22.94/Study 2: 439 participants (180 M, 250 F)-—190 university students, Age: 29.2	IVE (VR experience)	To differentiate between traditional perspective taking and perspective taking with virtual reality, and to compare the two	Across the three levels of immersion, narrative, 2D monitor and VR, all felt equally connected and empathetic toward the homeless, but those in VR were more likely to sign up to proposition A. Additionally, it offers empirical proof that, regardless of the medium and degree of immersion, the strategy of imagine-self perspective-taking tasks induces both other-oriented empathy and self-oriented distress
3	Herrera and Bailenson (2021)	937 participants (503 M, 422 F, 9 O). 95–>15–18 age; 423–>19–35; 337–>36–65; 42–>above 65 years of age. *Not university context*	IVE (VR experience)	To assess the effect on prosocial behaviors of the presence or absence of avatar representation	The results suggest that there should be no significant difference in prosocial response between having or not having a virtual representation (avatar); however, if the user is to be represented, the fact that they can choose the aspect of their avatar increases prosocial response
4	Kothgassner et al. (2021)	84 females. Age: 23.06. University context recruit	IVE (VR experience)	To monitor physiological responses to identify their relationship to stress states, in situations of ostracism vs. social inclusion in VR. Cyberball paradigm	Both real-life and virtual ostracism via avatars and agents affects basic social needs, belongingness, control, meaning of existence, self-esteem. Virtual social interactions turned out to be effective and comparable to real-life ftf interactions, from consistent results and based on a physiological sample system
5	Rosenberg et al. (2013)	74 participants. University context recruit	IVE (VR experience)	To examine the effects of prosocial behavior in VR and the prosocial effects of embodying a superpower	Flying participants were quicker to help than helicopter participants. Flyers picked up more pens than helicopter riders. Higher levels of presence elicit higher levels of immersion, thus more likely to affect behavior positively
6	Mado et al. (2021)	275 participants (118 M, 157 F) Age: 19.14. University context recruit	IVE (VR experience)	To test the prediction that empathy is analogous to a muscle that increases with practice and can transfer to unrelated contexts	The results replicate previous research showing the effectiveness of VRPT in enhancing empathy in related contexts. It does not provide evidence for the transferability of the empathy effect in non-relational contexts
7	Elzie and Shaia (2021)	145 medical students (74 M, 71 F). University context recruit	IVE (VR experience)	To test the impact of a perspective-taking virtual reality experience in which medical students put themselves in the shoes of a terminally ill patient	The majority of students said they had a better understanding of what terminal cancer patients and their families go through after the activity. Overall, the students thought that the activity was a very worthwhile learning opportunity
8	Zanon et al. (2014)	43 participants (30 M, 13 F) Age: 22.8. *Not university context*	IVE (VR experience)	To explore why altruistic actions are so differently engaged among individuals and which cognitive and neurophysiological mechanisms are predictive to such behaviors	It was possible to see that prosocial behavior varies between participants and that this variability is predicted by differential connectivity in specific functional brain networks by combining a VR-based experiential methodology with model free analysis of fMRI data
9	Van Loon et al. (2018)	180 participants (72 M, 106 F) Age: 20.28. University students	IVE (VR experience)	To find direct evidence that empathy mediates the relationship between virtual reality use and increased cooperation is lacking	There is no evidence that VRPT increases prosocial behavior. VRPT does, however, increase empathy, and this increase is moderated by presence. VRPT can be used to help people take more perspective-specific actions. The degree of immersion that people report feeling in the virtual environment, or their sense of presence, moderates this increase
10	Felnhofer et al. (2018)	95 participants, university students (12 M, 83 F) Age: 23.34	IVE (VR experience)	How do virtual humans impact users' cognitions, emotions and behaviors? The possibly differential effect of avatars vs. agents. To evaluate social reactions toward virtual avatars and agents, regarding social presence and empathy	Additional prosocial behavior predictors include one's physical presence and psychological involvement. There were no significant group differences for subjectively reported stress, social interaction anxiety, social presence, or physical presence when interacting with an avatar or an agent (computer controlled). Participants who interacted with human-controlled avatars showed greater psychological engagement and empathy than those who interacted with agents

(Continued)

TABLE 1 (Continued)

	Authors	Sample	Type of media	Objective/Hypothesis	Results
11	Bolt et al. (2021)	104 participants, university students	IVE (VR experience)	To alter participants' gender identity using an immersive virtual gender swap illusion, and to examine the effects of this virtual gender swap on social decision-making	Results contrary to the Proteus Effect. The reduced level of agency drives the user to a less social behavior. Participants in the different gender avatar also reported greater perceived dissimilarity to the virtual body in addition to the diminished sense of agency, which could further explain the observed decrease in generosity. The identification of gendered traits is unaffected by gender swapping
12	Gamberini et al. (2015)	96 participants, university students, Italian and White (48 M, 48 F) Age: 24	IVE (VR experience)	To analyze racial discrimination in helping behavior during a virtual emergency	Both experiences were experienced as an emergency, thus the IVES is validated with respect to navigation behavior and self-reported anxiety. The Black virtual human was helped by significantly fewer participants than the White one in terms of helping behavior. Therefore, discrimination based on race can influence how frequently virtual humans receive assistance
13	Kothgassner et al. (2017)	45 participants, university students (22 M, 23 F) Age: 25.71	IVE (VR experience)	To examine the impact of being socially excluded from a virtual ball tossing game by either a human-controlled avatar or a computer-controlled agent	Regarding social presence levels, there were no differences in participants' awareness and feelings toward the computer-controlled entity and the human controlled avatar. In comparison to all other participants, those who were rejected by an avatar expressed more sadness, while those who were included by an avatar expressed more confidence. In the sitting task, participants excluded were seated at a significantly larger distance from the confederate. NO difference between avatar and agent groups. The more the distance the less the prosocial behavior. Similar to the seating task, excluded participants also showed less prosocial behavior in the pen-drop task
14	Patil et al. (2018)	80 participants (26 F) Age: 23.71. *Not university context*	IVE (VR experience)	To assess whether there are any structural differences between the brains of altruists vs. non-altruists	People who perform risky acts of altruism that endanger their own lives in order to save others are motivated by other-oriented concern (empathic concern), and they have an enlarged AI that supports their compassionate response to the suffering of others and prosocial behavior
15	Gillath et al. (2008)	Study 1: 37 university students (20 M, 17 F) Age: 18–23/Study 2: 70 university students (42 M, 28 F) Age: 18–22	IVE (VR experience)	To examine helping behavior and see if social behavior and behavioral tendencies in a virtual environment could be predicted from dispositional measures of compassion and empathy by utilizing the features of IVET	Prosocial dispositions and IVET-measured prosocial tendencies may be causally related. Findings imply that IVET may be applied therapeutically and educationally to promote prosocial behavior
16	Hamilton-Giachritsis et al. (2018)	12 Spanish mothers in a pilot study, then 20 non-high risk Spanish mothers in the final study. Age: 39.3. *Not university context*	IVE (VR experience)	To establish whether placing mothers in the bodies of young children and interacting with a virtual mother encourages empathy and perspective-taking	Following a negative interaction with the virtual mother, participants performed better when evaluating emotional states, supporting the claim that the technique increases feelings of empathy for the child. Empathy for the conflict portrayed develops as a result of negative virtual environment experiences. Embodiment—the act of embodying another body rather than one's own—can be useful in increasing self-compassion. (otherness)
17	Kothgassner et al. (2019)	56 participants university students (54% F) Age: 24.36	IVE (VR experience)	To investigate whether various types of social support—real vs. virtual—reduce stress. Additionally, while accounting for affective states and social presence, assess the impact on subsequent in-person social behaviors (helping and approaching)	Less seating distance was maintained by participants who had received emotional support from the confederate actor, whether it had been through an avatar or in-person. The difference between participants in the agent condition and those with high levels of perceived social support (real and avatar conditions) may be due to interfering cognitive processes (with low perceived support). People frequently exchange resources of a similar nature, so assistance given by one person is frequently reciprocated

(Continued)

TABLE 1 (Continued)

	Authors	Sample	Type of media	Objective/Hypothesis	Results
18	Crone and Kallen (2022)	Study 1: First-year undergraduate psychology students (N = 65; 41 female, 24 male; Age = 20.34, SD = 4.66). Study 2: The final sample (N = 131) comprised 67 female and 64 male participants (Age = 20.92, SD = 5.09)	IVE (VR experience)	To explore bias toward women in STEM fields, examining how gendered embodiment, which is either congruent or incongruent with participant gender (self-identified), affects the selection and evaluation of virtual STEM candidates by using a simulated interview task	While between-group distinctions were not found after virtual self-representation on the web platform, men's and women's experiences of completely immersive embodiment after exposure to virtual reality perspective taking significantly differed. While interpersonal proximity did not, empathy showed up as a significant contributor to variation in candidate assessments, indicating that the process of behavioral change after virtual embodiment may at first be dependent on changes in empathy. The link between virtual immersion and behavioral change may be driven by empathy
19	Laurin and Bernache-Assollant (2022)	34 participants (31 males, 3 females; Age = 19.2 years, SD = 1.3). Undergraduate sports science program students	IVE (VR experience)	To examine, for the first time, the impact of outgroup emotional display (expressive vs. inexpressive) on individual rage experienced by supporters after an unfair defeat and how it affects outgroup assistance	Results discovered, in a virtual setting, that soccer supporters were more likely to want to assist a rival soccer supporter who was suppressing his excitement after an unfair victory. The findings showed that while the outgroup supporters' positive feelings were more inexpressive (facial, physical, and vocal) than expressive, the fans' level of rage after an unfair defeat was lower. Under these conditions, purposeful assisting behavior toward the outgroup rose. The desire to assist a teammate symbolically accountable for the loss increases as the level of anger felt decreases (as a member of the outgroup). This is the first study to demonstrate such favorable effects of emotional restraint on intergroup cooperative behavior
20	Ho and Ng (2020)	40 participants, (17 M, 23 F) Age: 23.6. University students	IVE (video game)	To analyze perspective taking as a cognitive process (moderator)	The findings provide evidence for the association between prosocial attitudes and perspective taking, proximity, empathy, and game immersion
21	Breves (2020b)	86 participants white students from a German university (43 M, 43 F) Age: 20.98	IVE (video game)	To test the parasocial contact hypothesis using VR as a mediator of intergroup contact, to see whether it reduces implicit and/or explicit interracial bias	Although all 2D and VR participants reported improvements in their attitudes, they were significant in VR, which has the role of enhancing the positive effect. Although VR could be an effective tool for reducing prejudice, depending on the type of contact it could be a double-edged sword
22	Richards et al. (2021)	130 students from BA Ancient History, Archeology and Arts Degree	IVE (video game)	To ascertain whether taking students to a virtual ancient Greek historical site, where they can view virtual artifacts and interact with virtual historical figures, will enhance their ability to remember factual information as well as to interact with and empathize with what they see and learn	According to the students' post-test quiz results, the VR experience did not help the pupils learn and retain more factual knowledge than they did in the classroom. The analysis of the comments also showed that, in contrast to the classroom group, who did not seem to have a personal connection with the ancient Greek lived experiences described in the classroom context, those in the VR group were more likely to describe the perspective of the character rather than their own perspective
23	Tassinari et al. (2022)	64 participants, high school students	IVE (video game/AltspaceVR Online Social Platform)	To investigate how situational affective empathy (i.e., how to lessen personal discomfort and boost empathic interest) may be influenced by direct positive intergroup VR contact when no perspective-taking instruction is provided. Participants in the experimental condition interacted with an avatar that represented someone of African ancestry, whereas those in the control condition played with avatars of a Caucasian racial background	When compared to the impact of an ingroup contact in the control group, a constructive, cooperative intergroup contact intervention would not significantly affect participants' empathy. This was true to a similar extent for both groups of individuals, even though perceived discomfort and empathetic interest were both lower following the VR session in comparison to pre-test scores. Both in the ingroup contact condition and the outgroup contact condition, empathic interest and personal suffering decreased following the VR encounter

(Continued)

TABLE 1 (Continued)

	Authors	Sample	Type of media	Objective/Hypothesis	Results
24	Kambe and Nakajima (2022)	11 students, 6 in the 1 pp condition and 5 in the 3 pp condition. University students	IVE (video game)	To analyze the visual information that a player encounters during play about a distressed individual, based on the hypothesis that this information influences the player's empathetic attitude toward that person, comparing 1 and 3 pp for the same player character to empirically evaluate the impact of the different player perspectives on empathy orientation	The VR game dramatically increased ISP, EM, and EC compared to personality-derived empathy. Because the VR game had substantially more information than the images did, the outcomes of these empathic indices were also significantly higher in the VR game. The lack of a discernible variation in the orientation of empathy between 1 and 3 pp in the persuasive VR game has two possible causes. The findings demonstrated that there was no discernible difference in the two viewpoints' empathy orientation
25	Hu et al. (2022)	140 middle school students ($n = 59$, 47.5% female, Age=13.98, SD = 0.89, in Study 1; $n =$ 81, 44.4% female, Age = 15.31, SD = 1.18, in Study 2). Study 1: The final sample consisted of 58 (31 male) adolescents, Age: 13.98. Study 2: The final sample consisted of 78 participants (42 male), Age: 15.31	IVE (video game)	Practicing prosocial activity may improve prosocial understanding	The findings showed that doing prosocial acts helped increase prosocial self-awareness more than self-reflection, and this differential effect was mostly shown in teenagers who had low levels of private self-consciousness. This study discovered the beneficial impacts of prosocial VR game play on adolescents' self-awareness • According to the findings, prosocial conduct may be more useful for teenagers than self-reflection in helping them develop prosocial self-knowledge. Prosocial activity may also help most teenagers realize who they are, regardless of their cognitive resource levels
26	Bujić et al. (2020)	87 participants (55 M, 30 F, 2 Other)/Age: 26.38. University students	IVE (360°)	To investigate how media content consumption may evoke changes in human rights attitudes	Participants' attitudes toward human rights only changed statistically significantly under the 2D and VR conditions. While this study indicates that VR is generally more effective at causing attitudinal changes, in some circumstances 2D formats may be just as effective but more financially and practically feasible
27	D'Errico et al. (2020)	40 participants (21 M, 19 F) Age: 23.76. University students	IVE (360°)	To explore differences in calmness, engagement, and alertness in simulated helping situations in relation to the ethnicity (Black or White). Empathic responses	Emotional arousal was physiologically monitored during actual helping interactions, extracted by an EEG. Individuals acted with alarm and more distress with intergroup interaction both to help and to receive help, with low status ingroup and high status outgroup members
28	Roel Lesur et al. (2020)	71 participants at a museum (30 M, 41 F) Age: 34.1 + 43 participants university students (11 M, 32 F) Age: 22.40	IVE (360°)	To determine whether greater ecological sensorimotor interactions would maximize sensorimotor sharing	No reduction of bias after as compared to before the transgender experience was found, contrary to previous studies that claim a reduction of bias toward outgroup members after embodying an outgroup member, perhaps because there is no representation of self or avatar, and the identity we occupy is revealed through voice and narration
29	Pressgrove and Bowman (2021)	296 participants, university students (117 M, 158 F)	IVE (360°)	Participants will feel the highest levels of presence when viewing content through HMD technologies, moderate levels when viewing 360° video with digital-only controls, and lowest when viewing on a 2D monitor	Technology is not what mediated the impact through presence to foster attitudes toward helping people or willingness to help people; it is more about storytelling and narrative engagement. Investing in technologies is not as critical as investing in telling compelling stories
30	Ma (2020)	216 participants, university students (54.6% F, 45.4% M) Age: 19.42	IVE (360°)	To explore how immersive stories achieve the observed effects. Is involvement with the narrative and characters a key mechanism? Is presence afforded by IVEs a key mechanism? Or are story involvement and presence working together to achieve persuasiveness?	Contrary to the researcher's prediction, viewing a story in immersive virtual or traditional mediated environments did not directly affect transportation or identification. If the story is compelling, the storytelling is enough to add a strong emotional component and generate enough engagement to induce a relatively large degree of transportation and identification regardless of media platforms

(Continued)

TABLE 1 (Continued)

	Authors	Sample	Type of media	Objective/Hypothesis	Results
31	Cummings et al. (2021)	95 participants, university students in communication studies (15.8% M, 84.2% F) Age: 20.81	IVE (360°)	To examine how a media message's psychological presence may act as a mediator between the effects of immersion on empathy	While the positive association between immersion and cognitive empathy is facilitated by one's psychological connection with others in that space (copresence), the positive relationship between immersion and associative empathy is facilitated by one's sense of self-location
32	Breves (2020a)	90 participants, German university students (64 F)	IVE (360°)	To investigate the effects of different levels of immersion on users' perceptions of their spatial presence, their ability to empathize with others, and their involvement with specific issues	This investigation supported the proposed effect mechanism. A higher situational empathic PSI with the protagonist was reported by participants who felt physically present in the virtual environment. As a result, they thought the topic of malaria to be more engaging
33	Pimentel et al. (2021)	110 participants, US university students (20 M, 90 F) Age: 18–24	IVE (360°)	Social presence and interactivity can be successfully manipulated in 360º video and both can jointly contribute to prosocial results	The relationship between social presence and empathy for fictional characters will be moderated by perceived interactivity. The effects of social interaction and presence on prosocial intentions and behaviors will be moderated by empathy concern
34	D'Errico et al. (2019)	40 participants (21 M, 19 F) Age: 23.76	IVE (360°)	To test attentive and emotional dimensions of intergroup helping interactions using a Virtual Environment in helping situations where a person in need belongs to a different ethnic group	The findings indicated that while people tend to give generous help (free tickets) in the ingroup condition (White ethnicity) when considering their affective state of need, by giving higher levels of generous help in the beggar condition. They give minimal help in the outgroup condition when considering their affective state of need across conditions with no difference, with attention and engagement acting as moderators
35	Kahn and Cargile (2021)	Study 1: 154 participants, communication courses students (35% M, 65% F). Study 2: 188 participants (53.7%M, 44.7%F, 1.1% transgender, 0.5% no gender listed) Age: 36	IVE (360°)	To test the "Wow!" effect's mediating function in VR's ability to awe users, exploring the idea that presence is created by content and medium, resulting in a sensation of expansiveness and a need for conformity, which in turn leads to awe, and to test the hypothesis that prosocial behavior results from amazement, which is brought on by a mediated overview effect and the immersive qualities of VR	Because it is linked to emotional intensity in immersive contexts and frequently acts as a mediating variable, presence is essential to inspiring awe. According to the findings, only immersive VR (with stereoscopy, head tracking, and a large field of view) can establish presence and then inspire awe. There didn't seem to be any correlation between presence or amazement and the tracking offered by 360-degree interactive video or the wide range of vision offered by larger screen sizes and full-screen viewing. Awe was shown to influence reported prosocial conduct in turn, however the scope of these findings in Study 1 was rather constrained. The consequences of awe on prosociality afterward were less certain. Prosociality is mediated by a sophisticated interaction between wonder, presence, and enjoyment. Video circumstances for appreciation and/or enjoyment were found in study 2, which raises the possibility that some unidentified eudaimonic and hedonic emotions may be acting as mediators
36	Lamb et al. (2022)	69 students from a high-needs urban public-charter school in the Northeastern United States. Age: 5–15	IVE (360°)	To compare three different types of therapy: face-to-face therapy without VR, VR-enhanced therapy, and wait-list time-delayed control, utilizing virtual reality to promote socioemotional wellness and as an aid in carrying out practice exercises based on mental health abilities	According to the observations, the usage of virtual environments facilitates implementation at the group level as opposed to the individual level and fosters successful outcomes involving student-to-student relationships. This implies that using VR-enhanced DBT to treat students who are dealing with latent trauma and cumulative stress is a realistic strategy. Over the course of the 12-week timeframe, VR-aided DBT led to improved skill development and application. When compared to the treatments with VR DBT and DBT alone, participants in the delay control condition showed considerably less skill growth

(Continued)

TABLE 1 (Continued)

	Authors	Sample	Type of media	Objective/Hypothesis	Results
37	Chen et al. (2022)	163 university students, Participants ranged in age from 18 to 28 years (Age = 20.78, SD = 1.40) and included 88.3% female, 11.0% male, and 0.6% indicating other in terms of gender	IVE (360°)	To test the possibility for elevating, catharsis, and compassion to be facilitated by meaningful and thought-provoking or eudaimonic storytelling, and whether eudaimonic entertainment experiences of consumers are influenced by immersive narrative	When compared to hedonic content, eudaimonic content produced stronger emotions of elevation in viewers, increasing their enjoyment of, appreciation for, and intention to engage in altruistic conduct. Catharsis was discovered to increase viewers' enjoyment—not appreciation—and to mediate the transition from immersion to delight. Appreciation and enjoyment of media content, then, were the next most reliable predictors of moral reasoning. It is crucial to emphasize the mediating role of elevation in the relationship between the nature of the content and altruism because it theoretically explains and supports the association between watching moving, upsetting, or dramatic media content and the desire to carry out moral deeds in the real world
38	Nguyen and Noussair (2022)	141 participants in the study were University of Arizona undergraduate students	IVE (360°)	To apply a novel technique for evoking emotions-−360-degree movies displayed in virtual reality—to investigate an important social science subject, focusing on the relationship between emotional state and the propensity to collaborate	Incidental emotions, regardless of their valence—positive or negative—were found to have a smaller impact on contributions than a Neutral condition. Individuals generally contributed 27.5% less throughout the three emotion treatments—Fear, Happiness, and Disgust—than they did during the Neutral condition, and the differences became more noticeable over time

The sample designs of the studies reviewed typically target university students and high school students. Only five of the studies extend their target audience outside educational contexts. The average sample size is 120.18 subjects, considering that the 38 papers reviewed covered 44 studies (as six of them included two studies). The largest sample is in Herrera and Bailenson's (2021) with 937 participants; the rest mostly range from 40 to 296 participants (seven studies sample size range from ∼40 to 56). The study by Hamilton-Giachritsis et al. (2018) has the second smallest sample, unsurprisingly given the complexity of its composition (non-high-risk expectant mothers), while the study by Kambe and Nakajima has the smallest, with a sample of 11 students. The mean age of the subjects involved in 30 of the papers whose samples are composed of university students is 22.82 while in eight of these articles age data is not provided and the other eight articles included in this SLR drew their samples from outside the university context. Among the aforementioned 30 articles, three present results from two studies with a sample of university students, so that the mean age noted above is obtained from 25 studies presented in 22 papers in which age data is provided.

Regarding the immersive audiovisual narrative content used (stimulus), 13 of the articles use 360-degree video format content, while 25 use VR content with 3D synthetic images, designing interactive strategies using video game engines. The scenarios and the characters who inhabit them are three-dimensional representations based on computer graphics rendered in real time, incorporating animations and programmed behaviors. A total of 14 of the studies compare the effects of content consumed on a traditional medium with immersive VR content. In terms of themes, all of the studies explore social conflicts and prosocial behaviors in relation to otherness, ranging from exposure to the suffering of the other to an emergency situation in which the other needs help. The issues addressed include human rights, organ donation, homelessness, ostracism and exclusion, race and ethnicity, gender identity, terminal illness, refugees and climate change refugees. In all cases we are invited as viewers to take the perspective of people in these situations, with 11 of the studies directly using the perspective-taking strategy in the design of their immersive VR narrative content.

The use of questionnaires appears to be a data collection trend in studies of this kind. The most popular models are the Interpersonal Reaction Index (IRI, Davis, 1983), used in six of the 38 studies reviewed; the Inclusion of Other in the Self (IOS) scale (Aron et al., 1992; Schultz, 2001), employed in four of the investigations; the Igroup Presence Questionnaire (IPQ) (Schubert et al., 2001) and the Spatial Presence Experience Scale (Hartmann et al., 2015), each used in three papers; the Temple Presence Inventory (TPI; Lombard et al., 2009), which is used in two. Other models used are the Human Rights Questionnaire (Diaz-Veizades et al., 1995), the Beliefs about Empathy (BE) scale, the Trier Social Stress Test (TSST; Kirschbaum et al., 1993), the Positive and Negative Affect Scale (PANAS) (Watson et al., 1988), and the Prosocial Orientation Questionnaire (Cheung et al., 1998). There are also some more recent and therefore less established models, such as the State Empathy Questionnaire (Shen, 2010), the Game Immersion Questionnaire by Jennett et al. (2008), the Brief Implicit Association Test (BIAT; Sriram and Greenwald, 2009), the Bermond-Vorst Alexithymia Questionnaire (BVAQ-B) (Vorst and Bermond, 2001), Body Transfer (Ahn et al., 2016), the Virtual Reality Embodiment questionnaire (González-Franco and Peck, 2018), Body Ownership (Peck et al., 2013), Spatial Presence (Bailey et al., 2012), the Basic Needs Scale (Williams, 2001), the Subjective Unit of Discomfort Scale (SUDS; Tanner, 2012), which is used to assess feelings of happiness and self-confidence, uncertainty, sadness and anger, and the Networked Minds Measure of Social Presence questionnaire (NMMSP; Biocca et al., 2001a,b),

TABLE 2 Correlations between DSMM model categories.

	Authors	Topic	Predictors—moderators—mediators—effects
1	Li and Kyung Kim (2021)	Organ donation	Embodying another person (moderator) -> empathy (mediator) -> prosocial behavior (effect) (altruism, donating your organs); embodying oneself (moderator) -> personal distress (mediator) -> donating, voluntary work (effect) (egoistic motivation)
2	Herrera et al. (2018)	Homelessness	Imagine-self perspective-taking tasks (moderator) -> other-oriented empathy (mediator); imagine-self perspective-taking tasks (moderator) ->self-oriented distress (mediator)
3	Herrera and Bailenson (2021)	Homelessness	Head side-to-side movement (predictor)
4	Kothgassner et al. (2021)	Ostracism-exclusion	Social basic needs, sense of belonging, control, self-existence meaning, self-esteem (mediators) = effects
5	Rosenberg et al. (2013)	Prosocial effects of embodying a superhero	Level of presence (moderator) -> levels of immersion (mediator) -> feeling the experience real (mediator) ->> positive attitudinal change toward prosocial (effect)
6	Mado et al. (2021)	Homelessness - environmental issues-acidification of the marine environment	VRPT experiences of abstract natural phenomena (moderator) -> related context empathy and no related context empathy (mediator) -> prosocial outcome; VRPT experiences of human social targets (moderator) -> only human related empathy (mediator)
7	Elzie and Shaia (2021)	Illness - Terminally ill patients	VRPT experience (moderator) -> better understanding of what terminal cancer patients experience (mediator)
8	Zanon et al. (2014)	Altruistic behavior in danger situations Emergency training	Emotional response (mediator) -> empathic/altruistic outcome (effect)
9	Van Loon et al. (2018)	Empathy increase in VRPT	VRPT (moderator) -> presence (mediator) -> empathy (effect)
10	Felnhofer et al. (2018)	Otherness	Predictors= empathy, presence and involvement
11	Bolt et al. (2021)	Interpersonal generosity	Reduced level of agency -< social behavior; Gender swap (moderator) does not alter identification with gendered traits (mediator)
12	Gamberini et al. (2015)	Altruistic behavior in danger situations/withdrawal of help due to racial discrimination	Racial discrimination (moderator) -< helping responses (effect); Being part of the ingroup of the helpee (predictor) ->> prosocial response (effect)
13	Kothgassner et al. (2017)	Ostracism-exclusion and agency	Being rejected by an avatar (moderator) -> level of sadness (mediator) -> personal distance (effect); Being included by an avatar (moderator) -> level of self-confidence (mediator); Being rejected by an avatar (moderator) -> level of sadness (mediator) -< prosocial behavior (effect); +Distance -< Prosocial behavior
14	Patil et al. (2018)	Helping others - altruistic behavior	Empathic concern (mediator) -> prosocial behavior (effect); empathic concern (mediator) -> helping attitude toward predicted ingroup members (effect); empathic compassion (mediator) -> prosocial behavior toward outgroup members (effect)
15	Gillath et al. (2008)	Helping behavior	Predictors of prosocial outcome = Compassion, fantasy, perspective taking, empathic concern, personal distress
16	Hamilton-Giachritsis et al. (2018)	Parenting - empathy regarding childcare	Perspective taking (moderator) -> Negative experience (mediator) -> empathy in the conflict depicted (effect); Embodying another's body (mediator) -> self-compassion
17	Kothgassner et al. (2019)	Race/ethnicity (Black/White) - refugee/immigrant	Social support (mediator) -> befriending tendencies (effect)
18	Crone and Kallen (2022)	Gender bias in a STEM job hiring position	Embodiment, perspective taking and gender exerting (moderator) -> empathy (effect) Embodiment (moderator) -> gender bias (effect) Virtual immersion (moderator) -> Empathy (mediator) -> behavioral change (effect)
19	Laurin and Bernache-Assollant (2022)	Helping outgroup member (soccer team) ingroup member team loses illegitimately	Emotion inhibition (mediator) -> positive behavioral responses toward outgroup members (effect)
20	Ho and Ng (2020)	NPCS. Perspective- taking	Perspective taking (moderator) -> immersion (mediator) -> closeness (mediator) -> empathy (mediator) -> prosocial attitudes (effect); expertise of gamer (moderator) >< immersion (mediator)
21	Breves (2020b)	Race/ethnicity (Black/White)	VR experience (moderator) -> spatial presence (mediator) -< explicit biases when interacting with Black NPCs
22	Richards et al. (2021)	VR to create empathy and promote learning	Perspective-taking experience (moderator) -> empathy (mediator) -> enhance learning process (effect)

(Continued)

TABLE 2 (Continued)

	Authors	Topic	Predictors—moderators—mediators—effects
23	Tassinari et al. (2022)	Intergroup relationships in virtual environments	Intergroup interaction in VR with outgroup member (moderator) -> copresence (mediator) -> situational empathy (effect)
24	Kambe and Nakajima (2022)	Empathy difference between 1 and 3 pp VR game conditions	Point of view (moderator) ->> empathy orientation; point of view (mediator) /= empathy
25	Hu et al. (2022)	Helping behavior and prosocial self-concept	Prosocial self-concept functions (mediator) -> positive behavior (effect)
26	Bujić et al. (2020)	Human rights	Involvement (mediator), partial presence (mediator) and the feeling of being there (mediator) -> intensity of change in users' attitudes to human rights
27	D'Errico et al. (2020)	Race/ethnicity (Black/White) - refugees/ immigrants	Intergroup contact situations (moderator) -> intergroup anxiety (mediator)
28	Roel Lesur et al. (2020)	Gender identity - transgender	Age (moderator) >< embodiment (mediator); sensorimotor condition (moderator) -> embodiment (mediator) -<< reduction of bias (effect)
29	Pressgrove and Bowman (2021)	Community	Technology (moderator) /= presence (mediator) -> helping attitudes; Storytelling (moderator) and narrative engagement (moderator) -> presence (mediator) -> helping attitudes
30	Ma (2020)	Refugees	Storytelling and narrative (mediator) -> social presence and identification (effect); immersive technology (mediator) -> spatial presence and transportation (effect)
31	Cummings et al. (2021)	Homeless persons and refugees	Immersion (moderator) -> self-location (mediator) + copresence (mediator) -> cognitive empathy (effect); immersion (moderator) -> self-location (mediator) -> associative empathy
32	Breves (2020a)	Refugees - Malaria, basic health issues, environmental and political problems, social injustice	Spatial presence (mediator) -> positive effect of immersive technology on situational empathy (effect); situational empathy (mediator) -> positive effect of immersive technology on issue involvement
33	Pimentel et al. (2021)	Alaskan climate change refugees	Social presence (moderator) + interactivity (moderator) -> empathic concern (mediator) + empathic distress (mediator) -> prosocial behaviors and attitudinal positive change (effect); interactivity (moderator) -> social presence (mediator) -> empathic concern toward story characters; social presence (moderator) + interactivity (moderator)-> empathic concern (mediator) -> prosocial behaviors and intentions
34	D'Errico et al. (2019)	Race/ethnicity (Black/White) - refugees/immigrants	Attention (moderator) and engagement (moderator) -> empathy (mediator)
35	Kahn and Cargile (2021)	"Wow!" Effect and its prosocial impact; eudaimonic content	Presence (mediator) -> emotional intensity (awe) (effect); VR eudaimonic content (moderator) -> awe, presence and enjoyment (mediators) -> prosocial attitudes (effect)
36	Lamb et al. (2022)	Using VR to develop DBT skills in students with latent trauma	Presence (mediator) -> positive social skill acquisition (effect)
37	Chen et al. (2022)	Eudaimonic content	Thought-provoking content (moderator) -> elevation (mediator) -> altruistic motivation (effect); immersion (moderator) -> catharsis (mediator) -> joyful experiences
38	Nguyen and Noussair (2022)	Cooperation and emotion	Emotion inhibition (mediator) -> positive cooperation behavior
	Codes		-> make higher, increase; -< make lower, reduce; ->> likely to provoke or affect positively; -<< not likely to provoke or affect positively; = identified as/equals or result; /= not identified as equals or result; + plus; - less; >< inversely proportional

which measures different variables such as empathic concern and empathic distress or spatial presence, level of embodiment and social presence, for which the Social Presence Survey (Bailenson et al., 2003), used in the study of Kothgassner et al. (2017), is also used.

The experimental design of each research study varies depending on the study objectives. Some seek to compare the prosocial impact between immersive media and conventional media, while others aim to measure the impact of immersive media on prosocial behaviors and in contexts of emergency and requests for help, the effectiveness of perspective taking in VR to instill prosocial values, or prosocial behavior in contexts of virtual interaction between members of different groups. For each of these objectives, different experimental conditions are proposed. A rigorous selection of experimental conditions is therefore observable in relation to the research objectives, indicated in Table 1. The narrative strategies and immersive audiovisual content used in the research also vary, as these are produced specifically based on the aims of the study in which they are used, except in some cases in which previously produced VR or 360-degree video productions are used.

Some of the studies reviewed also monitor the user's movements and record physiological data, such as collecting saliva samples (Kothgassner et al., 2021), measuring galvanic skin

response and heart rate (Hamilton-Giachritsis et al., 2018), or recording brain activity with magnetic resonance imaging (MRI) (Patil et al., 2018), functional magnetic resonance imaging (fMRI) (Zanon et al., 2014) or an electroencephalogram (EEG) (D'Errico et al., 2020). Such studies thus incorporate neuroscientific measures into research on media effects, providing innovative procedures that may be able to shed light on what happens in the mind of the user or viewer during exposure to media content. The collection of such data during this phase could be particularly useful for understanding the physiological and cerebral responses to different media.

In addition, 22 of the studies apply post-exposure behavioral variables, which attempt to measure the possible impact of immersive media content on the participant's response to the prosocial issue explored in the study, and six studies incorporate attitudinal tasks to measure the immediate impact. These include the pen-drop task, in which a container with pens is accidentally knocked down in front of the participant and the reaction time (from the time they fall until the participant begins to pick them up) and number of pens picked up are measured, as such responses are understood to be related to the level of empathy and the intention to help. Behavioral variables of the decision-making type are used in the measurement of medium- and long-term media impact, such as the intention to support a municipal proposal for the promotion of affordable and decent housing for homeless people.

The data was processed using descriptive statistical techniques and different models of correlation analysis, such as Pearson's correlation, the analysis of variance (ANOVA) models (the most frequently used, adopted in 24 of the studies reviewed), multivariate analysis of covariance (MANCOVA) and multivariate analysis of variance (MANOVA), analysis of covariance (ANCOVAs), cross tabulation, and Fisher's exact test. Most of the studies reviewed use SPSS statistical software, applying models such as PROCESS macro (Hayes, 2013–2018). To calculate the sample, it is also common to use G*Power statistical power analysis software, which is also used for data processing using *t*-tests, F tests, chi-squared tests, *z*-tests, exact tests, independent proportion analysis, ANOVA and multiple regression.

The data collected on EEG devices were processed with Matlab2019a to obtain the different frequency bands of brain activity [α (8–13 Hz), β (13–30 Hz), βlow (13–15 Hz), βhigh (23–30 Hz), and θ (4–8 Hz)], and to calculate the different results according to the engagement index (EI), attention index (BBR) and inattention index (TBR) formulas. The images obtained from fMRI was preprocessed with SPM8 statistical parametric mapping software (http://www.fil.ion.ucl.ac.uk/spm/software/spm8/) and then processed using the Group ICA of fMRI Toolbox (GIFT, http://mialab.mrn.org/software/gift/) (Calhoun et al., 2001). For preprocessing and statistical analysis of MRI images in Patil et al.'s (2018) study the Computational Anatomy Toolbox (CAT12: http://dbm.neuro.uni-jena.de/cat12/) for SPM12 in MATLAB R2013a (MathWorks, Natick, Massachusetts, USA) was used.

Another of the most widely used software programs is R, which incorporates different data analysis models, including the Bonferroni correction. The study that uses R and MLM is the one from Kothgassner et al. (2021). The study of Kalyanaramana and Bailenson does not apply any of those tools. This is used in the study by Kothgassner et al. (2021), which also employs multilevel modeling (MLM) techniques to evaluate differences in the presence of cortisol in the saliva and heart rate samples collected. The study by Roel Lesur et al. (2020) employs JASP software for analysis of variance (ANOVA) for nonparametric factor analyses (ART-ANOVA; Wobbrock et al., 2011) and R software for comparative data analysis. Mplus (Muthén and Muthén, 2013) is the program used in the study by Ma (2020), which also uses path analyses to test the model of the main hypothesis. R was also the statistical analysis tool in the study by Bolt et al. (2021), which also used Matlab for the analysis of behavioral data. In other studies, such as Gamberini et al. (2015), the VR environment itself collects the user's positions and maps their sequences to generate the models to be analyzed.

3.2. Standardizing the experimental method and decision-making strategies

Altruistic motivation and helping attitudes are some of the behaviors that are measured to test the prosocial effect of VR content. To this end, the user normally has to make some decisions after the immersive media experience. The study developed by Gillath et al. (2008) laid the groundwork for research on prosocial reactions and behavioral tendencies using immersive virtual environment technology (IVET). Their findings suggested that "IVET might be used educationally and therapeutically to foster prosocial behavior" (Christofi and Michael-Grigoriou, 2017, p. 4). This research established the basic method and structure of the experimental model that subsequent empirical studies would build on, identifying compassion, fantasy, perspective taking, empathic concern and personal distress as predictors of the prosocial outcomes.

Using the same procedure in three phases (initial data collection, exposure of participants to the media, and final data collection), Rosenberg et al. (2013) arrive at the conclusion that VR may cause participants to focus on the extraordinary abilities that the user has in the scenario, a common trope in video games, in a more realistic fashion than is typical in game-based play. Higher levels of presence (moderator) provoke higher levels of immersion in the experience (mediator) and feel more real (mediator) and are therefore more likely to affect behavior in a positive way.

Making decisions to help others in what is called the *altruistic phenomenon* (Lieberman, 2012) is a constant that is also addressed in the study by Zanon et al. (2014), which concluded that differences in prosocial behavior can be identified and predicted through the connectivity of the functional brain networks engaged during the process. Specifically, the anterior insula and the anterior mid-cingulate cortex showed less intense activity in users who acted prosocially, while medial orbital/prefrontal areas and the anterior cingulate cortices showed an increase in activity when acting prosocially. Finally, the study suggests that in addition to the processes that induce altruistic and prosocial attitudes, it is important to consider contextual factors and the emotional state of the individual, identified as differential susceptibility variables (DSMM, Valkenburg and Peter, 2013, p. 226). According to the empathy-altruism hypothesis (Batson et al., 1991; Singer and Lamm, 2009; Hein et al., 2010), emotional response can function as a mediator for empathic/altruistic outcomes.

This same group of researchers (Patil et al., 2018) developed another experiment using the same VR experience but designed to test whether there are any anatomical differences between the brains of altruists and non-altruists. They identified a volumetric increase on the right insular lobe of the brain of the altruistic individuals, associated with the coordinates of anterior insula (AI). Based on the evidence that a person who engages in a costly altruistic act is motivated by other-oriented concern, empathic concern works as a mediator for prosocial behavior. Increased activation in the AI correlates with characteristic and self-reported empathic concern and compassion that mediate the helping attitude toward predicted ingroup members and prosocial behavior toward outgroup members.

Helping decisions in emergency situations also constitute the main object of study in the research by Gamberini et al. (2015), but in this case the focus is on differences in helping behavior based on the ethnicity of the helpee. The study showed that racial discrimination affects helping responses, as the White virtual human was helped significantly more often than the Black one. Thus, being part of the ingroup of the helpee predicts prosocial response in cases of need, identified as a differential susceptibility variable within social and dispositional predictors.

The pilot study developed by Laurin and Bernache-Assollant (2022) tests the role of outgroup emotional displays in individual anger of soccer fans after an irregular defeat and their impact on the decision to help an outgroup member. The results show that fans who did not outwardly express positive emotion after a dubious victory for their team were more likely to induce helping behaviors from outgroup team fans. Since decreasing anger encourages outgroup team fans' intentions to help a member of the other team, emotion inhibition functions as a mediator for positive behavioral responses from outgroup members. In a similar vein, the study by Crone and Kallen (2022) assesses the effect of congruent and incongruent gendered embodiment on an interview and hiring perspective-taking task both online and in immersive VR, finding that participants usually take on their assigned avatar identity, showing greater identification with same gender identity actors. The VR experiment suggests that embodiment, perspective taking, and gender could function as moderators for empathy. It was also found that women reported greater empathy than men, and that virtual embodiment moderates gender bias for men and empathy mediates between virtual immersion and behavioral change.

Helping situations constitute one of the common features identified in most of the experimental designs developed in the studies reviewed. In the study by Hu et al. (2022), this helping situation is also a meta-condition, as they test the potential of prosocial behavior to increase prosocial self-understanding, thereby fostering prosocial attitudes in high school students. The findings show that prosocial self-concept functions as a mediator of positive behavior. Helping others may enhance prosocial self-concept, thus eliciting positive social attitudes. The study concludes that exercising prosocial behavior might help adolescents to understand themselves and enhance their self-awareness.

One final example of this trend of decision-making strategies being used to test the impact of immersive VR media is the study by Nguyen and Noussair (2022), which tests the moderating effect of the emotions of fear, happiness, and disgust on cooperation. The results showed that participants under conditions of fear, happiness and disgust tend to contribute less in a public goods game than participants under the neutral emotion condition. Thus, in consonance with the work of Laurin and Bernache-Assollant, emotion inhibition might function as a mediator for positive cooperation.

3.3. Interacting with virtual entities, agents, and avatars

Kothgassner et al. (2017) explore exclusion and inclusion mechanisms in VR and their impact on prosocial attitudes. Differentiating between two types of virtual social entities (agents and avatars), the study used a virtual ball tossing game (The Cyberball-Paradigm, Williams and Jarvis, 2006) to identify differences in individual reactions to being socially excluded by an avatar or an agent. Although excluded participants displayed fewer prosocial responses, the behaviors measured (the participant's seating distance from a confederate, the pen-drop task) showed no difference between exclusion by an avatar and by an agent. In 2021, Kothgassner et al. used the same social inclusion/exclusion ostracism VR experience again, this time combined with heart rate and salivary measurements to monitor the presence and concentration of chemicals (cortisol). Their findings demonstrate that social interactions in virtual environments are effective and comparable to those in real life.

Kothgassner et al. (2019) explored further in this direction by attempting to measure the effects of virtual vs. real-world social support in reducing the stress produced by the Trier Social Stress Test (TSST). The results were in keeping with previous research that found that prosocial behaviors emerged when facing a stress situation (Taylor et al., 2000). Participants in real and virtual avatar conditions demonstrated a faster helping response and more friendly behavior. High levels of social support were mediators for befriending tendencies, in accordance with the Resource Exchange Theory (Foa, 1971; Rosenbaum and Massiah, 2007).

Testing for differences in the mediated experience with avatars vs. agents is also the main focus of the study carried out by Felnhofer et al. (2018), which considers social reactions to avatars and agents in virtual environments and their correlation with social presence and empathy, studying social avoidance, prosocial behavior, and the factors that may work as predictors. The study found no differences between the avatar group and the agent group. Acknowledging empathy as one of the major prosocial behavior predictors, presence and involvement were also identified as important predictors for these positive behaviors. Furthermore, outcomes differed depending on whether the interaction was with an avatar or an agent, with higher levels of empathy and involvement reported for the human-controlled avatar. While participants self-reported no difference in levels of stress and anxiety in each condition, measurements of empathy showed that there was indeed a behavioral difference depending on the virtual other with whom participants interacted.

Breves (2020b) studied the role of video game Non-Player Characters (equivalent to the "agent" in the discussions above) in a virtual reality context. The researcher tested whether helping an

NPC in a video game and in a VR video game can reduce implicit or explicit bias toward Black people. It seeks to test the parasocial contact hypothesis using VR as a mediator of intergroup contact. Results demonstrated that while player characters helping a Black NPC did not reduce implicit bias, it did reduce explicit bias. The study also compared the game experience on a 2D screen with the use of a VR device, demonstrating that the VR experience produces higher levels of spatial presence, reducing participants' explicit biases when interacting with Black NPCs. The reduction of implicit biases can mean improved intergroup interactions in the real world, positively altering intergroup behaviors. All participants in both conditions (2D monitor and VR) reported improvements in their attitudes toward Black people, but participants who were exposed to the VR experience showed significantly greater improvement in intergroup attitudes.

3.4. Presence and embodiment strategies: basement for vivid perspective-taking experiences as moderators

Breves (2020a) tested the hypothesis that spatial presence is a mediator for situational empathy, which would thus mediate a positive attitude toward an issue. Her study examines how the degree of immersiveness in a documentary might affect its influence on users' reported spatial presence, empathic parasocial interaction, and involvement with a remote health issue. Breves concluded that high and low immersive technologies could serve as catalysts for a stronger sense of spatial presence than a desktop audiovisual experience. Only those subjects who experienced high immersive tech reported higher empathic parasocial interaction (PSI) and issue involvement.

Similarly, describing the effect of perspective-taking tasks (PTTs) as putting oneself "in someone else shoes" (an expression used frequently in the studies reviewed), Herrera et al. (2018) differentiate between traditional perspective-taking tasks (PTTs) and VR perspective-taking tasks, which they compare in two separate studies. The results demonstrate that VR PTTs are more powerful than traditional media PTTs, eliciting more empathy and personal distress, but in the long term they do not produce a stronger feeling of embodiment, empathy, or angst. VR tasks do not produce more prosocial responses than traditional ones either, but they do contribute to an improvement in attitude, with more helping responses and social support than traditional PTTs. These studies also provide empirical evidence that the strategy of imagine-self perspective-taking tasks, regardless of the medium or the level of immersion it offers, results "in a combination of other-oriented empathy and self-oriented distress" (Herrera et al., 2018, p. 28). Similarly, Van Loon et al. (2018) tested for "increases in empathy as a mechanism through which VR PTTs elicit prosocial behavior" (p. 3), finding that as a moderator, VR PTTs increase the empathy effect and that this increase is mediated by presence. On the other hand, the study did not conclude that VR PTTs augment prosocial behavior as assessed through behavioral games.

Testing embodiment strategies and PTTs focusing on improving empathy and parenting was the main aim of the pilot study carried out by Hamilton-Giachritsis et al. (2018), which explores whether the embodiment of a mother in a young child in an interactive virtual context might facilitate the perspective-taking strategy and thus elicit empathy, and thus to determine whether compassion and empathy might function as dispositional predictors for prosocial tendencies. Negative experiences in the VR environment tend to elicit empathy in relation to the conflict depicted. The results of the experiment suggested that "embodiment can be effective in improving self-compassion," not only by embodying one's own role, but by embodying another (otherness).

In this same category, along the same line of research but adding the question of non-player characters, is the study by Ho and Ng (2020). This study tested the hypothesis that PTTs could be effective as a cognitive process (moderator), investigating whether the experience of being confronted with the suffering of an NPC can influence the user's attitude, and thus turn the game experience into a prosocial VR experience. These researchers suggest that the expertise of the gamer/user may itself be a moderator. Users who do not play video games regularly are more sensitive to the influence of the PT experience. Conversely, regular gamers are less sensitive to the influence of this strategy. Ultimately, taking the perspective of the NPC made players more involved and closer to the NPCs, enhancing their empathy toward them and other NPCs.

The study by Kilteni et al. (2012) also relates to the perspective-taking strategy, using agency and self-location with body ownership as mediators for an effective embodied PTT experience. Their findings show that the strategy of embodying another person (moderator) can elicit empathy and function as a mediator for prosocial altruism (effect; in this case, organ donation). Conversely, embodying oneself increases (moderator) personal distress, which works as a mediator, eliciting egoistic motivations (effect).

Herrera and Bailenson's (2021) suggests that there is no significant difference in prosocial response between having or not having virtual representation (avatar). However, if the user is going to be represented, being able to choose the appearance of their avatar will increase prosocial response. At the same time, there is no significant difference in the number of head movements made by the user under the different conditions, although the side-to-side movement is identified as a predictor for signing the petition, as the more a user performed this movement the more likely it was that they would sign the petition. This is the first study done in its entirety in VR (initial questionnaire, VRPT and final questionnaire in the VR application using a head mounted display), which, as Schwind et al. (2019) demonstrate, can decrease variance of response.

Mado et al. (2021) tested the possibility of training empathy like a muscle, so that it could then be transferred "to unrelated contexts instead of being just a mental state" (p. 1) related to a specific context. Their results suggest that although it is possible, not all contexts are amenable to the transfer of empathy. These findings also replicate previous research showing the effectiveness of VR PTTs in enhancing empathy in relational contexts. While the study does not substantiate the transferability of the empathic effect in nonrelational contexts, it does offer tentative evidence that VRPT where the user takes the place of abstract phenomena supports both related and unrelated context empathy. In contrast, if empathy only occurs in relation to a human or social target it

does not transfer to abstract entities, thereby suggesting that VR can train empathic muscles.

Another study dealing with perspective-taking tasks is the paper by Elzie and Shaia (2021), which suggests the possibility of combining virtual reality training with practice and clinical skills assessment. However, the results were not conclusive and might have been affected by external factors as the experimental design was a single-group model that lacked control. The study by Bolt et al. (2021) changed participants' gender identity through a "virtual gender swap illusion" in order to test its effects on social decision-making. The study found that regardless of their biological sex, subjects made more selfish choices when their avatar was not of the same gender. Contrary to the Proteus Effect (Yee and Bailenson, 2007), no evidence was found of an alteration of implicit or explicit identification with gendered traits (mediator) through the "different-gender swap illusion" (moderator) in the condition proposed. The reduced level of agency drives the user to behave less prosocially or generously. Participants in the "different gender avatar" also perceived substantial dissimilarity to their VR embodiment, which could also explain the lower generosity observed.

Using embodiment as a learning strategy by promoting empathy in the students is the main focus of the study by Richards et al. (2021), which attempts to determine whether using VR to visit an ancient Greek historical site would enhance participant learning processes, not only to acquire factual knowledge but also to engage with the population of the VR environment. Empathic learning did not emerge as a major outcome. The students in the VR condition did not acquire more knowledge than their peers in the classroom condition, but their VR perspective-taking task resulted in higher empathy levels than the classroom condition students. The perspective-taking experience functioned as a moderator for empathy, which works as a mediator to enhance the students' learning process.

Kambe and Nakajima (2022) explore empathic orientation toward the other elicited by VR persuasive games in a study to test whether providing a player with a different point of view could affect empathic behavior. In the experiment, participants first took part in a perspective-taking task with a picture of a person for whom they were required to write a diary. After answering a questionnaire to measure their empathy orientation in terms of imagine-self perspective, imagine-other perspective, emotion matching, and empathic concern, they played the VR game involving a distressed character from either a first person or a third person point of view. Finally, they answered a post-experiment survey on the same variables as those contained in the pre-experiment survey. The results show no significant difference between the two conditions in terms of empathy orientation, suggesting that point of view might moderate but not mediate the fostering of empathy.

Finally, Tassinari et al. (2022) research intergroup contact through VR, testing how VR contact might affect situational affective empathy, but in this case without perspective-taking instruction. Participants took part in an interactive play in AtlspaceVR, where they interacted with a person from a different ethnic background. The study measured empathy, body ownership, and copresence in both ingroup and outgroup contact experiences. The results demonstrated that empathic interest and personal distress were lower after the VR ingroup and outgroup experiences, suggesting that intergroup interaction in VR with outgroup member could moderate copresence that would mediate situational empathy, although the findings were not statistically significant enough to confirm this.

3.5. Storytelling, narrative perspective taking, and presence as moderators and mediators of prosocial media effects

Storytelling is one of the most effective ways of engaging an audience, and its use is therefore key to improving the communicative strategies of media content to elicit emotions. The study by D'Errico et al. (2019) "tested attentive and emotional dimensions of intergroup helping interactions in simulated helping situations where a person in need belongs to another ethnic group" (p. 1). There were complex results in terms of how participants gave help to in-group and out-group conditions depending on whether there was a match with race, and depending on the expressed need of the helpee, but the research clearly identified attention and engagement as moderators for empathy in a short-term impact experiment.

One year later, D'Errico et al. (2020) repeated this experiment, adopting Stephan and Finlay's differentiation of two types of emotional empathy (parallel empathy and reactive empathy) (Stephan and Finlay, 1999) to establish a clear definition that distinguishes between two aspects: personal distress and empathic interest. Emotional arousal while actually helping, monitored by an EEG device, appeared ultimately to converge with the measures of self-assessment of empathic involvement during personal distress after experiencing the VR content. The expected social conditions in terms of self-assessment measures elicited empathic interest. The results show that intergroup anxiety (mediator) increases in intergroup contact situations (moderator).

In the context of 360-degree video effects, Ma (2020) sought to test the impact of immersive stories in a study that compared traditional mediated experiences and 360-degree video stories with immersive virtual technology, in order to empirically determine which one is more effective in fostering prosocial behavior and eagerness to help among participants. The study examined whether a higher level of spatial and social presence augmented the user's sense of transportation and identification. The results found no difference in transportation and identification between an immersive virtual experience and a traditional mediated storytelling. If the story is compelling, the storytelling itself is enough to elicit a strong emotional response and generate sufficient engagement "to induce a relatively large degree of transportation and identification, regardless of the media" (p. 15) devices and technologies used. Social presence and identification are effects mediated by storytelling, while spatial presence and transportation are effects mediated by immersive technology.

Another study comparing traditional and immersive media is the paper by Bujić et al. (2020), which investigates how immersive media may elicit changes in human rights attitudes (HRA). The study found that although VR is more likely to have the effect of encouraging behavioral changes in the audience, in some cases 2D formats may be equally capable of doing so, while also being more cost-effective and commercially viable. VR content consumption had a positive impact on dispositional shift in two out of the three dimensions of HRA (social security and equality), but not in privacy or civilian constraint. 2D only affected attitudes toward social security. The bigger the involvement, the more positive the effect on changing attitudes toward HRA, indicating that *presence* and the *feeling of being there* affect and intensify positive shifts in users' human right attitudes.

Also, in this block is the study by Roel Lesur et al. (2020), which seeks to determine whether a greater "degree of ecological sensorimotor interactions from another's perspective would maximize sensorimotor sharing" (2020, p. 2). Although a greater effect of embodiment was predicted in the sensorimotor condition, the results do not suggest a difference in the effect of embodiment. The transgender experience did not have an impact on reducing prejudice. This contrasts with previous studies that claim a reduction in bias toward outgroup members after embodying an outgroup member, perhaps because there is no representation of self or avatar, and the identity of the character we occupy is revealed through voice and narration.

However, in 2021, Pressgrove and Bowman published a study testing whether immersive technologies might have a bigger influence on audience behaviors and attitudes than traditional mediated content (Pressgrove and Bowman, 2021). Previous research has already demonstrated that the manipulation of the audiovisual apparatus (technology) could increase presence without having any impact on engagement with the story. This study concludes that immersive technologies are capable of transporting the viewer and creating a feeling of being there, in a mediated space, but that they are not fully able to evoke feelings of being part of a mediated narrative. These technologies have no impact on the connection to the story and therefore no effect on the viewer's attitude or behavior.

Cummings et al. (2021) also compared immersive 360-degree video with traditional media. They concluded that the interactivity offered by computer-generated virtual environments compared to 360-degree video increases the level of spatial presence and influences the level of empathetic response. Copresence stands as a moderator for cognitive empathy. Therefore, the level of interactivity offered may define the perceived level of spatial presence, thus mediating the empathetic response. Self-location and copresence serve as unique mediators. The "positive association between immersion and cognitive empathy" (p. 14) is moderated by copresence, but the "positive connection between immersion and associative empathy" (p. 14) is moderated by the user's sense of self-location.

Pimentel et al. (2021) hypothesized that social presence may have an effect on prosocial outcomes and could be enhanced "when a user perceives a higher level of interactivity," (p. 2237) as the granting of agency over narrative events increases the viewer's sense of responsibility for the consequences experienced by the characters in the story. This study identifies interactivity as a moderator that immerses the user more fully into the narrative; social presence produces empathic concern while personal distress produces self-oriented behavior. Social presence and interactivity moderate the effect of empathic concern and empathic distress on prosocial behaviors and attitudinal positive change. The relationship between empathic concern and social presence is moderated by the level of perceived interactivity. The results again empirically demonstrate that the real prosocial capacity of 360-degree video lies in its ability to elicit the sense of "being there" and above all in the feeling of "being with" threatened populations and vulnerable groups as a form of copresence with outgroup members.

Presence without embodying someone else is the strategy used in the study by Lamb et al. (2022), which compared VR-enhanced dialectical behavioral therapy, face-to-face dialectical behavioral therapy without VR, and wait-list time-delayed control, based on the potential of VR to build a soft-failure environment for children to work on and learn skills and social interactions. The results showed a more highly skilled performance among the students using VR DBT than those under the DBT regular condition, suggesting that VR-enhanced DBT offers a positive means of helping students with cumulative stress and latent trauma, resulting in greater skill acquisition in a long-term effect experiment, considering presence as a mediator of positive social skill acquisition in high-needs school students.

The paper by Kahn and Cargile (2021) offers another analysis of the prosocial media impact of VR based on the "Wow!" Effect as a moderator for presence, which functions as a mediator of immersion, thereby eliciting prosocial behavior. The study distinguishes between immersion as a technological quality and presence as a psychological state result. While comparing VR with 360-degree video, their results suggest that immersive VR generates presence as a mediating variable for emotional intensity (awe). VR eudaimonic content has an impact on awe, presence, and enjoyment, which all operate as mediators for prosociality.

Finally, in one of the latest studies using 360-degree video that also compares the impact of traditional and immersive media, Chen et al. (2022) focus on the capabilities of eudaimonic storytelling to elicit elevation and catharsis as mediators of positive behavioral outcomes such as altruism. Their findings identify elevation as a mediator between thought-provoking content and altruistic motivation. The results show that eudaimonic content engendered greater positive attitudes toward others than hedonic content. Enjoyment is characterized as essential for the viewer to achieve these outcomes, and catharsis is identified as a mediator between immersion and joyful experiences. Thus, there is a connection between engagement with poignant, intense, emotional messages and the desire to perform prosocial and moral actions, triggered by eudaimonic content, which is more effective than hedonic content.

3.6. Results summary

Key question 1: Are there any trends identifiable in studies analyzing prosocial media effects of virtual reality audiovisual content? Based on the findings of this SLR, we identify three trends in relation to the first block and one for the second. The three trends

in the first block relate to decision-making strategies as part of the experimental method shared by all the studies; the use of virtual entities (agents and avatars) as key elements to test different types of outgroup interaction; and presence and embodiment for the design of perspective-taking tasks as moderators of prosocial media effects. The trend pertaining to the second block relates to storytelling and presence as moderators and mediators.

Key question 2: Does VR have validity as a tool for researching media effects? The studies included in this review and their experimental approaches support the ecological validity of VR as a tool for researching media effects. There is a vast and fertile universe of research on the integration of VR as a tool for communication, audiovisual content generation, and education, and as a method for training empathy-related skills. With the democratization of technological devices, their use is becoming more accessible, so that VR content can be developed for use outside the laboratory, such as in educational, cultural, and artistic contexts, which can ultimately have the effect of promoting a fairer, more empathetic, prosocial, and egalitarian society.

Key question 3: Are there any standardized methodologies for the study of VR narratives' prosocial impact? This subject of study is highly complex, as demonstrated by the fact that the literature reviewed confirms the transactional nature of media effects, including all those defined in the DSMM model, which in a certain sense makes the research difficult to standardize. This is also due to a need pointed out by the vast majority of the studies reviewed, that a specific instrument of measurement should be used to try to capture the different dimensions of prosocial behavior. It would therefore be important to consolidate a measurement system, composed of different types of measures, but this system would need to be validated and used in a standard way in future research to ensure standardized results, which would undoubtedly facilitate the task that lies ahead. In addition, attention should be paid to leveraging all of the capabilities of IVETs in order to measure behaviors quantitatively and directly. All the experimental designs are based on a similar structure (self-reported data collection; media content consumption + physiological data collection; self-reported data + behavioral data collection), which could be established as a valid standard format.

Key question 4: Is there enough evidence to assert that VR content is capable of eliciting positive attitudinal changes in audiences? There is a need to focus research on the narrative and the modes and strategies of creating audiovisual content rather than on the technology itself, as although most studies conclude that VR is more effective in provoking positive attitudinal changes in the audience, in some cases 2D screen formats can be more effective in evoking such changes, and 2D screen formats can be just as efficient while also being more cost-effective and commercially viable. This highlights the point that the narrative is the key element of media effects, and that it operates individually and independently of the technology to engage the audience, which means that it has its own capacity for impact.

Key question 5: What are the factors involved in achieving an effective prosocial outcome by experiencing VR content? How do they interact? Technological features are crucial, but the emotional factor is also fundamental to engaging the audience with media content, as it is capable of moderating and mediating that content's effects and prosocial results. Without emotion, the sense of presence and embodiment will not have the same impact on the viewer's consciousness. The role of technology is therefore limited to moderating and predicting the effects of the media. Hence, the main mediator of the impact on users to encourage helping behaviors is not the technology and the feeling of presence it creates, but the storytelling and the degree of narrative engagement. The crucial aspect is thus not technology but investing in telling compelling stories.

The results of the studies reviewed validate this type of intervention using immersive VR content, suggesting for example that including ethnically, socially and gender diverse NPCs at scale could have a positive influence on user behavior in real-world society. As Sora-Domenjó (2022) suggests, VR technology has the mediating capacity to enhance positive effects, although depending on the type of content and the type of virtual contact and interaction designed, negative effects may be similarly augmented, making this technology a double-edged sword.

Although it might be assumed that only positive experiences would be able to elicit positive effects on users, some of the studies reviewed demonstrate that negative experiences in VR can elicit empathy toward victims of the conflict depicted, if for example the user embodies a person being assaulted by an immigration officer, a baby being abused by an angry mother, or a racialized person being discriminated against at school or work.

Key question 6: Does virtual media intergroup contact work like actual intergroup contact? In relation to the embodiment strategy and perspective-taking tasks, there are studies that confirm the Proteus Effect and others that contradict it, so it is not yet possible to confirm its capacity to affect prosocial behaviors. Factors such as the difference between embodying a person belonging to an outgroup, embodying a person belonging to an ingroup, or simply embodying ourselves in the VR experience come into play. Nevertheless, the studies show that intergroup contact in VR could work as an effective simulation of actual intergroup contact. Future research should also compare imagine-self and imagine-other VR PTTs.

4. Discussion

There is a need for research comparing VR experiences where the user has no agency with experiences where the user has the capacity to make decisions. Furthermore, although any VR experiences that require participant interaction could be described as perspective-taking tasks, whether or not they are identified as such in each study, we can distinguish between two possible configurations: tasks that use an embodiment strategy (which can be labeled "deep perspective-taking tasks"); and tasks that simply identify the user as an individual in a virtual environment who must perform a particular task, be it a helping task or any other type of task. The novelty effect on experimental results should also be taken into account, given that it has been shown that users change the way they behave in VR experiences once they have been exposed to the technology several times.

One issue that has emerged from this review is a point raised by Peck et al. (2013) concerning the VR content that has been used to date to measure audience impact. Although the reported effects in terms of prejudice reduction are significant and promising,

it is not considered that this content has not been marketed or distributed, and that it has been created solely and exclusively for use in lab conditions. This reflects the oxymoron of lab-controlled vs. ecological validity and suggests that there is probably not yet a target audience for this kind of VR content. As it is unlikely that even the gaming community would be interested in consuming these products, they cannot have a prosocial impact on society, given that they are not productions designed for mass consumption. It is therefore necessary to investigate how to make such products attractive to the general public and how to design them, not only for experimental purposes, but also for their introduction to a mainstream audience. In this respect, it should be noted that volumetric capture and volumetric cinema techniques have not yet been used to produce VR content for the purpose of measuring its prosocial impact. No VR production or experience using these techniques has been identified in the literature reviewed, although there are authors who work with these media and who, without aiming to have a scientific impact, have begun to measure the viewer's reaction to their productions in order to improve their design.

Creativity in the experimental and methodological design of research on media effects, and specifically on the prosocial impact of VR content, is obviously important. Thus, the creation of the stimulus (VR storytelling audiovisual content) is the key focus of all the studies reviewed, with data collection before, during and after exposure to the immersive content. Most of these immersive productions are made specifically for the studies in which they are used, and the need to include content creation in the study methodology necessarily increases its complexity. The integration of content creation into the study for which it is designed is therefore important, since in this way all the issues and specificities of the objectives and hypotheses of each project can be addressed. However, there are studies that use pre-existing content, in which case it is essential for the methodology to include a phase of content curation in line with the objectives of the study.

The quality of audio and graphics as perceptual inputs could also have a significant impact on the audience. Technological advances in video games that enable the use of sophisticated real-time realistic rendering systems in VR have an impact on the user's experience (Ivory and Kalyanaraman, 2007), which in turn leads to an increased sense of presence (Lombard and Ditton, 1997). Although sound has little impact on game immersion (Rogers et al., 2018), the combination of current VR audio and image technologies can enhance the visual and auditory experience, resulting in a more concise and plausible perception of space and embodiment. Immersion in the simulation would result from the user's physical connection to the environment and spatial participation, which can have a prosocial impact (Young et al., 2022). As a result, today's VR experiences have greater potential to influence prosocial user behavior than those created a decade ago. However, because story matters most, achieving prosocial goals requires a balance of technology and storytelling elements, with user experience and engagement at the forefront. Emotion can significantly change the way media creators, storytellers, and viewers interact. This, in turn, helps us understand the potential of citizen-led immersive media for social change (Baía Reis, 2023).

In the context of the power of images, motion pictures can simulate mental processes and influence how individuals perceive and interact with their environment (Deleuze, 1987). When compared to other forms of media, the audiovisual replication of the world's perception to which we are exposed creates a significant difference in the transmission of messages (Pajoni, 2008, p. 432). According to Elsaesser (2004), the "cinema effect"—the integration of audiovisual elements into our cognitive processes and experiences—accounts for this capacity to influence viewers. Moreover, embodied experience provides the foundation for our understanding and perception of our everyday surroundings (Biocca, 1997; Gibbs Jr et al., 2004; Kilteni et al., 2012; Shin, 2018). On this basis, VR audiovisual experiences have the potential to enhance 2D moving images by eliminating the gap between the embodiment of the screen and that of the viewer. The audience is immersed in the audiovisual diegesis itself thanks to VR, which surpasses the two-dimensionality of the conventional moving image. Due to the immersive nature of the VR image, the viewer's physical presence is heightened, bringing them closer to the story and facilitating a more realistic and dynamic kinesthetic experience (Popat, 2016). As a result, fiction is viewed as being more authentic. Thus, the power of immersive VR images creates a more vivid experience. VR perspective taking and embodiment enable the viewer to better understand other people's views, feelings, and attitudes, in addition to evoking emotions and empathy (Heeter, 1992; Slater and Wilbur, 1997; Sundar et al., 2017), suggesting the power of VR as a prosocial tool (Hamilton-Giachritsis et al., 2018; Herrera et al., 2018; Van Loon et al., 2018; Ho and Ng, 2020; Mado et al., 2021; Crone and Kallen, 2022).

Finally, it is necessary to highlight three very specific limitations that undermine the consolidation of the results of the studies reviewed. Firstly, of the 38 studies selected, only five use samples of users that do not come exclusively from university or educational contexts, or do not specify the context of the sample. In other words, 86.84% of studies whose objective is to measure the prosocial impact of VR content have been carried out with samples of individuals from university and educational contexts or comprised solely of university students (78.94% of the studies), which means that the results cannot be extrapolated to the general population. As Breves (2020a, p. 15) suggests, it would be interesting to repeat these studies with a different and more diverse sample in order to get a broader picture of the immersive effects of VR media. Secondly, there is a tendency to replicate the studies using the same virtual reality experiences as used in the original study. Although it is understandable that the effort involved in the creation of this type of immersive content would make researchers keen to make the most of them, the fact that content created in 2017 is still being used in 2021, for example, represents a limitation, as the technological advances in those four years would facilitate the design of more complete experiences with more levels of interactivity, which is surely of vital importance for the study of the impact of these media on prosocial behavior. Finally, regarding the type of timing, it is important to highlight that only three of the studies reviewed measure medium- and long-term impact, pointing to a need to design research methodologies that look beyond the immediate impact.

5. Conclusion and outlook

This manuscript presents a narrative synthesis of 38 experimental studies on the prosocial effects of VR audiovisual content included in this systematic review. The main study question is whether VR audiovisual content can affect someone's perception of otherness and induce prosocial behaviors based on a sense of social justice, equality, and fairness. A coding model was developed based on nine operators that allowed us to identify predictors, moderators, mediators, and effects of VR and their direct interrelationships. This allowed us to uncover correlations between the categories of the DSMM model in the studies reviewed. For example, presence is found to be a mediator rather than a moderator, and empathy is also mostly identified as a mediator rather than a moderator. Technology is a moderator and predictor, but narrative and emotion are the key elements of prosocial media effects. Our analysis of the trends in the experimental methodological design of the research reviewed reveals a standardized structure based on three phases: initial data collection, exposure of participants to the media, and final data collection. The types of variables used in these studies also fall into four categories: demographic, self-reported, behavioral, and physiological. To enhance our understanding of how people respond to immersive audiovisual content, it is imperative to incorporate physiological measures into experimental designs, such as the use of EEG to measure electrical brain activity. These findings are relevant to the study of the prosocial media effects of VR and can contribute to the design of methodologies for future research on its impact as a prosocial tool.

This SLR contributes to two ongoing studies and lays the foundations for a prospective meta-analysis. In addition, the results have supported the design of an experimental methodology to measure the impact of a VR series titled *The Stigma Machine* (Martínez-Cano et al., 2023), conceived as a four-episode VR series that addresses the problem of social stigma by using the virtual film medium to increase audience awareness and encourage supportive behaviors about contentious issues in contemporary society. Our final goal is to conduct a preliminary analysis of the effectiveness of this VR experience in achieving prosocial goals in comparison to more conventional 2D and non-interactive cinema, and of how traditional film pre-production and production methods have changed to accommodate the process.

Although it would be premature to affirm that VR experiences have the capacity to shape the prosocial behaviors of their audiences, especially in relation to their long-term effects, it is necessary to continue with this line of research to explore the prosocial media effects of VR and their prevalence, especially in view of the emergence of the metaverse and the evolution of immersive audiovisual content.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

FJMC obtained funding, wrote the manuscript, and designed the operators used in the coding system. FJMC and FC conceived and designed the SLR. FJMC and RL provided resources and supervised the development of the SLR. FJMC, RL, and FC contributed to the coding. All authors reviewed and edited the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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