

Towards structuring research on mediated social interactions

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Abstract

The difficulty of understanding mediated social interactions lies in exploring the various scientific areas, such as social psychology, communication, or neuroscience, and connecting them through different theories. We propose that it would be beneficial to the community to create a framework for this field. In this way, the ethical and moral issues could be addressed more efficiently and unequivocally. In this paper, we propose a first part to overview the subject of mediated social interactions by exploring theories from social psychology, and a first attempt to gather these theories in a schematic representation of the dynamic of social interactions in Virtual Reality. Then we propose a second part to address some of the ethical and moral issues, before a conclusion.

Keywords

Social Interactions, Mediated Communication, Social XR, Virtual Reality

1. Introduction

Throughout history, human beings have invented new techniques and technologies leading to new communication means. The last industrial revolution brought digital technologies, enabling remote communication in real time and the sharing of more and more information. In this context, some technologies enable the sharing of real-time body movements, reproduced in digital human representations, such as avatars. In particular, Virtual Reality (VR) allows users to engage both physically and cognitively in a shared Virtual Environment (VE) [1]. Therefore, a wide range of research orientations arises, from avatar design to technological possibilities (hardware, VE [2], User Interfaces [3], User Experience [4]), and also crosses the social psychology and communication fields of science. Indeed, human beings uses the same cognitive processes to communicate together, even through digital medium, such as VR [5]. Therefore, the mediated social interactions field of research gather different theories from different research field. Consequently, it is challenging for researchers to conduct experiment that holistically take into account the various parameters that may influence the results, or even to unintentionally omit to mention all the parameters that influence them. For example, a collaborative study may fail to note the common ground between participants, which appears to influence the level of co-presence. [6].

Within this vast field, we propose in this paper that it would be relevant for the community to structure this area of research in order to pool efforts and strive to be as comprehensive as possible.

To illustrate this proposal, the first part of this paper explore a non-exhaustive state of the art of mediated social interactions, and a second part overview ethical issues.

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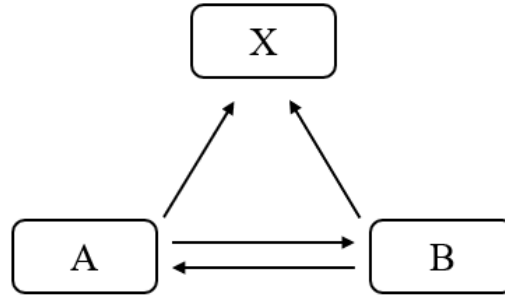


Figure 1: Newcomb’s ABX model [10]. A and B represent the interlocutors and X represents the message transmitted in a social situation. The double arrows between A and B represent the reciprocal influence of social interaction, while the arrows represent the attention paid by each individual to the other and to the subject (X).

2. Understanding mediated social interactions

2.1. How to define social interactions?

We think that before proposing social interactions augmented with XR technologies, it is necessary to understand how social interactions work, what their parameters are, and what their effects are.

Social interaction can be considered as a special case of communication [7], where a reciprocal influence exists between at least two interlocutors [8]. Several factors (or parameters) can influence it, such as the social or environmental context or interpersonal influence. Indeed, individuals will not communicate in the same way depending on the location (an amusement park, a museum, or at work), depending on the people with whom the exchange takes place (with a colleague or a superior), or even depending on the means of communication (a telephone exchange with or without a camera, or a face-to-face exchange). Thus, we adapt our verbal and nonverbal communication depending on the situation. We consider location a social element because it engenders specific behaviors.

Communication enables humans to collaborate, cooperate, give meaning to the world, and function as social animals. It allows us to feel integrated into society through various forms of belonging (such as family, colleagues, or specialized groups). This approach to communication is based on the idea that humans construct a cultural and social reality by constantly communicating their values, attitudes, and ideas [9].

Unlike linear communication models that do not take into account the physical and social environment [7], Newcomb’s ABX model [10] schematizes socially situated communication with three elements: two interlocutors (A and B) and the content of the message transmitted in a specific context (X) (Fig. 1). Newcomb [10] proposes the hypothesis that the social environment influences communication, in the sense that communication is used to construct and maintain a social reality, which is different for everyone. The idea behind this theory is that our everyday representations, the representations we take for granted, or even simple and objective “truths”, are all created and reinforced by social interactions. This is the approach known as “social constructivism” which posits communication as a tool for constructing one’s own worldview.

This model provides a visualization of a communication situation and can be adapted to suit the case being studied, for example, to schematize an exchange mediated by a virtual reality system. The model can also be used by treating A and/or B as a group, and the dynamics will differ from those when A and B are treated as individuals.

Tomasello’s cooperative model of human communication [11] provides additional insights into interpersonal interaction, e.g., the internal processes of each individual during a social interaction.

This theory takes into account **individual goals** and values in the act of communication. To achieve these goals, individuals may need help, exchange information, or share skills with others, which constitutes **social intention**. Social intention is then communicated through **communicative**

intention, allowing common goals to be shared. Consequently, references to the outside world can be used to communicate the message and intention, which constitutes **referential intention**. Based on **cooperation norms**, which indicate how to cooperate with others, the other person will try to understand why communication is being attempted, and cooperative reasoning will help to understand this. Therefore, to understand the element of referential intention, an individual will base their reasoning on **common ground**, the elements that both individuals share. Finally, the individual will decide whether or not they wish to cooperate.

2.2. Social psychology theories

We have defined social interaction as a situation of mutual influence between at least two individuals, with the aim of communicating. We propose to explore cognitive processes studied in social psychology that may explain—or help us understand—certain factors that can influence communication dynamics, also known as cognitive biases [12].

The theory of social representations offers a reflection on how thought works [13], explaining the origin of the relationships between knowledge, representations, and context [14]. In other words, it is a theory explaining how and what structures our representations (or thoughts) of a socially situated subject are composed of, hence the term *social* representations. A social representation associates an object and a subject. The subject's vision or point of view toward the object is defined by their beliefs and their own constructs. The individual's reality is represented and reconstructed according to their characteristics, which will become their own reality [15]. Social representations originate from a socio-cognitive system that processes socially situated information. For each individual, these representations are constructed and updated throughout their life, through their social experiences. They enable us to understand and explain perceived reality, and are part of both individual and group identity. These representations also guide behavior and justify behavior and decisions after the fact [16, 17, 18].

Another socio-cognitive process for social interactions is described by the theory of mind [19]. The theory of mind corresponds to our ability to theorize about the intentions, desires, beliefs, and emotions of others. It consists of representations of what is going on “in the minds of others” in order to explain or predict their reactions. We develop this ability around the age of 3, through the detection of gaze, intentionality, and shared attention mechanisms [20]. Intentionality corresponds to understanding that others have their own thoughts and intentions [21]. The theory of mind, therefore, implies that the ability to infer the mental states of others may vary from one individual to another and that, consequently, these inter-individual differences may have an impact on the perceived experience of social interaction. Indeed, given that social interactions are based on mutual influence, it is essential to understand the mental states of others.

In addition, humans tend to categorize elements, particularly social elements, and this is accompanied by cognitive and behavioral biases that influence social interactions [22]. Indeed, Tajfel [22] indicates that humans categorize all elements in order to process them more quickly. Consequently, biases can arise from these categorizations, particularly when two groups are in opposition. If an individual considers themselves to be part of a group, the other members of the group will be perceived as more similar to the individual than they actually are. In addition, the individual will consider the members of the other group to be more different than they really are. These effects tend to diminish in the presence of a third group, as the opposition between the home group and the second group is reduced. In the case of multi-user VR applications, it can be assumed that the appearance of the avatar may lead to categorization bias, depending on the situation, and thus influence social interaction.

We can add that the mutual influence during social interaction induces verbal and non-verbal communication. Nonverbal communication includes different categories: conscious imitation, learning, social analysis, adaptation [7], and automatic reactions [11, 23]. One of the automatic reactions is behavioral mimicry: an unconscious imitation of the postures, mannerisms, facial expressions, and other behaviors of a social interaction partner. Behaviors change unintentionally depending on the social environment [23]. Imitation is called “social glue” because it creates bonds, empathy, and a sense

of affiliation. This imitation is called the “chameleon effect”: just as a chameleon changes color, humans change their behavior [24].

2.3. Social presence in VR

Social interactions in Virtual Reality have been studied in the literature since the development of the first headsets. It is possible to quantify social interactions mediated by VR by measuring social presence [25], which has been studied in particular for Computer-Mediated-Communication (CMC) [26, 27] using various devices or tools, such as instant messaging on a computer, for example.

Social presence corresponds to the impression of interacting with an entity, human or otherwise, and if this impression is similar to that felt during a face-to-face interaction, rather than one mediated by a communication tool (or media). In line with this definition, Harms and Biocca [28] proposed a questionnaire divided into six parts, each representing an aspect of social presence. Social presence is a concept, a set of six psychological dimensions measured by a questionnaire, corresponding to six feelings. Among the subcategories measured in the questionnaire, one concerns the measurement of co-presence, or the feeling of being with someone else in the virtual environment, a feeling that is essential for social interaction that approximates reality [19].

Co-presence is associated with various definitions which, broadly speaking, refer to the sensation of feeling the presence of someone else in the virtual environment [29, 30]. This feeling can be seen as a result of the perception, defined as an active process that diminishes prediction error [31], provided by the brain’s internal model [32]. Co-presence can thus be described by the perception built on previous social interaction, mainly experienced without the mediation of virtual reality. Furthermore, without this feeling of being in the presence of others in a (virtual) environment, social interactions with others in that environment will be affected, according to the theory of mind [19].

The measurement of co-presence is also used to verify the effects of experimental conditions. For example, the study by Bailenson et al. [33] compares different avatars in a VR dyadic situation and notes a higher co-presence value with a more realistic avatar. The study by Poinot et al. [34] indicates a higher co-presence value when the perceived nature of the interlocutor is human, compared to a machine. On the other hand, other studies also show no effect on the co-presence value. We can cite the study by Roth et al. [35], which compares two tasks (a ball game and a role-playing game) in VR and in the real world. The study shows equivalent co-presence values between VR and the real world. However, the authors highlight the many parameters that could influence social interactions in VR, such as the lack of facial expressions or eye contact. For example, the study by Dubosc et al. [36], which examined the degree of anthropomorphism in robot avatars, showed that the robot’s appearance had no effect on co-presence.

This non-exhaustive review of the literature shows that the factors that can influence co-presence, and by extension mediated social interactions, are not clearly identified. Identifying these factors will enable us, first, to isolate them through experiments and measure their effects, and second, to develop XR applications with a better perceived quality of social interactions.

2.4. A first attempt to describe the dynamics of mediated social interactions

This overview shows how complex social interactions are as an interdisciplinary field of study. However, we propose a first attempt to describe mediated social interactions, specifically those in VR, which we consider the medium with the greatest number of parameters we can modify. First, we propose the *Koinos* concept to name the **perceived quality of mediated social interaction**, based on neuroscience that uses predictive coding theory to explain perception [32]. Secondly, we propose a model (Fig. 2) which represents the dynamics of social interactions mediated by VR. These concepts and theories complement the actual theories by offering an interdisciplinary perspective [37]. This is a preliminary study that requires further investigation.

To propose this first attempt, we first study the theories that explain how social interactions works in face-to-face, but also how the brain works to understand why user have different perception of

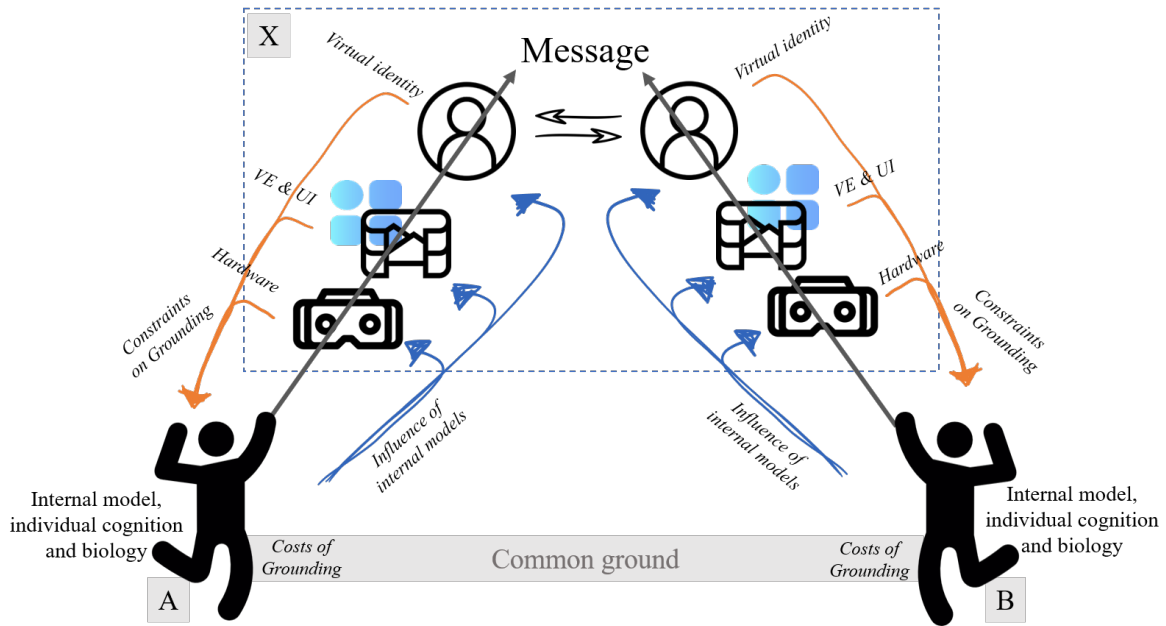


Figure 2: The *Koinos* model: dynamics of social interactions in virtual Reality [37].

digital and real world experiences. Then, through experiment studying co-presence in VR, we connect the result to our understanding of the communications theories, which lead us to propose the *Koinos* concept, the *Koinos* model, but also to a method to design or evaluate the perceived quality of social interaction in VR [6]. We think that this methodology could be use to better structure the mediated social interactions research field. For instance, a mind map of the different theories that could influence social interaction could be relevant in order to consult it to get an holistic view.

3. Is social augmentation necessary?

In this second part, we propose to discuss ethical issues of social augmentation through XR technologies. We propose the following question: Is it worthwhile to work toward improving the *Koinos* at all costs, or is it more relevant to conduct more theoretical and holistic research on mediated social interactions in order to propose parameters that are relevant to the objectives of the applications? Indeed, in the literature, we identify that each experiment focuses on a specific question, without being structured in a wider vision of this research topic. We can propose that it would be interesting to conduct theoretical studies to understand the full dynamics of social interactions before focusing on a specific subject. Indeed, without the wider view, the research questions or the experiment could be unintentionally incomplete, and by mistake may vary unwanted parameters, or fail to report some parameters (e.g., the common ground between participants during a collaborative task). Therefore, during the structure of the field, it could be interesting to include ethical issues. Some work already encompasses these subjects, but it could be interesting to take them into account in this holistic vision.

For instance, it could be interesting to start with the definition of “ethics” in this context. Is the meaning the same in the different fields tackling mediated social interaction? From a philosophical perspective [38], the distinction between ethics and morality is clear: morality comes from laws, rules, and ethics signify a thinking of how to live [39]. Therefore, the common ethical issues we encounter in this field of mediated social interactions (i.e., harassment, private data policy, regulation of agents behavior, cybersickness, cognition, etc. [40, 41, 42, 43, 44]) may stem from a lack of morality, in the sense that there are no laws or rules, as in a society. The difficulty arises from the internationalisation of the exchanges. Each society has its own laws; therefore, some countries consider these questions to be either prior or not in this turbulent period. One of the first steps is to distinguish moral from ethical questions.

Then, it could be interesting to study history to understand how these questions were answered in the real world. Each solution may not be relevant to the digital world, but it may still be inspiring. For instance, considering perception as an active process based on the brain's predictive coding system, what could the consequences be for perception if users spend more time in a VR collaborative application? Can their perception of themselves can be changed? With what consequences?

Another way of thinking could be inspired by moral and experimental philosophy [38]. For instance, the Tramway dilemma was designed to understand the motivations behind moral judgements. In this study [45], participants must answer a single question across four cases. In each case, it concerns a choice to make about a tramway that is moving very fast toward five people on the rails. The question was: Does this action seem moral to you? The four cases are:

- Case 1. Operate a lever to divert the tramway to another track where a person is standing;
- Case 2. Push someone onto the tracks to stop the tramway;
- Case 3. Divert the tramway onto a track where an obese person is standing, allowing the tram to stop;
- Case 4. Divert the tramway onto a track where someone is standing in front of an object that can stop the tram.

The results indicate that participants consider the first case the most morally acceptable (85%), and the second case the least morally acceptable (12%). Based on these first two results, it could be tempting to conclude that the means to stop the tramway is the reason for the results (double effect principle), even if the result is the same (1 death or 5 deaths). To validate this hypothesis, two additional cases were added, with results of 56% for case 3 and 72% for the last case. The results did not validate the double effect hypothesis, and led to the hypothesis of emotions' effect on the choice [38, 45]. Later, several studies have shown the effect of emotions on moral judgment [46, 47].

These questions about the origins of moral judgment could help shape the community of mediated social interactions research field and raise new questions. For instance, the origins of harassment in the virtual world are sometimes associated with the anonymity enabled by the screen, but could the origin of the actions be linked to the tramway dilemma? E.g., in a virtual world, users do not interact directly with others, so it is more acceptable to act non-morally, such as taking direct action to push someone to stop the tramway or taking an indirect action with the lever.

In summary, we can propose that the field of mediated social interactions is wide and transdisciplinary, illustrate with this philosophical perspective; it could be interesting to structure the research to move forward. In addition, the exchanges about ethical (or moral) questions could be easier and more efficient.

4. Conclusion

Mediated social interactions have been studied since the creation of digital technologies. Extended Realities (XR) enable users to engage both physically and cognitively in shared virtual environments and to conduct social interactions with other users represented by avatars. We propose that it is fundamental to understand the dynamics of social interactions on mediated devices, taking into account other fields of science that offer further insight into these dynamics. For instance, designing a shared mind map to gather the different theories that influence mediated social interactions could be created. Therefore, it could be beneficial to the community to structure this research field to mutually support one another and move forward together. In addition, we propose that structuring the research field could allow us to identify and discuss ethical and moral issues.

Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

References

- [1] M. Slater, Immersion and the illusion of presence in virtual reality, *British journal of psychology* 109 (2018) 431–433.
- [2] K. Kim, M. Z. Rosenthal, D. J. Zielinski, R. Brady, Effects of virtual environment platforms on emotional responses, *Computer methods and programs in biomedicine* 113 (2014) 882–893.
- [3] J. G. Grandi, Z. Cao, M. Ogren, R. Kopper, Design and simulation of next-generation augmented reality user interfaces in virtual reality, in: *2021 IEEE conference on virtual reality and 3D user interfaces abstracts and workshops (VRW)*, IEEE, 2021, pp. 23–29.
- [4] Y. M. Kim, I. Rhiu, M. H. Yun, A systematic review of a virtual reality system from the perspective of user experience, *International Journal of Human–Computer Interaction* 36 (2020) 893–910.
- [5] M. Slater, A note on presence terminology, *Presence connect* 3 (2003) 1–5.
- [6] E. Minder, S. Fleury, S. Neyret, J.-R. Chardonnet, The virtual reality koinos method: Analyzing virtual reality collaboration from the perspective of communication models, *arXiv preprint arXiv:2505.14078* (2025).
- [7] J. A. DeVito, *The interpersonal communication book*, Instructor 1 (2019) 521–532.
- [8] J.-M. Stébé, *Risques et enjeux de l’interaction sociale [Risks and stakes of social interaction]*, Lavoisier, 2007.
- [9] R. de Graaf, *Introduction to communication science*, Coursera, MOOC, 2015. URL: <https://www.coursera.org/learn/communication>.
- [10] T. M. Newcomb, An approach to the study of communicative acts., *Psychological review* 60 (1953) 393.
- [11] M. Tomasello, *Origins of human communication*, MIT Press, 2008.
- [12] M. G. Haselton, D. Nettle, P. W. Andrews, The evolution of cognitive bias, *The handbook of evolutionary psychology* (2015) 724–746.
- [13] S. Moscovici, D. Victoroff, *Psychologie sociale*, *Année Sociologique* (1963) 233.
- [14] G. A. Veltri, *Social semiotics and social representations* (2015).
- [15] J.-P. Pétard, *Psychologie sociale*, Editions Bréal, 2007.
- [16] J.-C. Abric, L’étude expérimentale des représentations sociales [experimental study of social representations], *Les représentations sociales* 4 (1989) 187–203.
- [17] J.-C. Abric, *Les représentations sociales: aspects théoriques*, *Pratiques sociales et représentations* 2 (1994) 11–37.
- [18] É. Tafani, S. Bellon, Principe d’homologie structurale et dynamique représentationnelle, *La dynamique des représentations sociales* (2001) 163–193.
- [19] H. L. Gallagher, C. D. Frith, Functional imaging of ‘theory of mind’, *Trends in cognitive sciences* 7 (2003) 77–83.
- [20] J. A. Fodor, A theory of the child’s theory of mind., *Cognition* (1992).
- [21] J. R. Searle, *Intentionality: An essay in the philosophy of mind*, Cambridge university press, 1983.
- [22] H. Tajfel, M. G. Billig, R. P. Bundy, C. Flament, Social categorization and intergroup behaviour, *European journal of social psychology* 1 (1971) 149–178.
- [23] T. L. Chartrand, J. A. Bargh, The chameleon effect: The perception–behavior link and social interaction., *Journal of personality and social psychology* 76 (1999) 893.
- [24] T. L. Chartrand, J. L. Lakin, The antecedents and consequences of human behavioral mimicry, *Annual review of psychology* 64 (2013) 285–308.
- [25] F. Biocca, C. Harms, J. K. Burgoon, Toward a more robust theory and measure of social presence: Review and suggested criteria, *Presence: Teleoperators & virtual environments* 12 (2003) 456–480.
- [26] J. B. Walther, Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction, *Communication research* 23 (1996) 3–43.
- [27] K. L. Nowak, J. Fox, Avatars and computer-mediated communication: a review of the definitions, uses, and effects of digital representations, *Review of Communication Research* 6 (2018) 30–53.
- [28] C. Harms, F. Biocca, Internal consistency and reliability of the networked minds measure of social presence, *Seventh annual international workshop: Presence 2004* (2004).

- [29] R. Schroeder, Being there together and the future of connected presence, *Presence* 15 (2006) 438–454.
- [30] S. Zhao, Toward a taxonomy of copresence, *Presence* 12 (2003) 445–455.
- [31] K. J. Friston, J. Daunizeau, J. Kilner, S. J. Kiebel, Action and behavior: a free-energy formulation, *Biological cybernetics* 102 (2010) 227–260.
- [32] K. Friston, The free-energy principle: a unified brain theory?, *Nature reviews neuroscience* 11 (2010) 127–138.
- [33] J. N. Bailenson, N. Yee, D. Merget, R. Schroeder, The effect of behavioral realism and form realism of real-time avatar faces on verbal disclosure, nonverbal disclosure, emotion recognition, and copresence in dyadic interaction, *Presence: Teleoperators and Virtual Environments* 15 (2006) 359–372.
- [34] K. Poinot, G. Gorisse, O. Christmann, S. Fleury, S. Richir, et al., Effect of social actors perceived agency on social presence in computer-mediated communication, *Advances in Human-Computer Interaction* 2022 (2022).
- [35] D. Roth, M. Latoschik, C. Bloch, G. Bente, When some things are missing: The quality of interpersonal communication in social virtual reality, in: *Presentation at the 68th Annual Conference of the International Communication Association (ICA)*, 2018.
- [36] C. Dubosc, G. Gorisse, O. Christmann, S. Fleury, K. Poinot, S. Richir, Impact of avatar facial anthropomorphism on body ownership, attractiveness and social presence in collaborative tasks in immersive virtual environments, *Computers & Graphics* 101 (2021) 82–92.
- [37] E. Minder, S. Fleury, S. Neyret, C. Guillet, J.-R. Chardonnet, The koinos model: compelling social interactions in virtual reality, *Theoretical Issues in Ergonomics Science* (2026) 1–14.
- [38] D. Bonnay, Introduction à la philosophie expérimentale [introduction to experimental philosophy], lecture notes, Paris Nanterre University, 2026.
- [39] J. Zigon, Within a range of possibilities: morality and ethics in social life, *Ethnos* 74 (2009) 251–276.
- [40] K.-M. Behr, A. Nosper, C. Klimmt, T. Hartmann, Some practical considerations of ethical issues in vr research, *Presence* 14 (2005) 668–676.
- [41] A. Skulmowski, Ethical issues of educational virtual reality, *Computers & Education: X Reality* 2 (2023) 100023.
- [42] P. Kaimara, A. Oikonomou, I. Deliyannis, Could virtual reality applications pose real risks to children and adolescents? a systematic review of ethical issues and concerns, *Virtual reality* 26 (2022) 697–735.
- [43] B. Kenwright, Virtual reality: ethical challenges and dangers [opinion], *IEEE Technology and Society Magazine* 37 (2018) 20–25.
- [44] L. Royakkers, J. Timmer, L. Kool, R. Van Est, Societal and ethical issues of digitization, *Ethics and Information Technology* 20 (2018) 127–142.
- [45] P. Foot, The problem of abortion and the doctrine of double effect, *Oxford* 5 (1967) 5–15.
- [46] J. D. Greene, R. B. Sommerville, L. E. Nystrom, J. M. Darley, J. D. Cohen, An fmri investigation of emotional engagement in moral judgment, *Science* 293 (2001) 2105–2108.
- [47] S. Nichols, How psychopaths threaten moral rationalism: Is it irrational to be amoral?, *The monist* 85 (2002) 285–303.