Psychological Issues for Designing XR Spaces

From Usability to Humability

Britta Essing[a], Dennis Paul[b]
Human-Centered Engineering & Design
Fraunhofer Institute for Applied Information Technology
FIT
Sankt Augustin, Germany
[a]britta.essing@fit.fraunhofer.de,
[b]dennis.paul@fit.fraunhofer.de

René Reiners
Chair of Information Systems and Databases (Computer Science 5)
RWTH Aachen University
Aachen, Germany
rene.reiners@rwth-aachen.de

Abstract—The rapid development of eXtended Reality (XR) technologies—and their integration into the emerging metaverse—brings both extraordinary opportunities and significant risks. As XR technologies increasingly penetrate various aspects of life, from entertainment to work, understanding their psychological impact becomes essential. The concept of Humability—defined as the extent to which XR environments are harmless or beneficial to mental health—emerges as an important criterion for the human-centered design of such technologies. This paper emphasizes the importance of Humability and aims to support the creation of virtual worlds that do not harm. To address this concern, we conducted a literature review and analyzed existing research from different psychological sub-disciplines. Through this we gained insights that are relevant for the human-friendly design of avatars, virtual environments, and user behavior in immersive XR spaces. By summarizing findings from developmental, social, cognitive, personality, work, organizational, and clinical psychology, we identified key factors that influence mental health in XR application contexts. From our findings, we conclude that virtual environments must balance immersion and cognitive load, encourage diverse interactions, and fulfill psychological needs in a healthy way. User behavior in XR/metaverse environments should be guided to promote positive social interactions and avoid psychological problems such as addiction and depersonalization. Our conclusion emphasizes the need for an interdisciplinary development of Humability as an applied science to ensure that the metaverse becomes a psychologically harmless or even enriching place for all users.

Keywords—Extended Reality (XR); Usability; Mental Health; Design Guidelines; Humability.

I. INTRODUCTION

As virtual and augmented reality, both components of eXtended Reality (XR) technologies, continue to advance, their integration into everyday life is increasing rapidly. This development has also revived interest in the concept of the metaverse, particularly since Meta's vision highlighted Virtual Reality (VR) and Augmented Reality (AR), as key enabling technologies for future virtual collaboration and social interaction. XR, i.e., VR, AR, and the combination thereof, has the potential to disrupt various areas, from entertainment to working environments. Thereby, the psychological impact of an extended stay in these immersive worlds raises significant concerns. It is essential that XR environments like the metaverse are designed to be human-friendly and focus on the mental health and wellbeing of users. However, despite the increasing relevance of this topic, we identified a significant lack of research on how XR environments can be designed to avoid potential harm and promote psychological health. The existing studies analyzed in this paper primarily focus on the potential harms associated with XR, such as addictiveness, deindividuation, and negative effects on body image and social interactions. However, research so far has neglected practical design strategies that can minimize these risks.

The aim of this work is to identify research gaps and formulate interdisciplinary research challenges necessary for the prospective development of human-friendly design principles for psychologically harmless XR environments. As an initial step, we provide a comprehensive literature review as an overview of the research work conducted in this area so far and as a basis for strategically setting up follow-up research.

We consider design guidelines from a psychological perspective as important for protecting users and enhancing their experiences in these emerging digital spaces. Our approach shall ensure that XR spaces and other XR environments do not harm mental health but enrich it. This perspective originates from usability research and will be extended and adapted to the XR domain. Thus, our research shapes the term **Humability** by raising future research questions from each considered psychological discipline.

The rest of the paper is structured as follows; After presenting a first definition of the term Humability and its relevance regarding the XR market value, Section III describes our literature research methodology. As results, Section IV describes relevant psychological issues that should be addressed for the design of "humane" XR environments. This paper concludes by providing first guideline ideas for XR design as first seeds for further research to merge conventional usability knowledge with the prospective post-desktop XR era.

II. HUMABILITY—A FIRST DEFINITION

At this point, we would like to present a first draft of a definition of Humability. Based on current thinking and knowledge, Humability as a concept should first be defined as "the extent to which a virtual and augmented reality context is harmless or beneficial to a person's mental health". This is based on the standard definition of usability [1]. Hereby, the "context" consists of interaction partners, the physical environment, and areas of life (work/leisure), among other things.

A virtual or augmented reality context can only be specifically designed in such a way that it is "harmless to mental health" if the risks associated with certain context characteristics have been identified and their mechanisms of action understood. In designing XR spaces that are even "beneficial to mental health", the focus is not on psychological dangers, but on the multiple insights into the therapeutic value of XR, which have the potential to alleviate people's psychological suffering. The challenge is to abstract these findings from their therapeutic application situations and translate them into everyday functions of virtual and augmented worlds so that people can spontaneously benefit from the positive effects on their psyche.

Our concept of Humability thus corresponds to the consideration of *Ethical, Legal, and Social Implications* (ELSI). Humability as a quality of an interactive technological system in this sense is the suitability of such a system for humans – or human suitability. As a design approach and field of research it answers the question of how to design to protect or promote mental health. Although the impact of technology on human well-being has been studied in various research areas, usability engineering, which also deals with the reduction of user harm, is still mainly concerned with users as functioning and task-performing entities and not as beings with their psychological feelings, needs, vulnerabilities, and potentials. In this way, we aim to introduce a new perspective for the consideration of interactive technologies, apart from usability engineering and Positive *User Experience* (UX) research.

The social relevance of this topic is emphasized by the significant financial investments that have already been made in XR technology. According to Statista [2], the industry forecasts predict that the worldwide market for XR reached $29.26 billion in 2022 and will rise to over $100 billion by 2026. This investment underlines the urgent need to ensure that these technologies are developed with people's mental health in mind.

III. METHODOLOGY

To systemically and methodically address the need for a "humane" XR design, we have conducted a broad literature review. This method involved a review of current research in various psychological sub-disciplines to identify existing knowledge, gaps, and potential risks associated with XR environments. Our approach was to gather the results of studies on the psychological effects of XR technologies and assess how these findings can inform the design of psychologically harmless or even beneficial virtual spaces.

The literature review was conducted as follows:
Selection of databases and keywords: We started by selecting relevant academic databases, including PubMed, PsycINFO, IEEE Xplore and Google Scholar. Relevant studies were found using keywords such as "virtual reality", "augmented reality", "mental health", "avatar design", "virtual environments", and "user behavior".
Screening and inclusion criteria: We screened articles for relevance based on their abstracts. Inclusion criteria included studies that addressed the psychological effects of VR/AR, user interaction in virtual environments, and the effects of design on mental health. Priority was given to articles from peer-reviewed journals, conference papers, and seminal work in the field.

IV. RESULTS

In this paper, we examine the literature on XR for mental health, integrating insights from key disciplines within psychology to propose a preliminary, meaningful framework. It is important to emphasize at this point that the following thoughts, scientific findings, and research questions do not claim to be exhaustive. Our intention is to exemplify and reinforce the need for the research topic or field of Humability. For that reason, we derive future research questions from each discipline.

A. Developmental Psychology

Developmental psychology deals with the description and explanation of intra-individual changes in human experience and behavior across the entire life span—from prenatal development to death [3]. Assuming that adolescents are one target group of XR spaces, special attention should be paid to the extent to which its use could have an influence on the development of identity, which is—according to *Erikson's Stages of Psychosocial Development*—an important challenge during the phase of adolescence between the age of 12 to 18 [4]. Identity means that a person is a unique and distinctive personality [5]. The inner consistency experienced by the person is embodied in the self-concept or self-image and goes hand in hand with the feeling of self-worth and the experience of one's own individuality [6].

There are first findings that show that a strong identification with an avatar in a game context is negatively related to self-concept clarity [7]. The developmental question "Who am I?", which is significantly answered through interaction with peers, remains distinctly separate from one's physical body. Although it is natural for teenagers to vary their behavior and appearance [4], the question now is whether the changeability of avatars influences this process of finding identity. Furthermore, it is known that media can have a great influence on the perception and acceptance of one's own body in adolescence. The significance of the media in the construction of beauty ideals of female adolescents has been controversially discussed in society for a considerable time [8]. Therefore, it cannot be ruled out that the personal manifestation as an avatar can also influence the evaluation of one's own body.

Derived research question: How should avatars be designed to not impair or even support adolescents in their search for identity?

B. Social Psychology

From a social psychology perspective, it is of great interest how virtual social life in virtual spaces affects a person's thoughts, feelings, attitudes, and behavior [3]. Avatar customization would allow for a greater extent of possible personalization and thus the users' identification with their avatar. In addition to *spatial* presence, the feeling of actually being there [9], *self-identification* as the feeling that 'the avatar is really me' [10] is another aspired effect of XR spaces. Since not just oneself but everybody will typically interact in XR spaces via an avatar, the third phenomenon to consider is social presence that is the conscious awareness of others [10]. Identification with one's own avatar along with the perception of other avatars and interaction with the associated social groups is expected to bring about several psychological effects that need to be accounted for when designing XR spaces. Three social-psychological phenomena that occur in virtual spaces will be presented exemplarily: echo chambers, the Proteus effect, and escapism behavior.

1) Echo chamber effect: Frequent stays in virtual spaces with a self-selected virtual community could easily lead to a narrow-minded worldview, which brings with it the risk of *confirmation bias*. Wickens *et al.* [11, pp. 261–261] define this as a tendency "for people to seek information and cues that confirm the tentatively held hypothesis or belief, and not seek (or discount) those that support an opposite conclusion or belief". In contrast to real life, in which one must deal with different views and characters, in self-selected, virtual spaces, one's own opinion is likely to be mirrored and thus reinforced, which is described as the *echo chamber effect* [12][13]. The existence of echo chambers is in turn likely to go along with *filter bubbles*, in which in-group members preferentially communicate with each other to the exclusion of outsiders [14]. This increases the danger of radicalization as a result of social learning effects [15].

2) Deindividuation and the Proteus effect: Another aspect to consider regarding XR spaces is the concept of *deindividuation*, which describes a loss of self-awareness and individuality due to the immersion in a social group. According to the *Social Identity model of Deindividuation Effects* (SIDE) [16], deindividualization causes people to rely more heavily on identity cues and thus conform to group norms in the context of computer-mediated communication. This is relevant to XR spaces and online social networks and communities in general, where anonymity and group identity can lead to antinormative behavior like harassment, profanity, or trolling.

Closely related to but opposite of the SIDE is the *Proteus effect*. Yee and Bailenson [17] refer to it as the influence of an avatar's features and characteristics on the user's behavior. In contrast to the deindividuation effect, the Proteus effect emphasizes conformity to individual (rather than group) identity cues. What is interesting or particularly noteworthy here is that behavior patterns, once trained virtually, could also be retained in real life, especially if the virtual world is particularly similar to the real one [18]. As Scarborough and Bailenson [10] suggest, virtual environments offer great flexibility in how they present reality. This can provide great therapeutic and educational potential; on the other hand, if uncontrolled, it can pose dangerous problems.

3) Uncanny valley effect: On a related note, not only the effects of customization need to be considered but also the implications of the more realistic replications of the users' real-world appearance in terms of the *uncanny valley effect* [19]. Shin *et al.* [20] showed that greater realism increased feelings of eeriness, which in turn impaired information processing and accurate thin-slice (i.e., based on a minimal amount of information) judgements of the people's real character traits, extraversion and agreeableness. Therefore, in XR spaces, we should carefully design avatars so to enhance relatedness and accurate judgements of other users' personality if we want people to mutually engage in a caring and trusting manner (cf. [21]).

Derived research question: How should avatars and avatar customization be designed so that they do not negatively affect mental health in terms of deindividuation, the Proteus effect, and the uncanny valley, or even positively affect mental health?

4) Escapism and psychological need satisfaction: A major kind of motivation for engaging in virtual worlds is supposedly the wish to escape the unsatisfying real world that is *escapism* [22]. In a recent work referring to Zuckerberg's metaverse vision, [23] elaborate on the possible risks that might arise when consumers seek to leave behind their real-world problems by escaping into VR. In line with the *Theory of Compensatory Internet Use* (TCIU) [24], VR experiences are thereby used to escape real-life problems, negative emotions, and stress—the mechanism of which can also be called *avoidance coping* [25]. Such self-indulgent escapism via technology can lead to negative psychological and social consequences, including depression and anxiety [26], low emotional intelligence [27], and loneliness [28]. Those effects, in turn, can increase the feeling that life is unbearable (which caused the escape into the virtual in the first place), resulting in a "(…) vicious cycle, which eventually can lead to even more detrimental effects on health and well-being" [22, p. 3].

Not all research supports the compensation hypothesis, however [29]. A different way of viewing escapism is through the lens of compulsive behavior. Research has shown that the need for *belongingness* [30] or *relatedness* [31] can constitute a powerful factor for addiction to social media. For example, it was found that gratification of purposive value (use for functional outcomes like learning) and social enhancement (gaining acceptance and approval) via social media networks increases the risk for *Obsessive-*

Compulsive Disorder (OCD) with regard to using online social networks [32]. In this way, OCD might also arise from a fulfilment of the need to belong resulting from the virtual experience. Assuming XR spaces can generate convincing feelings of social presence—and due to their immersive nature—the effects could arguably be even greater. Positive UX design traditionally attempts to satisfy users' inherent psychological needs [31][33], some of which are individual-focused, like *autonomy* and *competence*, and some of which are social, like relatedness/belongingness or popularity. The more XR spaces offer social experiences similar to real life, the greater the allure could be for people to seek substitution of (a lack of) real-life connections. Similarly, the virtual world beckons to gratify not just the need for relatedness but also for competence (by reaching achievements) and autonomy (by providing choice and customization) [23], in line with *Self-Determination Theory* (SDT) [31]. The extent to which those needs are fulfilled by interactive technology needs to be taken even more into account with the rise of fully immersive experiences in XR spaces. In the context of video games, low levels of real-life need satisfaction were shown to be related to obsessive and extensive gaming [34]. Future research must determine to what extent XR environments—like many video games—offer alluring need satisfactions with *immediacy* (quickly and easily accessible), *density* (with high frequency), and *consistency* (predictably and reliably) [35].

Derived research question: How should VR experiences be designed so that they minimize the potential allure for escapism while remaining psychologically fulfilling and meaningful?

C. Industrial and Organizational Psychology

Industrial and Organizational psychology (I/O psychology) examines behavior in the workplace regarding work processes, social work structures, and personnel [3]. Digitalization can lead to an increase in work intensity, information overload, the blurring of boundaries between work and leisure, the degradation of activities, and psychological problems due to the feeling of being under surveillance, all of which fall under the concept of digital stress or *technostress* [36][37].

The free choosing of one's personal avatar in XR spaces could enable people to overcome disadvantages that their own physicality or personality may have for the business world. Due to the *halo effect*, for example, the performance of good-looking and more attractive people may be rated higher than that of less attractive people [38]. But also gender or nationality can be disadvantageous in certain professional contexts and could be eliminated through the purposeful use of an appropriate business avatar. This offers opportunities, particularly in the personnel recruitment process and in the assessment center setting, to hire people purely based on their achievements, without the influence of prejudices or stereotypes. The purposeful use of avatars could also be useful in human resource development. For example, as stated above, an avatar that exhibits dominant and self-confident characteristics could make shy or quiet employees act more confidently and loudly so that they learn to better stand up for themselves in their professional lives.

However, the arbitrary selection of avatars can also lead to undesirable effects in working life. What happens if I choose an avatar that is unfavorable to me, and I suffer professional disadvantages as a result? Will there be virtual dress codes, and who will decide what others are supposed to "wear"? What if I can only achieve the required professional performance or contribute to discussions in the role of my avatar? All these are open questions for future research in I/O psychology with respect to XR spaces. Moreover, the aforementioned Proteus effect [17] can also manifest in a business context, for instance by influencing leadership style [39].

Derived research question: How should business avatars be designed so that they do not impair or that they promote working life?

D. Cognitive psychology

Apart from the more socially determined effects that immersion in XR spaces might entail, there are also a number of direct cognitive implications that need to be considered for the safety of the users. Cognitive psychology is concerned with mental processes like perception, attention, memory, and emotion [3]. Notably, it has been shown that the feeling of presence [9] is both a predictor of emotions [40] and cognitive abilities [41].

Research on the effects of spending time in VR has mostly looked at physiological effects like *cybersickness* and eye strain [42]. There is, however, also preliminary evidence for the potential negative effects of VR on affect. Lavoie *et al.* [43] demonstrated that negative scenarios in VR elicit a higher amount of the negative emotion, shame, compared to the identical scenario on a normal screen-based application.

Mittelstaedt *et al.* [41] found increased reaction times after VR immersion that were unrelated to experienced cybersickness. Szpak *et al.* [44] came to similar results with slower reaction times likely being related to decreased attention rather than motor performance. Future research should therefore determine the true extent and relevance of VR after- and concomitant effects.

Derived research question: To what extent and in which situations should XR spaces induce immersion and presence or alternatively, create psychological or physical distance between the user and the virtual experience in order to protect or foster mental health?

E. Personality Psychology

From the perspective of personality psychology, people's personality and its enduring components are of interest [3] when looking at how the effects of XR spaces differ depending on the person. One of the most famous and well-documented models in personality research is the *Big Five* or so-called OCEAN model, named after its five trait dimensions: *openness to experience*, *conscientiousness*, *extraversion*, *agreeableness*, and *neuroticism*. Studies have shown that personality is a relevant factor affecting the extent to which a person is influenced by the use of the

internet in general, but also by spending time in virtual worlds [45][46].

McLeod *et al.* [47] investigated the effects of personality on real-life changes due to virtual world experiences in Second Life. They found that individual differences in the Big Five personality traits predict the extent to which virtual world experiences change people's real life. Conscientiousness and emotional stability were found to be significant factors in preventing a person from blurring the virtual and real worlds. The more conscientious a person was, the more similar s/he was to his or her avatar in Second Life. The higher the emotional stability, the lower the emotional investment in Second Life and the smaller the resulting change in real life. Accordingly, conscientious and emotionally stable people could probably handle taboo breaks such as virtual violence or unethical behavior better than others, which again opens up room for research in the field of personality coaching [48].

Derived research question: How should XR spaces be designed so that people with susceptible personality structures experience no unintended behavioral changes in real life?

F. Clinical Psychology

"What stays is a strange feeling of sadness and disappointment when participating in the real world, usually on the same day (…) The sky seems less colorful, and it just feels like I'm missing the 'magic' (…) I feel deeply disturbed and often end up just sitting there, staring at a wall." [49]

The field of clinical psychology, which deals with emotional and behavioral disorders or illnesses [3], is obviously important for the implementation of XR spaces:

Park *et al.* [50] in their "Literature Overview of Virtual Reality in Treatment of Psychiatric Disorders" conclude, based on 36 studies, that the use of VR for treating mental disorders shows good therapeutic success, which will, however, not be discussed in depth here. The much more critical question for the design of XR spaces is how to avoid increasing the emergence of mental illnesses in our society. In the following, some potential dangers of (social) virtual and augmented worlds or networks are pointed out.

Independent of the use of VR and AR, there is evidence that the rise of social media has significantly increased the prevalence of depression and suicidal behavior in adolescents [51][52]. As the well-known psychological experiment of the *rubber hand illusion* shows, people's body perception is easily manipulated [53]. Accordingly, the use of VR and AR technologies raises questions about *depersonalization* and *derealization* effects. In a recent study [54], it could be demonstrated that VR techniques can indeed lead to both depersonalization and derealization.

Furthermore, there is evidence that the physical appearance of avatars could trigger eating disorders such as *anorexia nervosa*. Tambone *et al.* [55] could show that if the virtual body was slimmer than the subject's own, calorie-rich foods were avoided to a greater extent.

Another matter to consider when designing XR spaces is the matter of potential *Post-Traumatic Stress Disorder*

(PTSD). Virtual environments have the capacity to elicit real-life reactions from immersed individuals [56]. Whereas VR, when controlled, offers opportunities for the treatment of PTSD [57]—when uncontrolled, the life-like situations that an individual might encounter, could have detrimental effects. As Franks [58] illustrates, (sexual) harassment feels more realistic and thus worse than in other digital worlds, possibly inducing traumatic experiences.

Finally, we need to consider the topic of addiction to virtual technologies. As laid out before, according to the compensation hypothesis [24] and the *need density hypothesis* [35], people in XR spaces could be tempted to escape real-life problems and need frustrations. The overuse resulting from that can accordingly be described as "addictive". Recently, the DSM-5 added *Internet Gaming Disorder* (IGD) as a condition warranting further research. A systematic review and meta-analysis found the behavior of more than 3% of gamers to fall under gaming disorder [59]. A cross-sectional study [60] showed addictive use of social media to be associated with *Attention Deficit Hyperactivity Disorder* (ADHD), OCD, anxiety, and notably, lower levels of depression, whereas addictive use of video games was positively correlated with ADHD, OCD, depression, and anxiety. Another driver of social media overuse was shown to be the *Fear Of Missing Out* (FOMO) [34]. In fact, FOMO seems to mediate the impact of depression and anxiety on negative consequences of mobile device use [61] and the negative impact of increased social networking site use on self-esteem [62].

Derived research questions: How should XR spaces be designed so that mental illness is protected or that XR spaces contribute to its healing? How should XR spaces be designed to minimize addictive behavior regarding use?

V. HUMABILITY ASPECTS FOR XR DESIGN

The integration of XR technologies into everyday life offers immense opportunities but also poses significant psychological risks. In this paper we highlighted the need to prioritize Humability—a desired quality of an interactive system and a design approach that aims to ensure XR environments are safe for or even beneficial to mental health. Our comprehensive literature review revealed critical findings from various psychological sub-disciplines about the potential risks of XR environments that emphasize the importance of designing such environments to prevent psychological ill-being and instead promote well-being.

The specific findings can be categorized into three broad, intertwined aspects of the XR experience that need to be addressed by design. In the following, the presented aspects are accompanied by initial guideline proposals:

1) Avatars: Avatar design can have a significant influence on users' identity formation, self-concept, and body image. Improper design can lead to issues like deindividuation and negative body image, particularly among adolescents. Judgement of other people in XR can be impaired due to their avatar appearance and the resulting halo or uncanny valley effect.

Design Recommendations:

- Promote positive identity formation and body image.
- Avoid near-realistic avatar appearance to prevent the uncanny valley effect.
- Enable customization that balances user expression with psychological safety.

2) Virtual Environments: While immersion into a virtual environment can enhance the UX, it must be managed to prevent cognitive overload and negative aftereffects like increased reaction times and cybersickness. Virtual environments should promote diverse, inclusive, and open-minded social interactions to counteract phenomena like echo chambers and therewith social isolation. Design should encourage positive social behaviors and prevent radicalization.

Design Recommendations:

- Balance immersion with cognitive load management.
- Foster diverse, inclusive, and positive social interactions.
- Design systems to monitor and guide user behavior, preventing addiction and promoting healthy engagement.

3) User Behavior und Experience: XR environments offer a tempting escape from reality that can lead to addictive use behavior. Design strategies must minimize the lure of escapism while constructively meeting psychological needs. Proper design must ensure that users' do not suffer from or exacerbate their mental health disorders and self-destructive behavior as a result of their time spent in XR. On the contrary, the potential to mitigate mental health issues should be maximized.

Design Recommendations:

- Create features that satisfy psychological needs without encouraging escapism
- Integrate mental health support within XR platforms to address and mitigate potential issues like addiction and depression.

VI. CONCLUSION AND FUTURE OUTLOOK

The significant investment that industry leaders have already made in XR technologies and the forecasts for substantial market growth [2] underline the social relevance and urgency of this endeavor. With the growing interest in the metaverse as a persistent, immersive digital space for socializing, working, and learning, these developments highlight the importance of ensuring psychological safety in such environments. By establishing Humability as a guiding principle for XR design, we intend to ensure that XR spaces and other immersive environments become risk-free and supportive spaces that minimize harm and even contribute positively to users' mental health and overall wellbeing.

From our review, we conclude that there is an urgent need for interdisciplinary collaboration to develop Humability as an applied science. As XR technologies become increasingly integrated into our lives, there is a need

to ensure that they are designed to promote mental health rather than detract from it. Future research should bridge the gaps between psychology, human–computer interaction (HCI), and design in order to develop comprehensive guidelines for the design of Humable XR environments. This collaboration is crucial for translating psychological insights into practical design strategies.

REFERENCES

[1] International Organization for Standardization, "ISO 9241-110:2020(en) Ergonomics of human-system interaction — Part 110: Interaction principles." 2020. [Online]. Available from: https://www.iso.org/obp/ui/#iso:std:iso:9241:-110:ed-2:v1:en [Accessed: May 9, 2025].

[2] Statista, "XR market size worldwide 2021-2026," Statista. Accessed: May 9, 2025. [Online]. Available from: https://www.statista.com/statistics/591181/global-augmented-virtual-reality-market-size/ [Accessed: May 9, 2025].

[3] G. R. VandenBos, Ed., APA Dictionary of Psychology. in APA Dictionary of Psychology. Washington, DC, US: American Psychological Association, 2007, pp. xvi, 1024.

[4] G. A. Orenstein and L. Lewis, "Eriksons Stages of Psychosocial Development - StatPearls - NCBI Bookshelf," National Library of Medicine. [Online]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK556096/ [Accessed: May 9, 2025].

[5] J. M. Cheek, "Identity Orientations and Self-Interpretation," in Personality Psychology: Recent Trends and Emerging Directions, D. M. Buss and N. Cantor, Eds., New York, NY: Springer US, 1989, pp. 275–285. doi: 10.1007/978-1-4684-0634-4_21.

[6] P. Weinreich, "The operationalisation of identity theory in racial and ethnic relations," in Theories of Race and Ethnic Relations, Cambridge University Press, 1986. Accessed: May 9, 2025. [Online]. Available from: https://www.academia.edu/11148082/The_operationalisation_of_identity_theory_in_racial_and_ethnic_relations [Accessed: May 9, 2025].

[7] R. Green, P. H. Delfabbro, and D. L. King, "Avatar identification and problematic gaming: The role of self-concept clarity," Addictive Behaviors, vol. 113, p. 106694, Feb. 2021, doi: 10.1016/j.addbeh.2020.106694.

[8] A. T. Flügel, "The acceptance of one's own body in the context of everyday media and social negotiations about beauty using the example of the docu-soap "The Swan"," (in German) in Jahrbuch Jugendforschung, A. Ittel, L. Stecher, H. Merkens, and J. Zinnecker, Eds. Wiesbaden: VS Verlag für Sozialwissenschaften, 2008, pp. 49–71. doi: 10.1007/978-3-531-91087-1_4.

[9] M. Lombard and T. Ditton, "At the Heart of It All: The Concept of Presence," Journal of Computer-Mediated Communication, vol. 3, no. 2, p. JCMC321, Sep. 1997, doi: 10.1111/j.1083-6101.1997.tb00072.x.

[10] J. K. Scarborough and J. N. Bailenson, "Avatar Psychology," in The Oxford Handbook of Virtuality, Oxford Academic, 2014. [Online]. Available from: https://academic.oup.com/edited-volume/28128/chapter-abstract/212311197?redirectedFrom=fulltext&login=false [Accessed: May 9, 2025].

[11] C. D. Wickens, W. S. Helton, J. G. Hollands, and S. Banbury, Engineering Psychology and Human Performance, 5th ed. New York: Routledge, 2021. doi: 10.4324/9781003177616.

[12] M. Cinelli, G. De Francisci Morales, A. Galeazzi, W. Quattrociocchi, and M. Starnini, "The echo chamber effect on social media," Proc. Natl. Acad. Sci. U.S.A., vol. 118, no. 9, Mar. 2021, doi: 10.1073/pnas.2023301118.

[13] C. R. Sunstein, Going to Extremes: How Like Minds Unite and Divide. Oxford University Press, 2009.

[14] A. Bruns, "Echo chambers? Filter bubbles? The misleading metaphors that obscure the real problem," in Hate Speech and Polarization in Participatory Society, Routledge, 2021.

[15] W. J. Brady, K. McLoughlin, T. N. Doan, and M. J. Crockett, "How social learning amplifies moral outrage expression in online social networks," Science Advances, vol. 7, no. 33, p. eabe5641, Aug. 2021, doi: 10.1126/sciadv.abe5641.

[16] T. Postmes, R. Spears, and M. Lea, "Breaching or Building Social Boundaries?: SIDE-Effects of Computer-Mediated Communication," Communication Research, vol. 25, no. 6, pp. 689–715, Dec. 1998, doi: 10.1177/009365098025006006.

[17] N. Yee and J. Bailenson, "The Proteus Effect: The Effect of Transformed Self-Representation on Behavior," Human Comm Res, vol. 33, no. 3, pp. 271–290, Jul. 2007, doi: 10.1111/j.1468-2958.2007.00299.x.

[18] J. Peña, J. T. Hancock, and N. A. Merola, "The Priming Effects of Avatars in Virtual Settings," Communication Research, vol. 36, no. 6, pp. 838–856, Dec. 2009, doi: 10.1177/0093650209346802.

[19] M. Mori, "Bukimi no tani [the uncanny valley].," Energy, vol. 7, p. 33, 1970.

[20] M. Shin, S. J. Kim, and F. Biocca, "The uncanny valley: No need for any further judgments when an avatar looks eerie," Computers in Human Behavior, vol. 94, pp. 100–109, May 2019, doi: 10.1016/j.chb.2019.01.016.

[21] M. Seymour, L. (Ivy) Yuan, A. R. Dennis, and K. Riemer, "Have We Crossed the Uncanny Valley? Understanding Affinity, Trustworthiness, and Preference for Realistic Digital Humans in Immersive Environments," Journal of the Association for Information Systems, vol. 22, no. 3, pp. 591–617, 2021.

[22] B. Henning and P. Vorderer, "Psychological Escapism: Predicting the Amount of Television Viewing by Need for Cognition," Journal of Communication, vol. 51, no. 1, pp. 100–20, 2001.

[23] D.-I. D. Han, Y. Bergs, and N. Moorhouse, "Virtual reality consumer experience escapes: preparing for the metaverse," Virtual Reality, vol. 26, no. 4, pp. 1443–1458, Dec. 2022, doi: 10.1007/s10055-022-00641-7.

[24] D. Kardefelt-Winther, "A conceptual and methodological critique of internet addiction research: Towards a model of compensatory internet use," Computers in Human Behavior, vol. 31, pp. 351–354, Feb. 2014, doi: 10.1016/j.chb.2013.10.059.

[25] C. J. Holahan, R. H. Moos, C. K. Holahan, P. L. Brennan, and K. K. Schutte, "Stress Generation, Avoidance Coping, and Depressive Symptoms: A 10-Year Model," J Consult Clin Psychol, vol. 73, no. 4, pp. 658–666, Aug. 2005, doi: 10.1037/0022-006X.73.4.658.

[26] T. Panova and A. Lleras, "Avoidance or boredom: Negative mental health outcomes associated with use of Information and Communication Technologies depend on users' motivations," Computers in Human Behavior, vol. 58, pp. 249–258, May 2016, doi: 10.1016/j.chb.2015.12.062.

[27] E. Engelberg and L. Sjöberg, "Internet Use, Social Skills, and Adjustment," CyberPsychology & Behavior, vol. 7, no. 1, pp. 41–47, Feb. 2004, doi: 10.1089/109493104322820101.

[28] J. Morahan-Martin and P. Schumacher, "Loneliness and social uses of the Internet," Computers in Human Behavior, vol. 19, no. 6, pp. 659–671, Nov. 2003, doi: 10.1016/S0747-5632(03)00040-2.

[29] C. Herodotou, M. Kambouri, and N. Winters, "Dispelling the myth of the socio-emotionally dissatisfied gamer," Computers in Human Behavior, vol. 32, pp. 23–31, Mar. 2014, doi: 10.1016/j.chb.2013.10.054.

[30] R. F. Baumeister and M. R. Leary, "The Need to Belong: Desire for Interpersonal Attachments as a Fundamental Human Motivation," in Interpersonal Development, Routledge, 2007.

[31] E. L. Deci and R. M. Ryan, "The 'What' and 'Why' of Goal Pursuits: Human Needs and the Self-Determination of Behavior," Psychological Inquiry, vol. 11, no. 4, pp. 227–268, Oct. 2000, doi: 10.1207/S15327965PLI1104_01.

[32] T. L. James, P. B. Lowry, L. Wallace, and M. Warkentin, "The Effect of Belongingness on Obsessive-Compulsive Disorder in the Use of Online Social Networks," Journal of Management Information Systems, vol. 34, no. 2, pp. 560–596, Apr. 2017, doi: 10.1080/07421222.2017.1334496.

[33] M. Hassenzahl, "The Thing and I: Understanding the Relationship Between User and Product," in Funology 2: From Usability to Enjoyment, M. Blythe and A. Monk, Eds. in Human–Computer Interaction Series. Cham: Springer International Publishing, 2018, pp. 301–313. doi: 10.1007/978-3-319-68213-6_19.

[34] A. K. Przybylski, K. Murayama, C. R. DeHaan, and V. Gladwell, "Motivational, emotional, and behavioral correlates of fear of missing out," Computers in Human Behavior, vol. 29, no. 4, pp. 1841–1848, Jul. 2013, doi: 10.1016/j.chb.2013.02.014.

[35] S. Rigby and R. M. Ryan, Glued to Games: How Video Games Draw Us In and Hold Us Spellbound. Bloomsbury Publishing USA, 2011.

[36] M. Tarafdar, Q. Tu, B. S. Ragu-Nathan, and T. S. Ragu-Nathan, "The Impact of Technostress on Role Stress and Productivity," Journal of Management Information Systems, vol. 24, no. 1, pp. 301–328, Jul. 2007, doi: 10.2753/MIS0742-1222240109.

[37] J. Becker, M. Berger, H. Gimpel, and J. Lanzl, "Considering Characteristic Profiles of Technologies at the Digital Workplace: The Influence on Technostress," 2020.

[38] S. N. Talamas, K. I. Mavor, and D. I. Perrett, "Blinded by Beauty: Attractiveness Bias and Accurate Perceptions of Academic Performance," PLoS ONE, vol. 11, no. 2, p. e0148284, Feb. 2016, doi: 10.1371/journal.pone.0148284.

[39] J. Peña, M. Aridi Barake, and J. M. Falin, "Virtual leaders: Can customizing authoritarian and democratic business leader avatars influence altruistic behavior and leadership empowerment perceptions?," Computers in Human Behavior, vol. 141, p. 107616, Apr. 2023, doi: 10.1016/j.chb.2022.107616.

[40] G. Riva et al., "Affective Interactions Using Virtual Reality: The Link between Presence and Emotions," CyberPsychology & Behavior, vol. 10, no. 1, pp. 45–56, Feb. 2007, doi: 10.1089/cpb.2006.9993.

[41] J. M. Mittelstaedt, J. Wacker, and D. Stelling, "VR aftereffect and the relation of cybersickness and cognitive performance," Virtual Reality, vol. 23, no. 2, pp. 143–154, Jun. 2019, doi: 10.1007/s10055-018-0370-3.

[42] S. Cao, K. Nandakumar, R. Babu, and B. Thompson, "Game play in virtual reality driving simulation involving head-mounted display and comparison to desktop display," Virtual Reality, vol. 24, no. 3, pp. 503–513, Sep. 2020, doi: 10.1007/s10055-019-00412-x.

[43] R. Lavoie, K. Main, C. King, and D. King, "Virtual experience, real consequences: the potential negative emotional consequences of virtual reality gameplay," Virtual Reality, vol. 25, no. 1, pp. 69–81, Mar. 2021, doi: 10.1007/s10055-020-00440-y.

[44] A. Szpak, S. C. Michalski, D. Saredakis, C. S. Chen, and T. Loetscher, "Beyond Feeling Sick: The Visual and Cognitive Aftereffects of Virtual Reality," IEEE Access, vol. 7, pp. 130883–130892, 2019, doi: 10.1109/ACCESS.2019.2940073.

[45] T. Correa, A. W. Hinsley, and H. G. De Zúñiga, "Who interacts on the Web?: The intersection of users' personality and social media use," Computers in Human Behavior, vol. 26, no. 2, pp. 247–253, Mar. 2010, doi: 10.1016/j.chb.2009.09.003.

[46] R. A. Dunn and R. E. Guadagno, "My avatar and me – Gender and personality predictors of avatar-self discrepancy," Computers in Human Behavior, vol. 28, no. 1, pp. 97–106, Jan. 2012, doi: 10.1016/j.chb.2011.08.015.

[47] P. L. McLeod, Y.-C. Liu, and J. E. Axline, "When your Second Life comes knocking: Effects of personality on changes to real life from virtual world experiences," Computers in Human Behavior, vol. 39, pp. 59–70, Oct. 2014, doi: 10.1016/j.chb.2014.06.025.

[48] M. T. Whitty, G. Young, and L. Goodings, "What I won't do in pixels: Examining the limits of taboo violation in MMORPGs," Computers in Human Behavior, vol. 27, no. 1, pp. 268–275, Jan. 2011, doi: 10.1016/j.chb.2010.08.004.

[49] T. van Schneider, "The Post Virtual Reality Sadness," Desk of van Schneider. [Online]. Available from: https://medium.com/desk-of-van-schneider/the-post-virtual-reality-sadness-fb4a1ccacae4 [Accessed: May 9, 2025].

[50] M. J. Park, D. J. Kim, U. Lee, E. J. Na, and H. J. Jeon, "A Literature Overview of Virtual Reality (VR) in Treatment of Psychiatric Disorders: Recent Advances and Limitations," Front. Psychiatry, vol. 10, Jul. 2019, doi: 10.3389/fpsyt.2019.00505.

[51] C. Vidal, T. Lhaksampa, L. Miller, and R. Platt, "Social media use and depression in adolescents: a scoping review," International review of psychiatry (Abingdon, England), vol. 32, no. 3, p. 235, May 2020, doi: 10.1080/09540261.2020.1720623.

[52] B. A. Primack, A. Shensa, J. E. Sidani, C. G. Escobar-Viera, and M. J. Fine, "Temporal Associations Between Social Media Use and Depression," Am J Prev Med, vol. 60, no. 2, pp. 179–188, Feb. 2021, doi: 10.1016/j.amepre.2020.09.014.

[53] M. Botvinick and J. Cohen, "Rubber hands 'feel' touch that eyes see," Nature, vol. 391, no. 6669, pp. 756–756, Feb. 1998, doi: 10.1038/35784.

[54] C. Peckmann, K. Kannen, M. C. Pensel, S. Lux, A. Philipsen, and N. Braun, "Virtual reality induces symptoms of depersonalization and derealization: A longitudinal randomised control trial," Computers in Human Behavior, vol. 131, p. 107233, Jun. 2022, doi: 10.1016/j.chb.2022.107233.

[55] R. Tambone et al., "Changing your body changes your eating attitudes: embodiment of a slim virtual avatar induces avoidance of high-calorie food," Heliyon, vol. 7, no. 7, p. e07515, Jul. 2021, doi: 10.1016/j.heliyon.2021.e07515.

[56] M. Slater et al., "A Virtual Reprise of the Stanley Milgram Obedience Experiments," PLoS ONE, vol. 1, no. 1, p. e39, Dec. 2006, doi: 10.1371/journal.pone.0000039.

[57] R. Gonçalves, A. L. Pedrozo, E. S. F. Coutinho, I. Figueira, and P. Ventura, "Efficacy of Virtual Reality Exposure Therapy in the Treatment of PTSD: A Systematic Review," PLoS ONE, vol. 7, no. 12, p. e48469, Dec. 2012, doi: 10.1371/journal.pone.0048469.

[58] M. A. Franks, "The Desert of the Unreal: Inequality in Virtual and Augmented Reality," vol. 51.

[59] M. W. Stevens, D. Dorstyn, P. H. Delfabbro, and D. L. King, "Global prevalence of gaming disorder: A systematic review and meta-analysis," Aust N Z J Psychiatry, vol. 55, no. 6, pp. 553–568, Jun. 2021, doi: 10.1177/0004867420962851.

[60] C. S. Andreassen et al., "The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: A large-scale cross-sectional study.," Psychology of Addictive Behaviors, vol. 30, no. 2, pp. 252–262, Mar. 2016, doi: 10.1037/adb0000160.

[61] U. Oberst, E. Wegmann, B. Stodt, M. Brand, and A. Chamarro, "Negative consequences from heavy social networking in adolescents: The mediating role of fear of missing out," Journal of Adolescence, vol. 55, no. 1, pp. 51–60, 2017, doi: 10.1016/j.adolescence.2016.12.008.

[62] S. L. Buglass, J. F. Binder, L. R. Betts, and J. D. M. Underwood, "Motivators of online vulnerability: The impact of social network site use and FOMO," Computers in Human Behavior, vol. 66, pp. 248–255, Jan. 2017, doi: 10.1016/j.chb.2016.09.0