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Avatar design in Metaverse: the effect of avatar-user similarity in procedural and creative tasks

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Abstract

Purpose – Through the lens of self-perception theory, this paper investigates how avatar design (i.e. avatar user similarity) affects users' self-awareness and shapes their task engagement and performance in the Metaverse.

Design/methodology/approach – The authors conducted a 2 (avatar user similarity: high vs low) × 2 (task type: procedural vs creative) lab experiment and collected data from questionnaires, the recording of users' behavior during tasks and their actual task performance.

Findings – The results show that higher avatar user similarity leads to higher task engagement in general. Furthermore, while a similar avatar promotes users to regulate their behaviors and achieve better performance in a procedural task, high similarity also inhibits users' creativity by invoking habitual thinking, resulting in worse performance in generating original ideas in a creative task.

Originality/value – This study is expected to contribute to the information systems literature by revealing the value of avatar design and providing new perspectives on improving users' experiences in the Metaverse.

Keywords Avatar, Metaverse, Immersive virtual reality, Procedural task, Creative task

Paper type Research paper

1. Introduction

The rapid growth of virtual reality (VR) technologies and computing power has given birth to the Metaverse, which is characterized by an interactive, immersive and collaborative virtual environment that is shared among online crowds (Kim, 2021). With Metaverse applications (e.g. Horizon developed by Meta, [1] Mesh developed by Software, [2] Vive Sync developed by HTC [3]), users may play games, watch movies and, more recently, engage in work activities, such as job training, remote collaboration and innovative marketing practices, in an immersive virtual world (e.g. Kim *et al.*, 2020; Seymour *et al.*, 2018). Some of these applications also require each user to create an avatar (i.e. a graphic representation) to represent himself/herself in the virtual world (Kasapakis and Dzardanova, 2021; Miao *et al.*, 2022; Seymour *et al.*, 2018). In particular, in many work-related Metaverse applications, such as remote collaboration and virtual meetings, avatar representation is a necessary and critical feature, as users need to be present in the virtual environment and interact with others.

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Extensive research in information systems (IS) has studied avatar design and its effects on users' attitudes toward avatars (e.g. affection; Suh *et al.*, 2011), psychological states (e.g. anxiety; Pimentel, 2019) and behaviors (e.g. knowledge sharing; Fehrenbacher and Weisner, 2017). However, most studies focus on avatars in desktop two-dimensional (2D) and three-dimensional (3D) contexts, where an avatar is usually regarded as a "tool" or a "character" detached from the user's physical body. Avatars either do not have to respond to users' actions, or just perform simple actions according to users' control via a mouse and keyboard. This form of interaction does not establish a natural correspondence between users' and their avatars' behaviors, making it difficult for users to relate avatars to their actual selves and impose standards on the behaviors of avatars in the virtual context (Schultze, 2011). Indeed, prior research suggests that the detachment between avatars and users' physical bodies exacerbates de-individuation effects, that is, users cannot form self-awareness and personalities in the virtual world and are thus less motivated to regulate their behaviors based on their true values and standards, leading to seemingly impulsive, deviant and irresponsible acts (Festinger, 1950; Perfumi *et al.*, 2019; Silke, 2003).

Unlike traditional online environments, the Metaverse is mainly supported by immersive VR technologies, which enclose users in a virtual space, offer them a wide field of view (about 100° diagonally), enable natural bodily interactions with the space (e.g. walk), and provide visual feedback based on users' position and orientation in the virtual space (El Jamiy and Marsh, 2019). One of the most distinctive features of avatars in the Metaverse is that they can be physically connected to users, that is, the eye movements, facial expressions and motions of an avatar are synchronized with the user, which strengthens the relationship between the avatars and users, as well as users' feelings of self-presence in the virtual world (Aseeri and Interrante, 2021; Gonzalez–Franco *et al.*, 2020). As users are aware of a direct correspondence between their own behavior and the avatars' behavior and realize that all interactions with other virtual users are based on the avatars, avatars have become a direct extension of the users into the virtual world (Miao *et al.*, 2022). However, scant research has explored how the design of avatars in the Metaverse, which may have a close relationship with users' actual selves, shapes user perceptions and behaviors in the virtual world.

The goal of this study is to investigate how avatar design affects users' self–awareness and behaviors in the Metaverse. In particular, we look at work-related Metaverse applications as they are becoming increasingly important as means to address the challenges in traditional work practices (e.g. physical distance and limited access to resources). For example, Microsoft recently launched an application that enables people in different locations to participate in VR meetings represented by their avatars [4]. In these applications, users may conduct different types of tasks. Two predominant types are procedural tasks, which are characterized by explicit rules and repeated procedures (e.g. providing customer support), and creative tasks, which require users to stretch their thoughts to provide creative solutions (e.g. generating new ideas for a marketing campaign) (Bradler *et al.*, 2014; Brüggen *et al.*, 2018). For both types of tasks, user engagement and task performance are two important metrics in both research and practice (Agarwal and Karahanna, 2000). Specifically, engagement in an assigned task often depends on how a user can regulate herself in devoting effort persistently. In other words, how users can impose certain behavioral standards of their actual selves on their virtual representations (i.e. avatars) can be crucial to their task engagement in the virtual space (Santhanam *et al.*, 2016). Moreover, while the performance of procedural tasks primarily depends on how much effort users devote in following predefined task processes, users' performance in creative tasks also depends on how their creative thinking is unleashed during the task process (Brüggen *et al.*, 2018; Simonton, 2004). It is thus interesting to examine how users' self-regulation and creativity are reshaped in the Metaverse via their avatars. Accordingly, this study investigates the impacts of avatar design on users' engagement and performance in procedural and creative tasks in the Metaverse.

Literature has suggested that self-regulation and creative thinking are greatly influenced by self-awareness – that is, the extent to which individuals perceive and recognize their actual selves in terms of their own beliefs, values and goals (Duval and Wicklund, 1972; Savary and Dhar, 2020). As users are represented by avatars in the virtual world, one fundamental design dimension that affects users' self-awareness in the virtual world is avatar user similarity, which is defined as the similarity between the avatar's physical appearance and the user's physical appearance, including both facial (such as eyes and mouse) and body (such as weight and height) aspects (Suh *et al.*, 2011). Prior research suggests that physical similarity has strong implications for one's perception of the self (Liao *et al.*, 2019; Suh *et al.*, 2011). However, although technology giants have invested significantly in modeling techniques to improve avatar user similarity, our understanding of how avatar user similarity affects users' self-awareness and hence their behavior in different tasks is still limited. For example, while increasing avatar user similarity may lead to an enhanced perception of their actual selves in the virtual world, it may also restrict users' thinking, as they may miss the opportunity to explore different identities and experiences that can promote creativity. Hence, investigating the effects of avatar user similarity on user behavior is important to both industry and academia.

Drawing upon self-perception theory (Bem, 1967), we expect that avatar similarity evokes users' self-awareness, which leads them to regulate their behaviors in the virtual world. Heightened self-regulation will likely lead to higher engagement and, hence, better performance in procedural tasks. However, as people's self-awareness increases, they are also more likely to project their habitual thinking to avatars, which may inhibit their creativity in the virtual world, thus resulting in tempered performance in creative tasks. A lab experiment was conducted, and the results provided empirical evidence for our arguments.

This study is expected to make several theoretical and practical contributions. From a theoretical perspective, our research contributes to the IS literature by investigating how user behaviors are shaped by avatar design in the Metaverse. Furthermore, by applying self-perception theory, we are able to provide theoretical insights into an important avatar design element: avatar user similarity. From a practical perspective, practitioners will be able to guide users in choosing or designing different avatars adapted to the intended goals (e.g. self-regulation and creativity) in different activities.

2. Literature review

2.1 Literature on Metaverse

The Metaverse usually refers to a virtual space where users can interact with each other and virtual objects (Dwivedi *et al.*, 2022). In particular, in this study, Metaverse refers to a virtual world that is supported by immersive VR technologies, which allow users to fully immerse themselves in the digital environment and naturally interact with other users represented by avatars (Cheong, 2022). Existing studies have investigated user behaviors in diverse Metaverse applications, such as education, gaming, socialization and e-commerce (Dwivedi *et al.*, 2022). For example, Oh *et al.* (2023) found that users' social interactions are enhanced in the Metaverse enabled by immersive VR technologies, which leads to improved social presence and reduced loneliness in virtual environments. Shin (2022) observed that the spatial features of the Metaverse lead to better embodiment, which refers to the feeling of being present in a virtual body (i.e. avatar) and hence enhanced playability in gaming. It has also been found that in education and e-commerce contexts, enriched sensory experiences in the Metaverse can foster a sense of immersion and engage users, leading to improved learning and shopping experiences (Barrera and Shah, 2023; Guo and Gao, 2022).

Although the potential of the Metaverse to improve user experiences in virtual realms has been demonstrated by previous research, other studies have highlighted challenges in its development, For example, some researchers have argued that the Metaverse raises new questions in terms of how users will integrate physical reality and the virtual world and how they will extend their existing identity to the virtual world or create a new identity in the virtual world (e.g. Dwivedi *et al.*, 2022). This is an important question because one's self-identification largely drives her beliefs and behavior (Silvia and Gendolla, 2001). As a start of this line of inquiry, this study aims to investigate how individuals perceive themselves and behave in the Metaverse via an avatar representation (Cheung *et al.*, 2021). As mentioned earlier, an avatar acts as an extension of a user in the Metaverse, and the different avatar designs may affect how users perceive themselves and project their actual selves to the virtual world (Miao *et al.*, 2022; Ratan, 2013). To understand how avatar design affects user behavior, we will next review the literature on avatars, as well as the theoretical work on how one's appearance affects their behavior.

2.2 Avatar design and influence

Avatars have been studied extensively within the IS discipline (e.g. Suh *et al.*, 2011). In the context of desktop 2D and 3D (e.g. online shopping store, video game, and social community), most research has focused on the effects of avatar design on users' attitudes toward avatars (e.g. affection, perceived authenticity and reuse intention) and their experience on platforms (e.g. product evaluation, flow and trust) (Davis *et al.*, 2009; Goel *et al.*, 2011; Jones *et al.*, 2022; Kim *et al.*, 2007; Liao *et al.*, 2019). For example, Suh *et al.* (2011) found that the more closely an avatar resembles its user, the more the user is likely to have positive attitudes (e.g. affection, connection and passion) toward the avatar and the platform. Other scholars have investigated how users' psychological states and behaviors are affected by the use of different avatars (Bergmann *et al.*, 2017; Schultze, 2011). For example, in the context of psychological therapy, Pimentel (2019) found that creating an avatar that possesses some undesirable characteristics of the user and subsequently destroying that avatar helps the user reduce anxiety. In the context of a social community, compared to avatars with a real human figure, abstract avatars induce a greater feeling of social distance, resulting in users' lower willingness to share knowledge (Fehrenbacher and Weisner, 2017).

In the aforementioned research, an avatar is usually viewed as a "tool" or a manipulable "character" in the virtual world and has no bodily connection with the user. With the development of immersive VR technologies, recent research has started to focus on generating realistic avatars by increasing appearance fidelity (e.g. Aseeri and Interrante, 2018) and their motion sync with users (e.g. Kasapakis and Dzardanova, 2021). For example, users' real-time body movements and facial expressions are captured and are at the same time exhibited by the avatar (Park *et al.*, 2021). While some scholars have followed prior research to focus on users' attitudes to avatars and platforms (Dwivedi *et al.*, 2022; Seymour *et al.*, 2018), emerging research has shifted attention to how avatars affect users' bodily feelings (e.g. virtual body ownership; Latoschik *et al.*, 2017) and a sense of presence in the virtual world (e.g. self-presence; Aseeri and Interrante, 2021; Forster *et al.*, 2022; Gonzalez–Franco *et al.*, 2020). For example, a study by Kim *et al.* (2020) showed that matching the body size of an avatar to that of a user increased the user's sense of body ownership and self-presence.

2.3 Theoretical foundation: self-perception theory

Self-perception theory suggests that people become aware or reminded of their values and standards by observing their own appearances and then behave in accordance with their values and standards (Bem, 1967; Duval and Wicklund, 1972; Savary and Dhar, 2020). Self-perception theory is widely used to study self-regulation behaviors, which refer to the process of controlling and managing one's behaviors according to one's standards of correctness (Duval and Wicklund, 1972; Wrosch *et al.*, 2003). It has been suggested that focusing one's attention on one's appearance can lead to conscious awareness of the concept of "self" and trigger the process of controlling one's behavior to meet the values and standards of oneself (Duval and Wicklund, 1972; Silvia and Gendolla, 2001). If a discrepancy is found between one's current behavior and her standards, aversive feelings will arise. This aversive state then motivates the restoration of consistency, that is, the user will actively regulate her behavior to be more congruent with her own standards. Many prior studies have found support for this view (Bourrat *et al.*, 2011; Gendolla *et al.*, 2008; Hormuth, 1982; Silvia *et al.*, 2011). For example, Batson *et al.* (1999) found that in a resource assignment task, when the subjects are placed in front of mirrors (compared with the absence of mirrors), they report a higher awareness of morality and assign more resources to others to meet their own moral standards. Prior studies have also explored various ways to evoke people's attention to the self, such as showing people their images on monitors (Silvia and Phillips, 2004) and introducing observers (Carver and Scheier, 1978), and they have found these tactics effective in inducing users' self-awareness and an effort to behave to meet their standards (Gendolla *et al.*, 2008; Silvia *et al.*, 2011).

In traditional virtual settings (i.e. desktop 2D and 3D), the absence of one's own body in the virtual world weakens people's perceptions of their embodied feelings, resulting in a greater sense of anonymity. In this case, observing one's avatars is generally unlikely to trigger a strong sense of awareness of one's actual self. In immersive VR, however, people have a strengthened sense of bodily presence, as they are located in the virtual space and their motions are synced to those of their avatar representations. Therefore, when the avatar resembles the users' physical appearance, observing the avatars in the virtual world is similar to observing themselves in a mirror. Prior research suggests that when a person observes himself through a mirror, it may evoke a reflection on his behaviors and evaluate these behaviors based on his self-values and standards (Morin, 2004, 2006). Therefore, in the immersive virtual world, a high avatar-user similarity may promote people to establish a higher connection between the avatar and self, which then affects their self-regulatory behaviors.

3. Hypotheses

In this section, we first develop hypotheses on the effects of avatar-user similarity on users' engagement, defined as the extent to which users are involved in the task (Agarwal and Karahanna, 2000). Then, we hypothesize the effects of avatar-user similarity on users' task performance, that is, how well users accomplish their tasks (Santhanam *et al.*, 2016), in two different types of tasks (i.e. procedural and creative tasks).

3.1 The effects of avatar user similarity on engagement

In immersive VR, users perceive a sense of bodily presence through avatars that are connected to their expressions (e.g. smiling and frowning) and actions (e.g. walking around and body movement) in the virtual space. One may observe her own avatar (e.g. via mirrors) and know that other people will notice her presence via the avatar (Suh *et al.*, 2011). As self-perception theory suggests, when people use an avatar that resembles their appearance, they will develop a high level of conscious awareness of the self (Morin, 2004, 2006). This means that when others praise or criticize an avatar's performance, users may feel that their actual selves are praised or criticized (Green, 2021; Markus and Wurf, 1987). With heightened self-awareness, they will project their own abilities, values, and standards to the avatars (Morin, 2006). Specifically, engaging in and accomplishing an assigned task well is often considered a standard for a user in reality. Thus, when a user's avatar resembles her physical appearance, she will impose this standard on her virtual selves as represented by the avatar. Any inconsistency between what the avatar does in the virtual world and the user's own standard code of action will lead to an aversive feeling, prompting the user to alleviate this feeling by adjusting their behavior in the virtual world (Gendolla *et al.*, 2008; Silvia *et al.*, 2011). Accordingly, when the level of avatar-user similarity is high, the user may devote more effort to the task that they are assigned in the virtual world, achieving a higher level of engagement.

In contrast, people with avatars that do not resemble themselves will experience a lower level of self-awareness, thus feeling less responsible for the avatars' behaviors in the virtual world. As a result, they will be less motivated to devote effort to completing a task well in the virtual world. Therefore, we propose that:

H1. Avatar-user similarity is positively related to users' task engagement.

3.2 The interaction effects of avatar-user similarity and task type on performance

We further argue that the effects of avatar-user similarity on task performance may vary in different tasks. Specifically, a procedural task can usually be performed well as long as users can follow certain rules of action for each step carefully and persistently (Niederle and Vesterlund, 2007). To accomplish such a task well requires people to devote effort to overcoming boredom and exhaustion from repeated actions (Brüggen *et al.*, 2018). Hence, a high level of engagement in the task is essential to high performance in such tasks. As mentioned above, people with highly similar avatars will likely experience higher self-awareness and tend to regulate their behaviors to align with their own abilities and morals (Liao *et al.*, 2019). Hence, when performing procedural tasks, users with more similar avatars are more likely to devote effort to the tasks, be patient in going through the repeated steps, and hence achieve better performance. In contrast, as self-perception theory suggests, lower avatar-user similarity weakens the relatedness between the users' actual selves and their avatars (Morin, 2004, 2006). Users may care less about whether their behavior in the virtual world is aligned with their own values and standards (Liao *et al.*, 2019). Thus, they will be less likely to devote effort to overcoming boredom and exhaustion in procedural tasks. Therefore, we argue that avatar-user similarity has a positive effect on users' performance in procedural tasks.

However, for creative tasks, engagement and users' thinking styles jointly influence task performance. A creative task often does not have many given rules for users to follow but requires users to be open-minded and think in a nonstandard way. While high avatar similarity may increase users' engagement in a task, it may also evoke their habitual thinking as users relate their actual capabilities and values to their activities in the virtual world (Verplanken and Holland, 2002). In other words, with a similar avatar, people may tend to bring their cognitive inertia into the virtual world, which confines their thinking to their actual past experiences and prohibits them from thinking "out of the box" and being more creative (Brüggen *et al.*, 2018). In contrast, the lower similarity of avatars weakens users' self-awareness in the virtual world. Accordingly, their behaviors in the virtual world will be less regulated by their previous experience and habituation (Bélisle and Bodur, 2010). As a result, it is easier for them to think from new perspectives and be more adaptive, leading to better performance in creative tasks. Overall, while higher avatar-user similarity generally prompts users to devote more effort to tasks, we expect that a less adaptive and more constrained thinking style imposed by high avatar-user similarity may play a more deterministic role in affecting users' performance in creative tasks. Accordingly, we argue that avatar-user similarity has a negative effect on users' performance in creative tasks. Therefore, we propose that:

H2a. Avatar-user similarity is positively related to users' procedural task performance.

H2b. Avatar-user similarity is negatively related to users' creative task performance.

4. Methodology

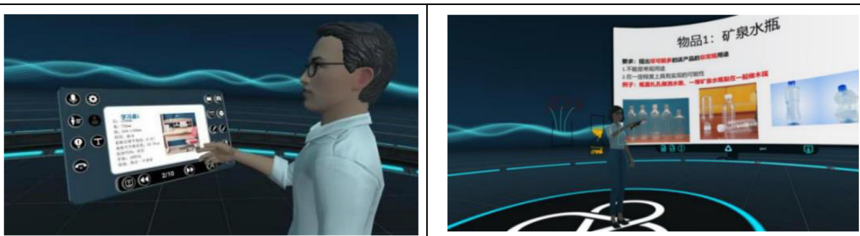
4.1 Experimental task and system

We conducted a 2 (Avatar similarity: low vs high) × 2 (Task type: procedural vs creative) between-subjects experiment. Subjects were recruited from a large public university and randomly assigned to one of four experimental conditions.

The experimental system was Vive Sync, which is one of the most widely used VR applications. The platform provides virtual meeting rooms, allowing multiple people to present in the same space and have face-to-face communication with each other. With this system, subjects were able to choose and design their own avatars. They could wear a head-mounted display (i.e. HTC Vive) to view the room and navigate it via physical actions (i.e. walking) and hand controllers. During the experiment, they could check digital files on their private small screen (see Figure 1a), share the file on a public large screen (see Figure 1b), and show their ideas to others by writing or painting in the air with a marker (see Figure 1b).

To create avatars with different levels of similarity to users, we adopted two different methods of avatar generation. First, to create an avatar that resembled each subject, we used Vive Sync to scan the subject's face and took high-resolution digital pictures to obtain a precise facial shape and image. By applying quick 3D modeling and rendering algorithms of facial shape, we were able to generate an avatar face with a closer resemblance to a subject in seconds (shown in Figure 2a). We then matched the avatars' height with that of the subjects. For the low-similarity condition, we assigned a generic avatar with matched gender and fixed height (i.e. 160 cm for females and 170 cm for males) to each subject (shown in Figure 2b). Specifically, as the subjects were all Asians, we chose 3D models generated based on white people with blond hair and blue eyes from Vive Sync to further lower the similarity between the avatar and the subjects.

The context of the experimental task was marketing and sales, which was a typical use scenario for current Metaverse platforms (e.g. Vive Sync, Engage, and Horizon). The procedural task was introducing products to customers (with well-defined product information provided), while the creative task was related to product design (without well-defined solutions). Specifically, in the procedural task, the subjects were asked to act as salespersons to recommend and introduce products that satisfied customer needs. The subjects first studied the product information on a brochure, which included three garden tables, five portable tables, seven computer tables, and nine study tables. Each table has eight attributes (length, width, texture, price, etc.). During the experiment, an experiment assistant acted as a customer to raise the requirements, for example, "*I want a portable table that can be*



Check files on a screen	Share files on a large screen and present ideas in the 3D space
(a)	**(b)**

Source(s): Author's own creation/work

Figure 1. Screenshots of the experimental systems

High similarity	Low similarity
(a)	(b)

Figure 2. Virtual avatars in high vs low similarity conditions

Source(s): Author's own creation/work

put into the trunk of my car. The trunk is about 70 cm long, 50 cm wide, and 20 cm high. Which table should I buy?" The subjects could then refer to the brochure and recommend one or more tables that satisfy customers' needs and verbally describe the products as much as they wanted. The subjects were expected to respond to a total of 10 product requests from the customer. There were one or more products that could satisfy each request. The purpose of the task was to help the customer find as many products as possible that satisfied the demand. The task was easy to explain and understand, and it had standard answers. To perform well in this task, the subjects needed to pay close attention to consumers' requests and check the product information on the brochures carefully. Thus, the task was considered standard and procedural, and the task performance mainly depended on the subjects' engagement and effort (Niederle and Vesterlund, 2007).

The creative task was about novel product design, originally developed by Guilford (1967) and then widely used in research on creative performance. In this task, the subjects were asked to think of as many unusual uses of an ordinary item (e.g. a tin can) as possible. This task required users to break their habitual thinking to think outside the box, which was key to a creative process; thus, it could be regarded as a proper task to measure the subjects' creativity (Runco, 1991; Simonton, 2004). In the current experiment, the subjects were asked to act as marketing persons to propose different uses of an ordinary product so that it could be used for different purposes. They needed to verbally describe the ideas, especially how they could be implemented. They were also provided with painting tools to write or draw freely in a 3D virtual space to visualize the designs. Specifically, the subjects had to propose the use of three items—a plastic bottle, a roll of tape, and a bicycle wheel—without being constrained by the size or quantity of each item.

4.2 Experimental procedure

Before the experiment started, we briefly introduced the experimental task, and each subject signed a consent form to take part in the study. In the procedural task condition, the subjects were asked to go through the product brochure for about five minutes to become familiar with the products. In the creative task condition, they were introduced to some examples of unusual designs based on an object (e.g. a plastic bottle). We then generated a high- or low-similarity avatar for each subject and asked them to stand in front of a mirror in the virtual environment to become familiar with the avatar. We then trained the subjects to become familiar with the system's functions, such as walking around, checking digital files, and writing and painting with the marker. They then started the experimental task. During the experiment, the experiment assistant took a picture of a subject's avatar every 30 s and presented it on a screen in the system [5]; thus, the subjects could observe the avatar's appearance and motions via these pictures.

The subjects' verbal content during the task was transcribed for later analysis. In particular, the verbal content is critical to assessing their performance on both the procedural and creative tasks because the subjects need to verbally describe products or design ideas to meet the requests of the task. After the main task, the subjects were asked to complete a questionnaire that measured their perceived similarity between the avatar and themselves, self-awareness, engagement, and other control variables. The experimental task lasted around 30 min. Finally, each subject was thanked and paid 60 RMB (around US$10) for their participation.

4.3 Measurement

4.3.1 Measures of task engagement. Perceived engagement was measured using a seven-point Likert rating scale (e.g. "*I concentrated fully on the task*" from Yi *et al.*, 2015; see Appendix 1 for items). We also objectively measured engagement based on the details of the subjects' descriptions of products in the procedural task or design ideas in the creative task, which reflected the effort devoted to the task (Brüggen *et al.*, 2018). Specifically, in the procedural task, we calculated the total number of attributes that the subjects mentioned when introducing the products to the customer. This is because the more engaged the user is, the more details they are likely to provide for a customer. For example, in the following states, "*I recommend a table with adjustable height around 70 cm to 130 cm. It is made of high-quality marble. And the price is around 1,600, which is also under your budget,*" there were three attributes mentioned (i.e. height, material, and price).

In the creative task, we calculated the total number of steps for how the subjects implemented their ideas as a measure of engagement. This is because a more engaged user will likely devote more detailed thoughts to their ideas. For example, the following states, "*Plastic bottles can be made into clothes. You can cut plastic bottles into strips, and dye them different colors, then knit them like a sweater,*" were counted as three steps (i.e. cutting, dyeing, and knitting).

4.3.2 Measures of task performance. We measured the performance of the procedural task as the number of correct answers provided by each subject—that is, the number of products that are recommended and satisfy the customer's requirements (Niederle and Vesterlund, 2007). The subjects were asked to respond to a total of 10 product requests from the customer, of which three requests had only one correct answer (i.e. one product that satisfies all the requested criteria), three requests had two correct answers, and four requests had three correct answers. Accordingly, the number of correct answers ranged from 0 to 21.

For the creative task, we used three standard measures to evaluate performance: fluency, flexibility, and originality (Brüggen *et al.*, 2018; Guilford, 1959). Fluency refers to the number of valid answers. An answer is valid if the stated design and use are possible to implement. Impossible uses beyond all possible realities are not counted. For example, it is valid to redesign a tin can into a flower pot, a pen container, or a drum, whereas designing a tin can into a television or a computer is invalid. In this task, each valid use is scored with one point. The second measure, flexibility, reflects the variety of a subject's design ideas and is determined by counting the number of different categories of designs. For instance, a candle holder falls into the category of decoration, while a rattle or drum belongs to musical instruments. For each unique design category, the subject received one point. Finally, the originality of the ideas was measured by the uniqueness of the answers. We constructed an idea pool that included all valid ideas for each object in the task. We then allotted one point to an idea if it was only proposed by one subject (i.e. it was unique to the idea pool). Evaluating originality in this manner has been widely adopted in previous research (Bradler *et al.*, 2014). Scoring for the above three measures was done by two research assistants who were acquainted with the task and the scoring procedures and were blind to the treatments.

4.4 Subject background information

A total of 120 subjects were recruited from a public university. Among the subjects, 59 (49%) were female, and the average age was 22.4 years. There were no significant differences in terms of gender (χ^2[3] = 0.41, $p > 0.05$), age (F[3,116] = 8.66, $p > 0.05$, $\eta^2 = 0.02$), personalities in terms of innovativeness (F[3,116] = 0.873, $p > 0.05$, $\eta^2 = 0.03$), efficacy in using new technologies (F[3,116] = 0.714, $p > 0.05$, $\eta^2 = 0.02$), familiarity with VR devices (F[3,116] = 1.291, $p > 0.05$, $\eta^2 = 0.03$), and perceived attractiveness of their avatars (F[3,116] = 1.054, $p > 0.05$, $\eta^2 = 0.03$) among the four conditions (See Appendix 2 for sample descriptives).

4.5 Manipulation check

We performed a check for the perceived avatar similarity manipulation by including a question that read, "*I think this avatar resembles me in appearance*" (Suh *et al.*, 2011). It was presented using a seven-point Likert rating scale. The results show that the subjects in the high-similarity condition ($mean_{high} = 5.14$) rated significantly higher avatar similarity than those in the low-similarity condition ($mean_{low} = 3.89$, F[1,118] = 28.47, $p < 0.001$, $\eta^2 = 0.4$). Thus, the manipulation is successful.

We also measured the subjects' self-awareness in the Metaverse with items like "*I think the avatar represents who I really am*" (Liao *et al.*, 2019). The results reveal that the subjects in high-similarity conditions reported higher self-awareness than those in low-similarity conditions ($mean_{high} = 4.97$, $mean_{low} = 4.15$, F[1,118] = 8.65, $p < 0.01$, $\eta^2 = 0.19$). This finding provides initial support for our argument that avatar-user similarity can help users establish their self-awareness in the Metaverse.

4.6 Results

4.6.1 Results of task engagement. We pooled samples of the two tasks to test the interaction effects of avatar-user similarity and task type on task engagement. The descriptives of task engagement are presented in Table 1. As prior research suggests that avatar attractiveness is an important factor that affects users' attitudes and responses to avatars (e.g. Liao *et al.*, 2019),

		Low similarity				High similarity			
		Mean	SD	Min	Max	Mean	SD	Min	Max
Panel A. Task engagement									
Perceived engagement		5.35	0.85	4.00	7.00	5.95	0.70	4.25	7.00
Verbal content		44.03	33.80	7.00	113.00	54.78	40.18	16.00	138.00
Panel B. Task performance									
Procedural task		15.45	2.63	10.00	19.00	17.95	1.64	15.00	20.00
Creative task	Fluency	11.95	4.75	3.00	19.00	14.00	3.61	9.00	20.00
	Flexibility	9.90	2.85	4.00	14.00	9.74	2.54	5.00	14.00
	Originality	2.75	1.33	0.00	5.00	1.84	1.30	0.00	4.00

Source(s): Author's own creation/work

Table 1.
Descriptives of task engagement and performance

we controlled avatar attractiveness in the following analyses. Specifically, we conducted a two-way analysis of covariance (ANCOVA) with avatar-user similarity and task type as fixed factors and avatar attractiveness as the covariate. With regard to perceived engagement, the results show that the main effect of avatar-user similarity is significant ($mean_{high}$ = 5.95, $mean_{low}$ = 5.35, $F[1,115] = 11.97$, $p < 0.01$, $\eta^2 = 0.14$), but the interaction effect between avatar-user similarity and task type is not significant ($F[1,115] = 1.13$, $p > 0.05$, $\eta^2 = 0.02$). Similarly, for the objective measure of engagement coded from verbal content, the results show that subjects with more similar avatars described more attributes or details when introducing products or ideas to customers ($mean_{high}$ = 54.78, $mean_{low}$ = 44.03, $F[1,115] = 6.41$, $p < 0.05$, $\eta^2 = 0.08$). However, we do not find a significant interaction effect between avatar-user similarity and task type ($F[1,115] = 2.02$, $p > 0.05$, $\eta^2 = 0.03$). Therefore, the above results show that in general, higher avatar-user similarity leads to higher task engagement (regardless of task type). Thus, H1 is supported.

4.6.2 Results of task performance. Since we had different measures of performance for the procedural and creative tasks (i.e. number of correct answers for the procedural task but fluency, flexibility, and originality of idea generation for the creative task), we were not able to pool the samples of the two tasks in our analysis. Hence, we performed ANCOVA (with avatar-user similarity as the fixed factor and avatar attractiveness as the covariate) to test the effects of avatar-user similarity on task performance in the two types of tasks separately. The descriptives of task performance are presented in Table 1. Specifically, for the procedural task, the results of task performance reveal that subjects with more similar avatars provided more correct answers ($mean_{high}$ = 17.95) than users with lower similar avatars ($mean_{low}$ = 15.45, $F[1,59] = 13.39$, $p < 0.01$, $\eta^2 = 0.27$). The results imply that users with highly similar avatars were more likely to regulate themselves in searching for correct answers through repeated actions, resulting in better performance in procedural tasks. Thus, H2a is supported.

For the creative task, results of ANCOVA show that subjects with higher similar avatars generated fewer original design ideas (i.e. originality: $mean_{high}$ = 1.84) than those with lower similar avatars ($mean_{low}$ = 2.75, $F[1,55] = 4.54$, $p < 0.05$, $\eta^2 = 0.11$). However, there is no significant difference in terms of total number of valid design ideas (i.e. fluency: $mean_{high}$ = 14.00, $mean_{low}$ = 11.95, $F[1,55] = 1.85$, $p > 0.05$, $\eta^2 = 0.05$), or number of idea categories (i.e. flexibility: $mean_{high}$ = 9.74, $mean_{low}$ = 9.90, $F[1,55] = 0.04$, $p > 0.05$, $\eta^2 = 0.01$). A plausible reason is that heightened engagement induced by high avatar-user similarity may positively affect fluency and flexibility. That is, as subjects pay more effort to the task, they tend to generate more ideas and be more comprehensive (i.e. cover more categories), even though these ideas may not be unique. However, originality (i.e. uniqueness) is mainly affected by the extent to which one can be open-minded and think outside the box; it is less likely to be greatly shaped by task engagement. Hence, high avatar-user similarity tends to have negative effects on originality. Taken together with the results of the three measures of creative task performance, H2b is moderately supported.

4.7 Additional analysis

We argued that the subjects' performance in procedural tasks largely depended on the effort they devoted to the task (i.e. engagement). To provide support for our arguments, a mediation test was conducted to examine the mediating role of engagement (Hayes, 2013). We used avatar-user similarity as the independent variable, engagement (i.e. verbal content) as the mediator, and task performance as the dependent variable. As Table 2 shows, a 95% bias-corrected bootstrap (based on 5,000 samples) confidence interval (CI) revealed that the indirect effect of avatar-user similarity on procedural task performance through engagement is significant (beta = 0.649, 95% CI = 0.429–1.407). The results indicate that in procedural tasks, engagement mediates the effect of avatar-user similarity on task performance.

	Beta	2.5% lower bound	97.5% upper bound	Zero included?	Mediation?
Procedural task performance (i.e. number of correct answers)					
(Direct impact)	1.851	0.519	3.182	No	–
Engagement (i.e. verbal content)	0.649	0.429	1.407	No	Yes
Creative task performance (i.e. originality of idea generation)					
(Direct impact)	−0.974	−1.902	−0.046	No	–
Engagement (i.e. verbal content)	0.074	−0.262	0.538	Yes	No
Creative task performance (i.e. fluency of idea generation)					
(Direct impact)	0.385	−2.436	3.205	Yes	–
Engagement (i.e. verbal content)	1.416	0.031	3.500	No	Yes
Creative task performance (i.e. flexibility of idea generation)					
(Direct impact)	−1.489	−3.168	0.190	Yes	–
Engagement (i.e. verbal content)	1.189	0.213	2.608	No	Yes

Source(s): Author's own creation/work

Table 2. Bootstrapping mediation tests

Similarly, in the creative task, we examined the meditation role of engagement in the three measures of task performance (see Table 2). Specifically, in terms of fluency (i.e. the total number of valid ideas) and flexibility (i.e. the number of idea categories), we found significant mediation effects of engagement (fluency: beta = 1.416, 95% CI = 0.031–3.500; flexibility: beta = 1.189, 95% CI = 0.213–2.608). However, the mediation effect of engagement on originality (i.e. the number of original ideas) was not significant (beta = 0.074, 95% CI = −0.262–0.538). The results are in line with our argument that the number and variety of ideas can be positively affected by engagement, but originality can hardly be affected by engagement.

5. Conclusion

5.1 Discussion of results

This study investigates how avatar-user similarity affects people's task engagement and performance in the Metaverse. The laboratory experiment reveals that people with higher similarity avatars in the virtual world are more engaged in the tasks. Specifically, users with high-similarity avatars devote more effort to describing the details of product attributes in the procedural task and the specific steps of their design ideas in the creative task. Our findings also demonstrate that higher avatar-user similarity leads to improved performance in procedural tasks and this effect is mediated by engagement. However, in creative tasks, while a similar avatar encourages individuals to generate more ideas in a creative task, it also inhibits their creativity, resulting in fewer original ideas generated.

Through the lens of self-perception theory, we propose a plausible mechanism for the positive effect of avatar-user similarity on user engagement, that is, users with higher similar avatars will develop a higher level of self-awareness, which likely makes them regulate their behaviors in the virtual space in accordance with the beliefs and standards of their actual selves. In fact, some prior studies have tried to describe the relationships between one's actual self and the virtual self-representation. In particular, research on self-presence suggests that users can be connected to their virtual self-representations at three distinct levels: body, emotion, and identity (Ratan, 2013). Under this framework, several studies have investigated avatar design in the virtual world and shown that avatar-user similarity may positively affect users' bodily feelings (e.g. sense of bodily connection with avatars; Kim *et al.*, 2020) and emotional feelings (e.g. emotional attachment to avatars; Suh *et al.*, 2011; Goel *et al.*, 2011), leading to behavioral changes in the virtual world (e.g. enjoyment and website usage). Our study thus builds upon and extends these studies by investigating avatar design in the Metaverse and highlighting the third level of connection, that is, between one's actual self-identity and that of the avatar. Based on a more specific theory, self-perception theory, this research reveals how avatar-user similarity affects users' self-awareness and behaviors in the Metaverse, shedding light on future research on self-presence in the Metaverse.

5.2 Theoretical contributions

This research has several theoretical implications. First, this study contributes to the IS literature by highlighting the value of avatar design in shaping people's behaviors in the Metaverse. Prior research on avatars mainly focuses on their effect on users' attitudes toward the avatar (e.g. affection and reuse intention; Suh *et al.*, 2011), the platform (e.g. enjoyment and revisit intention; Goel *et al.*, 2011), and their experience in the virtual world (e.g. self-presence and social presence; Heidicker *et al.*, 2017; Kim *et al.*, 2020). With the presence of more Metaverse applications, this study provides evidence that avatar-user similarity is an important design factor that affects user performance in various activities (i.e. procedural and creative tasks in the virtual world). It thus extends the existing literature on the Metaverse and provides important insights into the design of virtual environments and avatars to enhance user experience and performance.

Second, through the lens of self-perception theory, this research deepens our understanding of the mechanisms through which avatar-user similarity impacts user behavior. Our study highlights that highly similar avatars will increase self-awareness in the virtual world and encourage users to evaluate their behavior in the virtual space against the standards of their actual selves. Consequently, users are more likely to regulate their behavior in the Metaverse. This study aligns with current research trends on user behavior and governance in the Metaverse (Dincelli and Yayla, 2022) and underscores the significance of using non-intrusive design elements, such as avatars, to prompt users' self-regulatory behaviors in the Metaverse.

Third, this study contributes to IS research by revealing the opposite effect of avatar-user similarity on task performance in procedural and creative tasks in Metaverse. Prior research has mainly revealed a positive effect of avatar-user similarity on user behaviors (e.g. trust and loyalty to platforms, Suh *et al.*, 2011; Liao *et al.*, 2019). By focusing on two different types of tasks, this study disentangles the positive effect of avatar-user similarity on regulating their behaviors and hence engaging in the assigned task persistently, as well as its negative effect on generating creative thinking. Therefore, this study advances our understanding of the role of avatars in virtual environments by identifying a boundary condition (i.e. task type) for the effect of avatar-user similarity on user performance.

5.3 Practical implications

This study also has some practical implications. First, understanding how the design of avatars affects users' task engagement and performance in the virtual space is very helpful for Metaverse application developers and stakeholders. Based on the current study, avatar design can serve for regulatory purposes in terms of inducing users to treat their assigned tasks more seriously. Specifically, marketers and platform owners can help users create and use avatars that are physically similar to them to make them devote more effort in their virtual tasks and achieve better performance. This is important as increasingly more work-related activities, such as conferences and marketing campaigns, are conducted in Metaverse.

Second, our results suggest that when users' activities in the virtual world require creativity, such as new product design, practitioners should caution about inducing users to create avatars similar to themselves. Although people who use similar avatars may be highly engaged in the activities and hence contribute thoughtful and comprehensive ideas, they may also be constrained by their habitual thinking and are hence less likely to contribute truly original ideas. In other words, to encourage more original ideas, marketers or platform owners should direct and facilitate users to create avatars that are less similar to themselves. In fact, users' creativity in virtual activities has attracted much attention from both research and practice in recent years (e.g. Brucks and Levav, 2022). This study thus extends our current knowledge by providing an important and actionable way to improve users' creativity in the virtual world.

Third, Metaverse will likely evolve into a hub for a diverse range of community activities in the future, allowing greater social interactions among its users (Oh *et al.*, 2023). Considering this broader context, an important implication of this research is that the use of highly similar avatars may help users connect their self-identity in the virtual community with their actual identity in reality, thereby regulating their social behaviors in the virtual space. This regulation of social behaviors could potentially help to minimize socially deviant behaviors, such as trolling and cyberbullying, which might contribute to a safer and more welcoming virtual world for all users.

5.4 Limitations and future research

According to our research, avatars can impact users' self-awareness and behaviors in the Metaverse. Nevertheless, focusing on appearance similarity, our study is just an initial step in illuminating the influence of avatars on how people recognize themselves in an immersive virtual world. Thus, to better understand the role of avatars in the virtual world, a series of further experimental studies could be conducted to fully explore other important design aspects of avatars (e.g. stylized appearance and motion-sync design).

Second, our study builds on previous research (e.g. Duval and Wicklund, 1972; Silvia and Gendolla, 2001) and assumes that individuals are intrinsically motivated to regulate their behaviors to meet personal standards and goals. Self-awareness is an essential factor in this process, as it enables individuals to identify when their behaviors do not align with their goals and standards and to make the necessary adjustments. However, prior studies have found that users with different cultural backgrounds may have different levels of self-awareness. For example, Cullen *et al.* (2015) found that individuals from collectivist cultural backgrounds tend to underestimate their self-awareness (i.e. self-diminishment), while those from individualistic cultural backgrounds tend to overestimate their self-awareness (i.e. self-enhancement). Future research can thus investigate whether the effect of avatar design in invoking users' self-awareness and changing their behavior in the virtual world may vary across different cultural contexts.

Third, with the development of VR technologies and the maturity of Metaverse applications, an increasing number of activities are moving to the virtual world, and most of these activities involve multi-person interactions. Although we tested the effect of avatar design in a multi-person context (i.e. the subjects need to communicate with our research assistant in the virtual world), the focus of this research is still restricted to the impacts of avatar design on a single person. Thus, future research can explore the impacts of avatar design on interpersonal communication and collaboration.

Notes

1. https://www.oculus.com/horizon-worlds/
2. https://www.microsoft.com/en-us/mesh
3. https://sync.vive.com/
4. https://www.cnet.com/tech/computing/microsoft-teams-is-getting-avatars-launching-in-vr-and-ar-next-year/
5. The screen is seamlessly integrated into the virtual environment as a background, ensuring that users are able to notice pictures on the screen without being distracted from their current task.

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Appendix 1

Variables	Items	References
Engagement	(1) I concentrated fully on the task (2) I was absorbed intensely in completing the task (3) My attention was focused on dealing with the requests in the task	Yi *et al.* (2015)
Self-awareness	(1) I think the avatar represents who I really am (2) When someone criticizes this avatar, it feels like a personal insult (3) When someone praises this avatar, it feels like a personal compliment	Bhattacharya *et al.* (1995)
Avatar-user similarity	I think this avatar resembles me in appearance	Suh *et al.* (2011)
Avatar attractiveness	(1) The appearance of my avatar is good-looking (2) The appearance of my avatar is attractive (3) The appearance of my avatar is physically attractive	Liao *et al.* (2019)
Innovativeness	(1) I think I am a creative person (2) I like to try new things (3) I like to explore the new uses of a product (4) I prefer to use familiar products rather than try new ones	Burroughs and Glen Mick (2004)
Efficacy in using new technologies	(1) I believe that I can learn to use a new digital device by myself (2) I believe that I can learn to use a new digital device even without prior experience (3) With simple guides, I can learn to use a new digital device	Bandura *et al.* (1987)
VR familiarity	I have experience of using VR devices 1 – Never; 2 – Rarely 3 – Occasionally; 4 – Sometimes; 5 – Frequently; 6 – Usually; 7 – Everyday	Adapted from Suh *et al.* (2011)

Note(s): Seven-point Likert scale

Table A1.
Measurement items

Appendix 2

Variables	Group 1 High similarity Procedural task (N = 31)	Group 2 Low similarity Procedural task (N = 31)	Group 3 High similarity Creative task (N = 29)	Group 4 Low similarity Creative task (N = 29)
Panel A. Summary Statistics for Categorical Variables (Count, percentage)				
Biological sex Female	16 (51.6%)	15(48.4%)	15 (51.7%)	13 (44.8%)
Panel B. Summary statistics for continuous variables (mean, standard deviation)				
Age	23.10 (3.05)	22.10 (2.10)	22.41 (3.55)	21.97 (3.16)
VR familiarity	2.68 (1.51)	3.03 (1.87)	2.24 (1.09)	2.72 (1.66)
Technology efficacy	5.13 (1.53)	5.29 (1.22)	4.86 (1.46)	4.90 (0.97)
Innovativeness	4.81 (1.03)	4.90 (0.75)	4.81 (1.21)	5.28 (1.06)
Avatar attractiveness	4.20 (1.31)	4.08 (1.37)	4.29 (1.32)	4.65 (1.21)

Table A2.
Sample descriptives

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