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Proteus vs. social identity effects on virtual brainstorming

Stéphanie Buisine^a and Jérôme Guegan^b

^aCESI, LINEACT, Nanterre, France; ^bUniversité Paris Descartes, LATI, Boulogne Billancourt, France

ABSTRACT

Avatars are known to influence behaviour through their individual identity cues (Proteus effect) and through their shared identity cues (Social identity effect). The aim of this study was to investigate these two processes in a crossed design, in order to examine their interaction in the context of a brainstorming task. To activate the Proteus effect, we used creative avatars resembling inventors, and to make social identity salient, we made the avatars wear the traditional clothing of the participants' school. The resulting factorial design included four conditions: creative avatars with or without social identity cues, and non-creative avatars with or without social identity cues. The results show that creative performance was higher with creative than non-creative avatars, but only in the absence of social identity cues. Furthermore, the presence of social identity cues increased social identification to the group, but this unexpectedly decreased creative performance. This result is discussed together with an analysis of the meaning of the social identity cues we used, which appeared to be unrelated to creativity. This discussion highlights that the effects of social identity cues on performance are complex and may be moderated by their meaning and the particular facet of social identity they make salient.

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Avatar; Proteus effect; social identity model of deindividuation effects

1. Introduction

Avatars (i.e. digital self-representations) are projections of users, a 'tangible embodiment of their identity' (Ducheneaut et al. 2009). Avatars and virtual humans have been the object of interdisciplinary work – including, in particular, research in social science – using virtual humans to study social interaction, as well as research in computer science, employing emotional and behavioural theories to create believable virtual humans (Ahn, Fox, and Bailenson 2012). Customisation of one's avatar is likely to increase satisfaction in a collaborative context (Ratan and Hasler 2014). Users create avatars that do not necessarily resemble them (Dunn and Guadagno 2012), experience a multiplicity of identities or highlight certain aspects of their ideal self (Bessière, Seay, and Kiesler 2007; Messinger et al. 2008). Hence, the configuration of avatars allows users to change their appearance, their social roles and their identity in the virtual world.

Avatars have been shown to influence users' behaviour and performance in at least two ways: through their individual appearance, and through the social identity cues they wear (e.g. uniforms, costumes). Both these processes are based on the effects of anonymity and identity cues, and lead to behavioural modulations. However, they are fundamentally distinct in that the former relies on individual characteristics of the avatar whereas the latter is based on shared characteristics between avatars.

On the one hand, behavioural impacts of avatars' individual identity cues are attributed to the Proteus effect (Yee and Bailenson 2007). This line of research, based on Self-Perception principles (Bem 1972), posits that the use of an avatar modulates user's behaviours congruently to the avatar's appearance. On the other hand, avatar similarity within a group has been shown to increase group influence and related outcomes (social identification, normative action, group performance). This effect is in line with SIDE principles (Social Identity model of Deindividuation Effects; Reicher, Spears, and Postmes 1995; Spears and Lea 1994) that posit that the scarcity of individuating information in computer-mediated settings, combined with relevant membership cues (e.g. resemblance between avatars or collective symbols they convey), may lead to social identity salience and group-oriented behaviours.

The influence of both these processes on performance was recently observed in the context of creative tasks: it has been shown that engineering students brainstorming in groups produced more ideas, more original ideas, and felt more creative when embodying avatars resembling inventors with a comparison to more neutral avatars (Guegan et al. 2016). Besides, avatars wearing the engineering school uniforms led to the higher creative performance and higher group identification than avatars without uniforms (Guegan et al. 2017).

Although both effects are conveyed by avatars, the confrontation of Proteus and SIDE effects was never investigated and their potential interaction remains unclear. This fundamental question is so important that it was already present in Yee and Bailenson's (2007) seminal conceptualisation of the Proteus effect: 'SIDE theory emphasizes conformity to local group norms (...). On the other hand, the Proteus Effect emphasizes conformity to individual identity cues' (p. 274). Proteus effect and SIDE are close processes, triggered by the same kind of situations (computer-mediated communication, reduced social cues, virtual environment) and involving common factors such as deindividuation. They impact the same situations, but at different levels: individual for the Proteus effect, and social for SIDE. According to the social identity perspective, individual and social identity belong to a single continuum and one can activate only one facet of one's self-concept at a time: as one level of self-definition becomes more salient, the other levels become less so, which is termed functional antagonism (Hornsey 2008). Therefore, crossing the respective effects of individual and social identity activation through avatars may provide an operationalisation of functional antagonism and offer the opportunity of assessing the respective impact of Proteus effect and SIDE on performance.

The goal of the present study is to investigate the Proteus and SIDE effects in an integrative manner by manipulating individual identity cues as well as social identity cues of avatars in a brainstorming task. In so doing, we expect to better understand the processes at work when individuals use avatars in a virtual environment, and provide insights as to how to strategically apply those effects to increase users' performance. Besides, a more fundamental goal is to offer a deeper and more integrative comprehension of each one of these processes, by studying the Proteus effect in a group setting and the SIDE in conjunction with idiosyncratic cues. We will also operationalise functional antagonism to investigate whether these processes, although globally integrated in human functioning, are mutually exclusive.

In the following section, we develop the twofold theoretical background of Proteus and Social identity effects along with the elaboration of our hypotheses. We then describe the experimental setting used to test those hypotheses in the context of an avatar-mediated brainstorming (with and without creative avatars; with and without social identity cues). The effects of these conditions on creative performance, perception of avatar identity and social identification are developed and discussed. The concluding section highlights the contribution, originality, limitations and perspectives of the study.

2. Theoretical background

2.1. The Proteus effect

The influence avatars exert on users has been the subject of several experimental studies over the past decade. In line with the self-perception theory (Bem 1972), the individual explains his attitudes and internal states based on the observation of external cues. Therefore, the individual would adopt the same point of view as an external observer 'who must necessarily rely upon those same external cues to infer the individual's inner states' (Bem 1972, 3). For example, Frank and Gilovich (1988) showed that individuals wearing black uniforms exhibit more aggressive behaviour than individuals wearing white uniforms. This phenomenon was observed both in the laboratory and in the natural environment. Moreover, this self-perception process can be linked to deindividuation (Diener 1980; Festinger, Pepitone, and Newcomb 1952), which refers to a behavioural modulation in situations of anonymity. Although deindividuation was initially seen as a negative phenomenon (i.e. which leads to aggressive and antisocial behaviours; see Postmes and Spears 1998 for an overview), subsequent research has shown that deindividuation per se is neutral and increases the sensitivity of individuals to environmental influences (e.g. Gergen, Gergen, and Barton 1973; Spivey and Prentice-Dunn 1990). For instance, someone exhibits more prosocial behaviour when wearing a nurse costume rather than a Ku Klux Klan uniform (Johnson and Downing 1979), which is consistent with expectations an external observer might have. Moreover, individuals in nurse costume behave in a more prosocial way when they are anonymous (i.e. deindividuated). Consequently, it can be considered that deindividuation does not necessarily lead to aggressive and antisocial behaviour, but also (and perhaps most importantly) that 'deindividuation increases the self-perception reliance on identity cues' (Yee, Bailenson, and Ducheneaut 2009, 292).

This reasoning can be transposed to avatars in virtual environments. As noted by Yee and Bailenson (2007), virtual environments are conducive to deindividuation because of the physical isolation and anonymity of users. Moreover, the avatar may greatly influence self-perception process as it is even more than a costume or a uniform that is worn: 'the avatar is our entire self-representation' (Yee and Bailenson 2007, 274). Finally, the underlying mechanisms may also involve priming processes (Peña, Hancock, and Merola 2009).

In situation of anonymity in a virtual environment, the digital representation of self influences users and their behaviours to be consistent with the avatar's

identity. This behavioural modulation related to the appearance of the avatar, known as Proteus Effect (from the Greek God Proteus who possessed the ability of metamorphosis), has been observed in several studies. Yee and Bailenson (2007) have shown that attractive avatars lead to behave in a more intimate way in terms of self-disclosure and interpersonal distance (see also Waddell and Ivory 2015). It should be noted that this phenomenon results from the mere exposure to a virtual mirror allowing the participant to see his/her avatar for about one minute. In this respect, one can consider that the Proteus Effect is initiated almost instantly. In another study, Yee and Bailenson (2007; Yee, Bailenson, and Ducheneaut 2009) have shown that tall avatars lead to more confident behaviour in a negotiation task than short avatars. Recent studies have also shown that avatar's appearance may affect subsequent behaviour in the real world (Rosenberg, Baughman, and Bailenson 2013; Yoon and Vargas 2014). For example, the benefits of a tall avatar on negotiation endure in a subsequent negotiation task in face-to-face situation (Yee, Bailenson, and Ducheneaut 2009).

The Proteus effect was analysed in several contexts, such as prosocial/antisocial behaviours (Yoon and Vargas 2014), stereotypically masculine or feminine behavioural choices (Sherrick, Hoewe, and Waddell 2014), content of narrative production (Peña, Hancock, and Merola 2009), or creativity. In the latter context, the first step is to identify what kind of avatars would be likely to increase the perception of one's creative skills. For example, experiments conducted with engineering students required to study the cognitive representation of creativity in this population, which led to identifying the concept of the Inventor as a common relevant creative figure for engineers (Guegan et al. 2016). Avatars featuring characteristics of inventors (e.g. looking like Einstein, wearing a lab coat or using scientist's instruments) were expected to lead users, observing their digital appearance ('I embody an inventor'), to make implicit inferences about their creative skills ('I am creative') and improve their creative performance ('I have a lot of ideas/good ideas'). Consistently, it was shown that engineering students using inventor avatars during a virtual brainstorming session performed significantly higher in fluency and originality in comparison to students using more neutral avatars and students in a face-to-face electronic brainstorming situation (Guegan et al. 2016). This benefit proved to endure over time because participants allocated to inventor condition continued to perform higher in a subsequent face-to-face brainstorming.

Another study investigated whether avatars could be used to help engineers develop User-Centered

innovations, motivated by customer needs instead of technological value (Buisine et al. 2016). One group of employees from the innovation department of a transportation company were attributed inventor avatars like in the previous experiment, and another group was attributed avatars representing users of public transportation (Persona avatars, e.g. a mother with a newborn infant, a child, an elderly person, a train manager). As expected, the content of ideas was influenced congruently to avatars' appearance: the inventor condition led to a techno-centered ideation profile, oriented toward technological solutions, while the Persona condition led to more user-centered, needs-oriented ideas (Buisine et al. 2016). Consistently, inventors' production tended to be better evaluated through industrial criteria and Personas' production tended to be better evaluated by transportation users. These results suggest that avatar-mediated brainstorming could be a powerful tool enabling innovation team to align ideation to their strategy (e.g. technology-centered or user-centered).

Finally, the impact of self-perception on performance in a nominal brainstorming task was studied using avatars based on body-scanning of participants (de Rooij, van der Land, and van Erp 2017): in the control condition, participants used their 3D model to perform a divergent thinking task; in the non-creative condition, they had to wear a grey office-like jacket with a necktie during body-scanning and embodied this 3D model during brainstorming; finally, in the creative condition, they were scanned with a white painter's blouse and paint brushes and brainstormed with this avatar. The results show that the non-creative avatar decreases the quality of ideas with a comparison to the two other ones. Moreover, self-perception of similarity between self and the avatar was found to be a positive predictor of the quality of ideas.

The present study implements virtual brainstorming conditions in which participants are attributed either creative or non-creative avatars. In line with the Proteus effect and self-perception framework, we hypothesise that:

Hypothesis H1a: Creative avatars will increase participants' creative performance;

Hypothesis H1b: This effect will be mediated by the perception of the creative identity of avatars.

We also expect the effects of creative avatars to endure over time:

Hypothesis H2: Previous exposure to creative avatars will increase creativity in a subsequent session.

2.2. Social identity effects

Social Identity Theory (Tajfel and Turner 1979) posits that identity varies along a continuum referring to interpersonal behaviour on one side ('I' vs. 'you'; personal identity) and intergroup behaviour on the other ('us' vs. 'them'; social identity). Social identity relies on common features that are shared by group members and distinguish them from relevant other groups. In this perspective, group membership leads members to make intergroup comparisons promoting the in-group (in-group favouritism) because a positive evaluation of one's in-group may contribute to a positive evaluation of the self, even for groups based on trivial criteria (Tajfel et al. 1971). The self is a multi-faceted cognitive structure (i.e. different social groups organised in a system of inclusion levels; Turner et al. 1987). In this perspective, self-categorisation theory emphasises three important levels of self-categorisation: the superordinate level of human being (human identity), the intermediate level of social groups (social identity) and the subordinate level of interpersonal comparisons (personal identity). Moreover, as a function of the context, social categories may be salient and individuals see themselves and the others not on the basis of personal characteristics but as representatives of salient groups (depersonalisation process). However, functional antagonism principle (Hornsey 2008; Turner et al. 1987) posits that when a given level of self-categorisation becomes salient, the other levels are inhibited.

When individuals share the same salient social identity, they may no longer perform for their own sake, but on behalf of the group (James and Greenberg 1989). This may even lead to social labouring (Haslam 2004; van Dick, Tissington, and Hertel 2009; Worchel et al. 1998), in which individuals working as a group and for the group exhibit increased performance. Several studies have shown how salience of group membership may lead to improved performance. For example, Social Identity Cues such as group name (Alpha and Beta) and lab coats (Worchel et al. 1998; Study 3) are conducive to group salience in an intergroup context and improve group performance in a manual task.

Some specific features of Computer-Mediated Communication (CMC) – physical isolation and visual anonymity – may strengthen group processes related to group membership and performance. According to the Social Identity model of Deindividuation Effects (SIDE; Reicher, Spears, and Postmes 1995; Spears and Lea 1994), the scarcity of individuating information combined to relevant membership cues (e.g. the name of the group) lead to depersonalisation (Turner et al. 1987). Interlocutors cease to pay attention to individual

differences or personal characteristics of individuals, tend to reason on the basis of social categories and see themselves and others as prototypical group members. This cognitive effect fosters group influence, adherence to group norms (Postmes, Spears, and Lea 2000), social attraction between group members and in-group favouritism (e.g. Postmes, Spears, and Lea 1998). Although few studies have linked these cognitive effects to group performance, some findings indicate that anonymity may improve group identification in a collaborative task (Michinov, Michinov, and Toczek-Capelle 2004). Tanis and Postmes (2008, study 1) also found that individuals in anonymous dyadic computer-mediated communication experienced more satisfaction and considered their performance as higher, this effect being mediated by social identification. Similar results were found on objective performance (Tanis and Postmes 2008; study 2). In a recent study on brainwriting (Le Hénaff, Michinov, and Le Bohec 2018), anonymity of group members was manipulated through sticky notes (of different colours for each group member vs. same colour) used during the task. Following SIDE principles, results showed that participants generated more ideas in the anonymity condition when social identity was rendered salient through intergroup comparison.

The SIDE model was further extended by analysing the consequences of anonymity on perceived similarity within the in-group. In seminal SIDE studies, 'the operationalization of anonymity appears to confound two conceptually distinct factors – identifiability and similarity in presentation' (Lee 2004, 236). In this respect, avatars constitute a means to apply more accurately SIDE principles because they provide visual anonymity and mask idiosyncratic attributes of each member (lack of identifiability), while making it possible to manipulate the way each one is represented to the members of his/her group (variation of perceived similarity). Consistently, several studies have shown that similarity between avatars (i.e. identical appearance of avatars used by each group member, or clones) is conducive to group identification, both in intergroup (Kim 2011; Lee 2004) and intragroup contexts (Kim and Park 2011). For instance, keeping anonymity constant, Lee (2004) manipulated the appearance of avatars of group members to be identical or different in a task involving social dilemmas. When participants were interacting with identical avatars, they identified more to the group and exhibited greater conformity in an intergroup situation (students of different universities). In a later study, Kim (2011) demonstrated that people experience greater group identification when embodying identical avatars, even if the avatars differ from their actual self in terms of ethnicity. In group

work (van der Land et al. 2015), it was also shown that group members exhibit higher performance when they embody similar avatars designed to resemble everyone (avatars generated by morphing techniques). In other words, avatar similarity combined with the possibility for each one to recognise oneself lead to the greatest performance. However, avatar similarity also leads group members to perceive a threat to their uniqueness, which could produce psychological discomfort. Hence Kim and Park (2011) recommend seeking an appropriate balance between similarity and difference between group members' avatars. One way to achieve this can be to attribute different avatars to group members, but provide them with similar clothes.

In a recent study (Guegan et al. 2017), social identity cues were introduced on avatars' clothes as it could be implemented in various professional contexts (e.g. clothes in the colours and logo of a company, sport team jerseys). By perceiving themselves as members of a group rather than co-workers gathered together, individuals should be more likely to engage in online collaborative work. In this research, group performance and social identification were measured in face-to-face and virtual brainstorming settings, with or without social identity cues displayed on participants' or avatars' clothes. Traditional clothing of the participants' school was used as a means to convey meaningful social identity cues. The results show that the presence of social identity cues led to increased creative performance both in face-to-face and virtual settings. They also increased group identification, but only in the virtual environment.

In the present study, avatars will or will not display social identity cues on their clothes. Consistent with the SIDE principles, we hypothesise that:

Hypothesis H3a: Displaying social identity cues on avatars will increase performance;

Hypothesis H3b: This effect will be mediated by social identification.

Although speculative, we expect the effects of social identity to endure over time:

Hypothesis H4: previous exposure to social identity cues will increase performance in a subsequent session.

Moreover, in line with functional antagonism principle, we assume that:

Hypothesis H5: Personal identity effects and social identity effects will interact. However, the question as to which level (personal vs. social) will override the other when both individual and social identity cues are displayed at the same time remains open.

3. Method

3.1. Participants

Seventy-two final-year engineering students (6 women, 66 men, mean age = 23.6 years old; SD = 2.99) volunteered to take part in this study. They were arranged into 24 groups of three members, including 1 or 0 female student, to perform collective brainstorming tasks. They were awarded course credit for their participation.

All participants were students from a French school of engineering known for the strong social identity of its students. Traditional clothing includes a grey garb ('biaude') that students customise. This coat is intended to mask sociocultural origins of students and foster their *esprit de corps*, constituting 'the emblematic sign of their fraternity' (Cuche 1988, 52). We used virtual versions of these coats as social identity cues to be worn by participants' avatars.

3.2. Materials

We used Second Life for all conditions. Avatars were extracted from the material validated in previous research (Guegan et al. 2016). Creative avatars were selected among avatars resembling inventors (i.e. a creative figure for engineers) and perceived as the most creative and most likely to produce innovative ideas. Non-creative avatars were selected among those that had been validated as unrelated to the concept of creativity and not resembling inventors, but equivalent to inventor avatars in terms of attractiveness. For each condition, we selected three male avatars and a female one to be able to compose groups of either three male students or two male and one female student – which corresponds to the 15% proportion of female students in the engineering school.

To provide social identity cues to these avatars, we used virtual customised coats that had been validated in a previous study (Guegan et al. 2017). Figure 1 shows the collection of avatars used in the four conditions.

3.3. Procedure

Group members were distributed in three isolated boxes equipped with computers and joined a virtual brainstorming session online. Avatar attribution within a group was randomised but accounted for users' sex: male participants were randomly attributed to a male avatar and female participants were attributed to the female avatar. To preserve anonymity, the participants

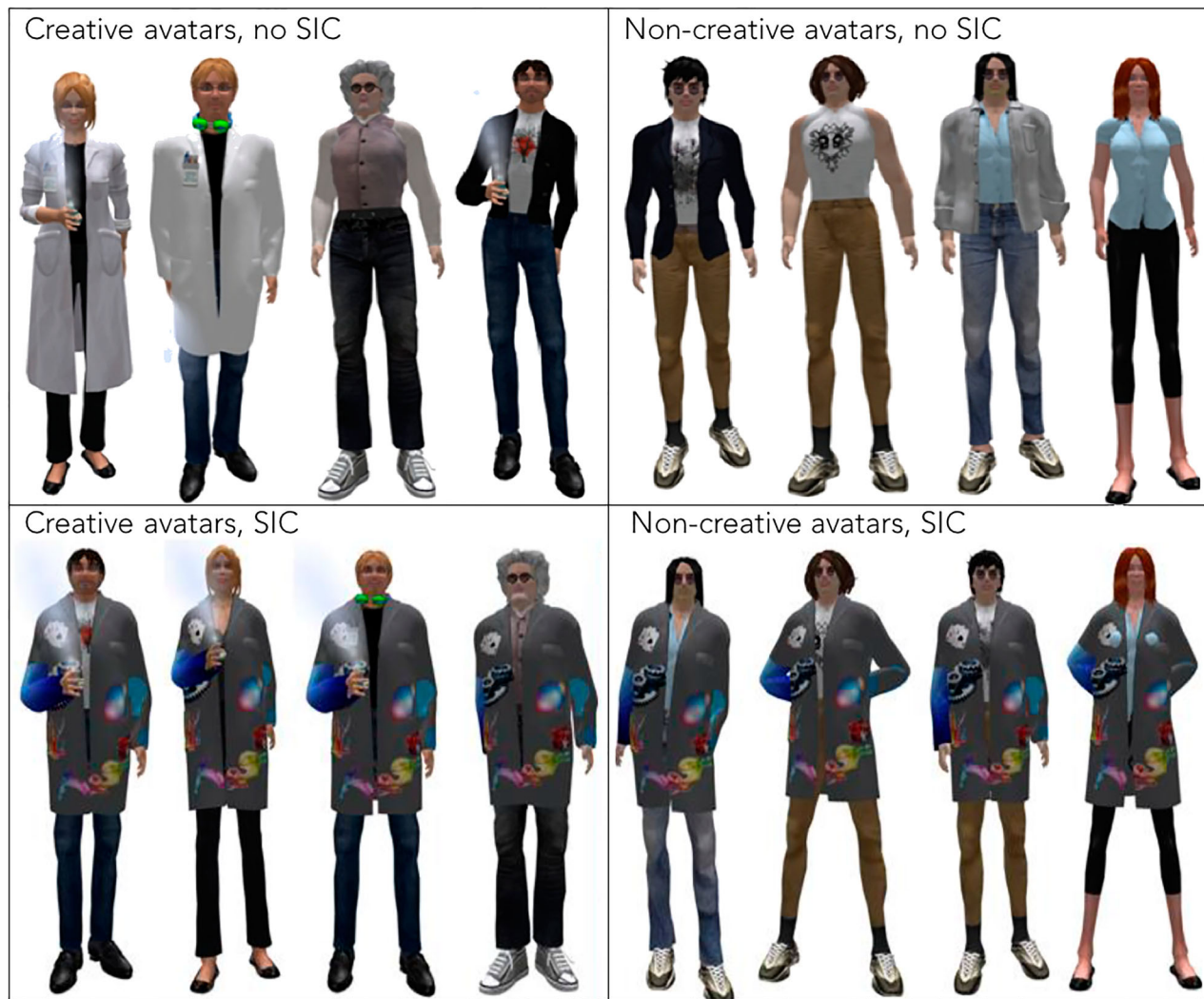


Figure 1. The collection of avatars differing in individual identity cues (creative vs. non-creative) and social identity cues (SIC vs. no SIC).

were not aware of who they were working with: they were welcomed in different parts of the laboratory and taken one by one to their box. The virtual session began with a familiarisation phase during which the participants had to take 1–2 minutes to observe their avatar in detail. They were also trained to move in the virtual room and communicate with each other using Second Life instant messaging system. By so doing, they also discovered the avatars of the other group members.

Participants were then presented with Osborn's (1953) brainstorming rules (focus on quantity, withhold criticism, welcome unusual ideas, combine and improve ideas) and asked to perform two successive 15-min brainstorming sessions: the first one in Second Life, using their avatars, and the second one face-to-face (to this end, they were invited to leave their individual boxes and gather around a table). The two brainstorming tasks concerned new transportation means: Task A 'imagine a crazy solution for travelling on snow, sand or

water' and Task B 'imagine a silent flying public transportation for the future'. These tasks were presented in a counterbalanced order.

After each brainstorming, the participants filled out a questionnaire measuring their perceptions of the session. The whole experiment lasted 50–55 minutes. They were then debriefed, which allowed us to check that they had not understood the goal of the research.

3.4. Measures

To test our hypotheses, we collected the following variables (all questionnaire items presented with 7-point Likert-type scales):

- Control measure: Two items were introduced to assess presence during the virtual brainstorming (*I consider that I embodied my avatar; I consider that I was in the same room as my avatar*; $r = 0.43$, $p < .001$).

- Mediating variables:
 - The perception of the creative identity of avatars was collected using two items (*My avatar looked like an inventor; My avatar could give innovative ideas*; $r = 0.51$, $p < .001$).
 - Social identification was measured using the Single Item Social Identification (Postmes, Haslam, and Jans 2013): *I identified with my group*.
- Dependent variable: Creativity was assessed through two measures:
 - Fluency, which corresponds to the number of ideas generated by each participant, after cleaning the corpus from off-task entries (i.e. discussions between participants that do not contain ideas related to the brainstorming task) and from duplicates in each participant's production.
 - Uniqueness, which is an assessment of originality corresponding to the number of unique ideas with regard to all the ideas proposed by all the groups. To find out unique ideas, semantic categories were manually annotated by two judges with an inter-judge agreement of 78.6%. Uniqueness was then decided within each semantic category, a given idea being considered as unique when appearing only once in its semantic category.

4. Results

To test our hypotheses, we performed 2 (Avatar: Creative vs. Non-creative) \times 2 (Social Identity Cues (SIC): Without vs. With) ANCOVAs¹ with Sex as a covariate, as well as stepwise mediation analyses (Baron and Kenny 1986).

4.1. Control measure

The score of presence proved to be constant in all conditions: No main effect of Avatar ($F(1, 67) = 0.564$, $p = .455$, $\eta^2p = .008$), no main effect of SIC ($F(1, 67) = 0.264$, $p = .609$, $\eta^2p = .004$) and no interaction effect ($F(1, 67) = 0.362$, $p = .549$, $\eta^2p = .005$).

4.2. Effects of avatars' individual identity cues

Avatars' appearance significantly affected the perception of their creative identity ($F(1, 67) = 9.50$, $p = .003$, $\eta^2p = .124$) with creative avatars (inventors) perceived as more creative ($M = 4.47$, $SD = 1.29$) than non-creative avatars ($M = 3.48$, $SD = 1.51$). Conversely, Avatars' appearance did not influence social identification ($F(1, 67) = 0.007$, $p = .932$, $\eta^2p = .000$; $M = 4.97$, $SD = 1.68$ with creative avatars; $M = 5.0$, $SD = 1.41$ with non-creative avatars).

The main effect of Avatars on fluency proved significant ($F(1, 67) = 6.74$, $p = .01$, $\eta^2p = .091$): participants using creative avatars were more fluent ($M = 12.27$, $SD = 6.64$) than those using non-creative ones ($M = 8.97$, $SD = 4.25$), which confirms Hypothesis H1a. The mediation analysis (Figure 2) shows that the presence of avatars' creative cues increased the perception of their creative identity ($\beta = 0.99$, $t = 2.97$, $p = .004$) but this perception did not increase fluency ($\beta = 0.16$, $t = 0.336$, $p = .738$). The effect of avatar's individual identity cues on fluency is therefore not mediated by perception, which invalidates Hypothesis H1b.

4.3. Effects of social identity cues (SIC)

The main effect of SIC on social identification proved significant ($F(1, 67) = 22.21$, $p < .001$, $\eta^2p = .249$) with higher identification to the group with SIC ($M = 5.75$, $SD = 1.13$) than without SIC ($M = 4.22$, $SD = 1.53$). Conversely, there was no main effect of SIC on the perception of the creative identity of avatars ($F(1, 67) = 0.83$, $p = .365$, $\eta^2p = .012$; $M = 3.83$, $SD = 1.41$ with SIC; $M = 4.13$, $SD = 1.56$ without SIC).

Contrary to expectations, fluency was not significantly affected by SIC ($F(1, 67) = 0.297$, $p = .887$, $\eta^2p = .004$; $M = 10.28$, $SD = 3.35$ with SIC, $M = 10.97$, $SD = 7.51$ without SIC), which invalidates Hypotheses H3a and H3b. Although this total effect was nonsignificant, we nonetheless examined the indirect effect through social identification (Fig. 3) in order to better inform our results. The analysis confirms that the presence of SIC increased social identification ($\beta = 1.53$, $t = 4.81$, $p < .001$) but surprisingly, social identification decreased

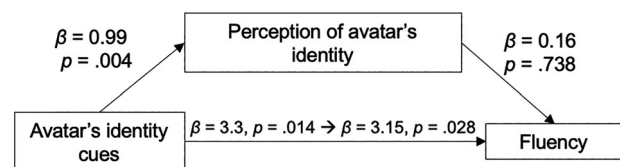


Figure 2. Results of the mediation analysis between avatar's individual identity cues and performance.

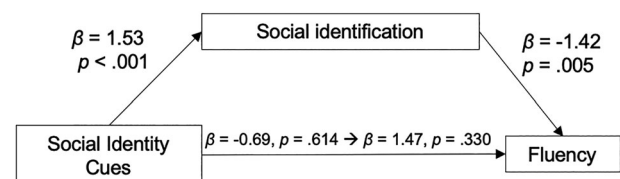


Figure 3. Results of the mediation analysis between SIC and performance.

fluency ($\beta = -1.42$, $t = -2.89$, $p = .005$). Additional Sobel analysis confirmed that the indirect effect of SIC on fluency through social identification is significant and negative ($z = -2.44$, $p = .01$).

4.4. Interaction between individual and social identity cues

The interaction between Avatars and SIC on the perception of the creative identity of avatars proved significant ($F(1, 67) = 7.06$, $p = .01$, $\eta^2p = .095$): the difference between creative and non-creative avatars was significant in the absence of SIC ($F(1, 67) = 16.47$, $p < .001$, $\eta^2p = .197$), but not in the presence of SIC ($F(1, 67) = 0.08$, $p = .77$, $\eta^2p = .001$). However, no interaction effect between Avatars and SIC appeared on social identification ($F(1, 67) = 0.014$, $p = .905$, $\eta^2p = .000$).

The interaction between Avatars and SIC on fluency (Figure 4) appeared as significant ($F(1, 67) = 6.048$, $p = .017$, $\eta^2p = .083$) and showed that the effect of Avatars was significant without SIC ($F(1, 67) = 12.77$, $p < .001$, $\eta^2p = .160$; $M = 14.11$, $SD = 8.50$ for creative avatars; $M = 7.83$, $SD = 4.79$ for non-creative avatars) but not with SIC ($F(1, 67) = 0.008$, $p = .93$, $\eta^2p = .000$; $M = 10.44$, $SD = 3.38$ for creative avatars; $M = 10.11$, $SD = 3.41$ for non-creative avatars). Finally, the effect of SIC was significant for creative avatars ($F(1, 67) = 4.53$, $p = .037$, $\eta^2p = .063$) but not for non-creative ones ($F(1, 67) = 1.84$, $p = .179$, $\eta^2p = .027$). This pattern of results is in line with Hypothesis H5.

4.5. Persistence over time

The analysis of the second (face-to-face) brainstorming shows that social identification was not influenced by

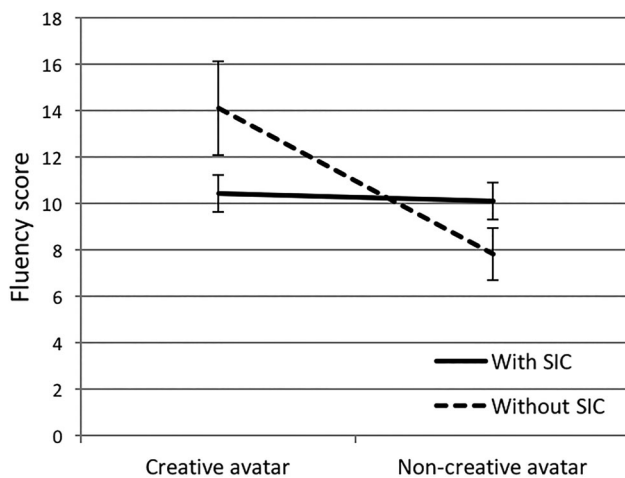


Figure 4. Interaction between individual (creative vs. non-creative avatar) and Social Identity Cues (with vs. without SIC) on creative performance (fluency score).

the Avatar used in the first brainstorming ($F(1, 67) = 2.186$, $p = .144$, $\eta^2p = .032$; $M = 5.66$, $SD = 1.51$ for those who had a creative avatar, $M = 5.22$, $SD = 0.92$ for those who had a non-creative avatar). Social identification in the second brainstorming was not affected either by the presence of SIC in the virtual brainstorming ($F(1, 67) = 0.137$, $p = .713$, $\eta^2p = .002$; $M = 5.39$, $SD = 1.27$ after exposure to virtual SIC, $M = 5.5$, $SD = 1.28$ without virtual SIC), and no interaction effect was observed ($F(1, 67) = 0.006$, $p = .937$, $\eta^2p = .000$).

Fluency scores in the second (face-to-face) brainstorming shows a main effect of the Avatar used in the first brainstorming ($F(1, 67) = 4.74$, $p = .033$, $\eta^2p = .066$): participants who had worked with creative avatars were more fluent subsequently ($M = 11.67$, $SD = 5.05$) than participants who had worked with non-creative avatars ($M = 9.27$, $SD = 4.28$). This effect confirms Hypothesis H2. However, the presence of SIC in the first brainstorming did not affect subsequent fluency scores ($F(1, 67) = 0.742$, $p = .392$, $\eta^2p = .011$; $M = 10.94$, $SD = 3.89$ with SIC; $M = 10$, $SD = 5.59$ without SIC), which invalidates Hypothesis H4. Finally, there was no interaction effect between Avatars and SIC on subsequent fluency ($F(1, 67) = 2.737$, $p = .103$, $\eta^2p = .039$).

4.6. Effects on uniqueness of ideas

Results on uniqueness were analysed separately from the other dependent variables, as this measure is collected at the group, and not the individual, level: uniqueness resulting from idea sharing in the group and cross-association of ideas, it would be unfair with regard to the brainstorming paradigm to attribute a unique idea to a specific member. Moreover, unique ideas being rather scarce, distributing them to individuals would result in many missing data and undermine the analysis.

We ran a 2 (Avatar: Creative vs. Non-creative) \times 2 (Social Identity Cues (SIC): Without vs. With) \times 2 (Time: T1 vs. T2) ANCOVA with Sex balance in groups as a covariate. The main effect of Avatars proved significant ($F(1, 19) = 7.73$, $p = 0.011$, $\eta^2p = 0.289$) with uniqueness scores higher for groups with creative avatars ($M = 7.37$, $SD = 4.07$) than for groups without creative avatars ($M = 4.54$, $SD = 2.79$). This result supports H1a.

The main effect of SIC was not significant ($F(1, 19) = 2.95$, $p = 0.102$, $\eta^2p = 0.134$) with similar uniqueness scores between the condition with SIC ($M = 5.08$, $SD = 2.64$) and without SIC ($M = 6.83$, $SD = 4.48$). This result invalidates H3a.

The interaction effect between Avatar and SIC was significant ($F(1, 19) = 5.07$, $p = 0.03$, $\eta^2p = 0.211$), showing that the effect of Avatars on uniqueness was significant without SIC ($F(1, 19) = 2.64$, $p = .002$, $\eta^2p = .399$)

but not with SIC ($F(1, 19) = 0.116, p = .74, \eta^2p = .006$). Finally, the effect of SIC was significant for creative avatars ($F(1, 19) = 7.90, p = .011, \eta^2p = .294$) but not for non-creative ones ($F(1, 19) = 0.16, p = .69, \eta^2p = .008$). This pattern of results, which is very similar to that on fluency, supports Hypothesis H5.

5. Discussion

The results regarding the effects of avatars' individual identity cues on performance to the brainstorming replicate previous findings on the Proteus effect (Yee and Bailenson 2007), in particular in its creative form (Guegan et al. 2016). Participants brainstorming with a creative avatar (inventor) were significantly more fluent and produced more unique ideas than participants with a non-creative avatar. However, the hypothesised mediation by the perception of avatars' creative identity was not confirmed. Although creative avatars were perceived as more creative, this change in perception did not account for the increase in performance to the creative task. This result opens several avenues for future investigations. First of all, it is possible that the conscious perception of avatars' traits is not the main factor explaining their behavioural impacts. In this respect, our results support Peña, Hancock, and Merola's (2009) view that 'Avatars had implicit, automatic effects on cognition, as participants were not aware of the effect of their avatar' (p. 851). Furthermore, considering the theoretical framework of self-perception, our mediation hypothesis may not have fully accounted for the underlying process of the Proteus effect. A self-assessment of one's own creative capacities could have completed the path between avatar's appearance and behavioural outcomes: the effect of avatar appearance on creative performance may be mediated by the perception of avatar's creative traits, which in turn may induce a perception of the self as creative (as an external observer may expect). Testing this serial mediation hypothesis in future research with a measure of self-perception in addition to the measure of avatars' traits would better fit the self-perception-based theory of Proteus effect. Other avenues, which have not been considered here, may also be identified.

The results also showed that avatars' individual identity cues influenced performance only when social identity cues were absent. Creative avatars were perceived as such, and led to higher creative performance only when they did not exhibit social identity cues. This finding is consistent with the notion that sharing common physical characteristics enhances social categorisation and therefore assimilation among group members (Oakes, Haslam, and Turner 1994; Worchel et al. 1998). Two

alternative explanations may account for our results. Firstly, the consequences of categorisation may explain the moderating effect of social identity cues because both kinds of avatars (creative and non-creative) were likely to be categorised at a higher level of inclusion (members of the in-group). With inventor avatars wearing social identity cues, the social self as member of the school may be more salient than the personal self as inventor. Because the social self is more inclusive than personal self, and given the functional antagonism principle, the creative traits of the avatars may have been inhibited. The second explanation relies on avatar similarity (e.g. Kim 2011; Lee 2004) that may have been enhanced by the social identity cues we used (grey garb). This coat may have partly hindered inventors' prototypical traits, and at the same time provided more homogeneous appearance for all avatars. Overshadowing personal traits may have altered the Proteus effect while emphasising perceived similarity between avatars, which was found to increase social identification (Kim 2011; Kim and Park 2011; Lee 2004).

The display of social identity cues on avatars proved to increase social identification to the group. However, social identification did not predict performance to the brainstorming task and participants were not more fluent with than without social identity cues. Moreover, the analysis of the mediation effect of social cues on performance through social identification showed that social identification had a negative impact on brainstorming performance. This result is surprising because it is generally acknowledged that the presence of social identity cues and/or avatar similarity, by making the group more salient, should have a positive influence on performance or on social influence in group decision making (Lee 2004; Kim, 2011; van der Land et al. 2015; Worchel et al. 1998). The present study differs from the previous ones in that it used preexisting social identity cues, which were meaningful to the experimental population. By so doing, we intended to observe the effects of more ecological, and possibly more powerful, social cues. The unexpected effect we observed may be related to the particular meaning of the grey coat. A more accurate analysis of its meaning reveals that it is seen as a symbol of technical and manufacturing skills of engineers from this school (Cuhe 1988), which is not related to creativity in any way. We, therefore, speculate that the nature of social identity cues and their meaning may impact their effect on performance. In the literature, social identity cues are generally seen as an absolute means to induce depersonalisation, foster group identification and increase collective performance: whatever these social identity cues, they are assumed to influence self-categorisation process and improve

group performance. However, the present study questions the impact of the nature and meaning of social identity cues on this general process. If students from our population had had social identity cues symbolising the creative skills of their group, using them in brainstorming may have increased creative performance and therefore produced a different pattern of results. These considerations would imply that improving group performance does not rely only on providing social identity cues, but rather on finding the best fit between task demand and the facet of social identity to activate with relevant cues. Other explanations remain possible, for example involving the influence of personality traits (such as Conscientiousness) on the proneness to identify with a social group (Bizumic, Reynolds, and Meyers 2012).

Finally, consistent with our hypothesis and with previous research on the Proteus effect (Rosenberg, Baughman, and Bailenson 2013; Yee, Bailenson, and Ducheneaut 2009; Yoon and Vargas 2014; Guegan et al. 2016), the effect of avatars endured over time and fluency in the subsequent face-to-face brainstorming was higher for participants who had embodied creative avatars just before.

6. Conclusion

An original feature of the present study was to use meaningful preexisting social identity cues instead of laboratory-based ad-hoc ones. This protocol enabled us to question the impact of their meaning beyond their mere presence. To further investigate this issue, one may manipulate the nature of social identity cues while keeping their presence constant. For example in the population we studied, several social identity cues exist and in particular one that conveys a totally different meaning from the grey coat: engineering students also have special costumes resembling officers' uniforms that they wear for ceremonies. These latter cues symbolise social and managerial skills of engineers (Cuche 1988). Hence to understand the role of their meaning with regard to the task at hand, these two social identity cues (grey garb vs. ceremonial costume) could be crossed with two different tasks (technical, e.g. functional analysis of a system, vs. managerial, e.g. project and resource planning) to examine a potential interaction effect on performance.

The fact that we used meaningful preexisting social identity cues makes the study more ecological than ad-hoc laboratory-based groups. In this respect, the results are more likely to be extrapolated to real-life groups, even if they are obviously circumscribed to a specific population. The specific population can be

considered a limitation to the study, but it was a unique opportunity to analyse social identity processes in greater depth, and to highlight the potential importance of the meaning of social identity cues with regard to task demands.

In accordance with recent lines of research regarding the influence of avatars on behaviour, the present study showed that the manipulation of both individual and social cues on avatars is likely to impact social identification and performance in a collective activity. Both Proteus and SIDE effects operated in the study results: embodying a creative avatar improved performance, but providing social identity cues to this avatar overrode this effect by re-configuring the perception of the avatar. Depending on the experimental conditions, avatars activated two facets of the self which interfered with one another and may have been functionally antagonistic. The personal identity cues we used (looking like an inventor) were positive and consistent with the task at hand, therefore leading to higher performance. In the future, we should strive to find social identity cues that are similarly positive and consistent with a creative task, without hindering personal identity cues. Moreover, we may increase the potential of social identity effects by finding a relevant outgroup in the creative field.

The present study holds several limitations that could be overcome in future experiments: firstly, despite significant increase when social identity cues are present, we observed high scores of social identification in all conditions. This may be due to the relative homogeneity of avatars in the conditions without social identity cues (group of inventors, group of casual young people), which may have provided a basic support for categorization. Moreover, as previously mentioned, the social identity cues we used may have overshadowed inventors' prototypical traits. Future research should strive to disentangle the graphical implementation of individual and social cues, for example by using the logo of a company or of a school as social identity cues. Finally, although we did not collect participants' personality profile, it is possible that interindividual differences moderate the effects of avatars, in particular with regard to personal identity processes (i.e. Proteus effect). When personal identity is activated, we may observe a polarisation on idiosyncratic behaviour and attitudes, whereas when social identity is salient, depersonalised individuals may be influenced by local group norms.

Our results may have several organisational and social implications in real-life work environments. First of all, they highlight the potential usefulness of virtual environments for stimulating creative activities. Many companies or consulting agencies already use

creative rooms: avatar-mediated creativity platforms could be a complementary/alternative and cost-effective solution in the creative process. Moreover, collaborating through a virtual world opens up the possibility to seamlessly integrate geographically distant participants, which is a growing demand for extended enterprises. Beyond distributed work, we may underline that the effects we observed in this research could also benefit to teams of people who are used to working together face to face. Indeed, temporarily masking group members' identities through avatars is likely to create new dynamics, which could be very useful to address innovation problems with a fresh viewpoint and/or change routines and habits among regular co-workers (e.g. hierarchical asymmetry, interpersonal relations, leadership). The fact that the effects of creative avatars persist during a subsequent offline session could also give rise to the design of more effective creativity workshops alternating virtual and face-to-face phases. Finally, organisational identity is recognised as an important leadership tool: effective leaders are sometimes characterised as 'entrepreneurs of identity' (Reicher and Hopkins 2001), whose primary project is to create, coordinate and control a shared vision of 'who we are' and 'what we want to be'. In this respect, using avatars wearing social identity cues displaying the name, logo, and/or motto of an organisation may increase social identification and support managerial efforts to build a common, shared identity fostering team performance.

To the best of our knowledge, the present study may be the first one to integrate Proteus and SIDE effects, and one of the few which used meaningful social identity cues to activate a shared identity (Peña et al. 2017; Guegan et al. 2017). This study also pushes forward the issue of the role of social identity on group performance by suggesting that the congruence between the facet activated by cues and the task to achieve may be worth investigating. To this end, both the nature and the shape of social identity cues should be considered to disambiguate the processes at hand. Further research is now required to uncover the whole complexity of individual and social identity effects that could be implemented into avatars to increase individual and collective performance.

Note

1. Part of the present dataset has previously been used to show the effect of avatar appearance on creativity (Guegan et al. 2016) and the effect of SIC on creativity (Guegan et al. 2017). All in all, 62.6% of the data used in the present study have never been published.

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