Computers in Human Behavior 77 (2017) 140–147

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Full length article

Social identity cues to improve creativity and identification in face-to-face and virtual groups

Jérôme Guegan [a, b, *], Frédéric Segonds [b], Jessy Barré [b], Nicolas Maranzana [b], Fabrice Mantelet [b], Stéphanie Buisine [b, c]

[a] Paris Descartes University, Institute of Psychology, LATI, 71 avenue Edouard Vaillant, 92100 Boulogne Billancourt, France
[b] Arts et Métiers ParisTech, LCPI, 151 boulevard de l'Hôpital, 75013, Paris, France
[c] CESI, LINEACT, 93 boulevard de la Seine, 92000, Nanterre, France

ARTICLE INFO

Article history:
Received 21 April 2017
Received in revised form
24 July 2017
Accepted 29 August 2017
Available online 29 August 2017

Keywords:
Group identity
Computer-mediated communication
Brainstorming
Avatars
Creativity

ABSTRACT

This research draws on the social identity approach to investigate group performance in face-to-face and virtual brainstorming settings. In particular, we display Social Identity Cues (SIC) on participants or on avatars to foster group membership. We compare four conditions in a factorial design: Brainstorming in Face-to-face or Virtual setting, With or Without SIC. Seventy-two students belonging to a population with a strong social identity participated in the experiment, using their traditional clothing as SIC. The results show that the presence of SIC led to increased creative performance both in face-to-face and virtual settings. SIC also increased group identification, but only in the virtual environment. These results highlight the potential of avatars to support teamwork in a meaningful way.

Technological and organizational evolutions shape a new reality of teamwork: in a globalized world, distributed collaborators have to work together and achieve high performance (Gilson, Maynard, Young, Vartiainen, & Hakonen, 2015). Virtual environments may constitute a promising tool to support remote collaboration, as long as they foster engagement, efficiency and provide meaning to teamwork. The present research takes a social identity approach to investigate group identification and performance in a creative task.

Creativity is the ability to produce work that is both novel and appropriate (Sternberg, 1998). One of the most classical creative methods is group brainstorming (Osborn, 1953), which enables the group to benefit from creativity levers, such as *cognitive stimulation* (Dugosh & Paulus, 2005; Nijstad, Stroebe, & Lodewijkx, 2002) or *social comparison* (Dugosh & Paulus, 2005; Michinov & Primois, 2005). However, brainstorming also suffers from several limitations such as *social loafing* (Karau & Williams, 1993; Serva & Fuller, 1997) in which some participants tend to under-contribute when they are in group. This is particularly the case of computer-mediated contexts such as electronic brainstorming.

In electronic brainstorming, participants generate ideas on computers networked together. This was shown to increase idea generation with regard to spoken brainstorming (Dennis & Valacich, 1993; Gallupe, Bastianutti, & Cooper, 1991; Gallupe et al., 1992; Kerr & Murthy, 2004; Valacich, Paranka, George, & Nunamaker, 1993), in particular for large groups (DeRosa, Smith, & Hantula, 2007; Gallupe et al., 1992; Paulus, Kohn, Arditti, & Korde, 2013). In electronic brainstorming, participants can contribute anonymously (i.e., ideas are collected without being associated to each one's name or pseudonym), which further improves idea production (Connolly, Jessup, & Valacich, 1990). Moreover, with regard to brainwriting (idea generation on post-it notes), electronic brainstorming supports higher attention to others' ideas (Michinov, 2012). However, electronic brainstorming provides low levels in perceived importance of group membership and sense of belonging (McKinlay, Procter, & Dunnett, 1999). This analysis is consistent with early conceptions of computer-mediated communication (Kiesler, Siegel, & McGuire, 1984; Sproull & Kiesler, 1986), which considered that the reduction of social cues decreases social influence and remote collaborative work (Straus & McGrath, 1994).

To overcome these limitations, avatars (i.e., digital self-representations) may provide a means of introducing visually

* Corresponding author. Paris Descartes University, Institute of Psychology, LATI, 71 avenue Edouard Vaillant, 92100 Boulogne Billancourt, France.
E-mail address: jerome.guegan@parisdescartes.fr (J. Guegan).

http://dx.doi.org/10.1016/j.chb.2017.08.043
0747-5632/

perceptible social cues and increase the motivation of participants to work together and combine their efforts. This could be explained in the social identity perspective (Tajfel & Turner, 1979), according to which social identity is part of the self-concept linked to group membership: depending on the situation, individuals feel more or less part of a given social group. In the current study, we use avatars to introduce Social Identity Cues (SIC, e.g., symbols of group membership, uniforms; Worchel, Rothgerber, Day, Hart, & Butemeyer, 1998) and switch from personal to social identity. Although avatars in virtual environments have recently been used in creativity research (Buisine, Guegan, Barré, Segonds, & Aoussat, 2016; Guegan, Buisine, Mantelet, Maranzana, & Segonds, 2016; de Rooij, van der Land, & van Erp, 2017), they were never used for improving brainstorming through a social identity perspective. To do so, SIC should be immediately perceptible in the situational context to enhance social identity salience, for example when group members wear the same uniform or when they embody avatars showing high visual similarity. Because they are expected to stimulate performance both in face-to-face and in computer-mediated context, our aim is also to compare groupwork in virtual and face-to-face settings, while keeping SIC constant.

Given the pervasiveness of computer-mediated communication and virtual teams (Gilson et al., 2015), understanding how to foster social identity processes in such contexts may be of importance to the design of more efficient organizational and technological settings. The present research aims to stimulate group creativity in a meaningful way, through highlighting what group members have in common.

1. Theoretical background

1.1. Social identity perspective and group performance

Social Identity Theory (Tajfel & Turner, 1979) posits that identity varies along a continuum referring to interpersonal behavior on one side ("I" vs. "you"; personal identity) and intergroup behavior on the other ("us" vs. "them"; social identity). Social identity relies on common features that are shared by the 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 favoritism) 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, Billig, Bundy, & Flament, 1971).

As an extension of the social identity theory, Self-Categorization Theory (SCT; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) suggests that, depending on the situation, the individual will feel more or less part of a given social category. SCT views the self as a variable, multi-faceted cognitive structure (i.e., different social groups organized in a system of inclusion levels). Social categories are internalized to define the self by combining individual components with elements of a salient category in a given context. As a function of the context (*accessibility* and *fit*; Turner et al., 1987; Turner, Oakes, Haslam, & McGarty, 1994), 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 (*depersonalization process*; Turner et al., 1987). Thus, in line with SCT, a common characteristic/appearance among group members (e.g., group name, uniform) is conducive to the activation of a social identity by enhancing the process of categorization within the in-group (Oakes, Haslam, & Turner, 1994). Moreover, because groups exist in relation to other groups, the presence of an out-group (allowing intergroup comparison) is important to define group boundaries and to enhance social identity salience (e.g., Haslam & Turner, 1992; Wagner & Ward, 1993). Therefore, the characteristics of an individual hinge upon personal identity (and idiosyncratic attributes) and multiple social identities.

These propositions highlight some of the processes related to group performance. Indeed, meaningful membership and social identity salience may increase the motivation of people to work together and combine their individual work efforts. Because depersonalized individuals share the same salient social identity, they may no longer perform for their own sake, but on behalf of the group (James & Greenberg, 1989). This may even lead to *social laboring* (Haslam, 2004; Worchel et al., 1998; van Dick, Tissington, & Hertel, 2009), 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. However, interestingly, the same SIC produce reverse effects in the absence of out-group and decrease group performance (Worchel et al., 1998; Study 3). More recently, van Dick, Stellmacher, Wagner, Lemmer, and Tissington (2009, study 1) manipulated social identity salience in school-teachers performing a brainstorming. High group salience (information that group performance would be compared to another group) leaded to better creative performance than low group salience conditions.

Based on these results, it is not surprising that laboratory-based or transient groups are less efficient than everyday work groups (e.g., Erez & Somech, 1996), where people have high meaning group memberships linked to relevant social identities. Leading people to perceive themselves primarily as members of a group is therefore a relevant means to improve group performance. The present study intends to extend previous literature in several ways. First, we will use meaningful preexisting Social Identity Cues instead of ad-hoc laboratory SIC. Moreover, as Worchel et al. (1998) have shown that ad-hoc SIC improve group performance only in an intergroup context, we will focus on the effects of meaningful SIC by themselves, which requires disentangling them from the implicit or explicit presence of out-group. Finally, we will investigate whether these effects are similar in face-to-face or in a virtual setting.

1.2. Computer mediated communication and social identity

Following a social identity perspective, some specific features of Computer-Mediated Communication (CMC) - physical isolation and visual anonymity - may strengthen group processes related to group membership and performance. CMC introduce the possibility to communicate in technical anonymity (when identifying information are removed from any material exchanged) and social anonymity (perception of unidentifiability; Hayne & Rice, 1997). Indeed, the *Social Identity Model of Deindividuation Effects* (SIDE; Reicher, Spears, & Postmes, 1995; Spears & Lea, 1994) posits that the scarcity of individuating information combined to relevant membership cues (e.g., the name of the group) may lead to depersonalization (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, & Lea, 2000), social attraction between group members and in-group favoritism (e.g., Postmes, Spears, & 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, & 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 & Postmes, 2008; study 2). Likewise, anonymity in a situation of social identity salience may improve performance in computer-mediated learning environment (Le Hénaff, Michinov, Le Bohec, & Delaval, 2015).

The SIDE model was further extended by analyzing the consequences of anonymity on perceived similarity within the in-group. Indeed, in seminal SIDE studies, "the operationalization of anonymity appears to confound two conceptually distinct factors – identifiability and similarity in presentation" (Lee, 2004, p. 236). 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 possible to manipulate the way each one is represented to the members of his/her group (variation of perceived similarity). In line with this, 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 context (Kim & 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 groupwork (van der Land, Schouten, Feldberg, Huysman, & van den Hooff, 2015), it was also shown that group members exhibit higher performance when they embody similar avatars designed to resemble every one (avatars generated by morphing techniques). In other words, avatar similarity combined to the possibility for each one to recognize oneself lead to the greatest performance. However, avatar similarity also leads group members to perceive a threat to their uniqueness, which could lead to psychological discomfort. Hence high visual similarity may have a negative influence on group identity. To mitigate this, an appropriate balance between similarity and difference between avatars should be sought (Kim & Park, 2011).

Consistently, our purpose is to implement relevant Social Identity Cues on avatars rather than using identical avatars. A computer-mediated group of avatars that share similar SIC could provide the best combination between member-avatar similarity and group visual similarity, which are both important to performance (van der Land et al., 2015). SIC enable participants to perceive the resemblance between themselves and their avatar. Most importantly for the goal of this study, they also enable group members to perceive their shared identity while minimizing threat to uniqueness. Unlike most of avatars-based SIDE studies, which used 2D non-animated avatars (e.g., Kim, 2011; Lee, 2004; van der Land et al., 2015), we use animated avatars in a real-time full 3D virtual world, which remain rare (e.g., Peña et al., 2017) despites their ecological validity. Such environments, especially among the most popular online games (e.g., World of Warcraft), provide many possibilities for customization of avatars and configuration of identity cues that may enhance identification with the group (group name, costumes, collective symbols) and introduce a social dimension into the game (Guegan, Moliner, & Buisine, 2015). Finally, the investigation of the influence of social identity on group brainstorming is original with regard to the literature in the domain.

2. Hypotheses

The current study aims to analyze the effect of visual cues of social identity on group performance in brainstorming. As seen above, by perceiving themselves as members of a group rather than co-workers who are "gathered together", individuals should be more likely to engage in collaborative work. Therefore we will examine the effect of SIC in real and virtual settings, and hypothesize that performance will increase in both situations when SIC are present (Hypothesis H1). Considering the proposals of the SIDE model, the effect of SIC should even be stronger when they are provided in a context of anonymity (i.e., on avatars in the virtual environment) than in face-to-face (i.e., on the actual clothes worn by the participants) (Hypothesis 2).

To test these hypotheses, we designed two identity salience conditions (with vs. without SIC) and two environments (face-to-face vs. virtual). This factorial design results in four experimental conditions: (1) a control condition without SIC in a face-to-face setting, (2) group members wearing SIC in face-to-face, (3) avatars without particular SIC in a virtual environment, and (4) avatars wearing SIC in a virtual environment.

3. Method

3.1. Participants and context

Seventy-two final-year engineering students (15 women, 57 men, mean age = 22.7 years old; $SD = 1.9$) 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 rewarded course credit for their participation.

All participants were students from ENSAM (École Nationale Supérieure d'Arts et Métiers), which is a French school of engineering known for the strong social identity of its students. This is a prestigious school, which has trained over 85,000 engineers since its foundation in 1780. Students and alumni of the school call themselves *Gadzarts* (in the remainder of the article, we use the term "ingroup" to refer to *Gadzarts*), which means "*Gars des Arts*" (i.e., "Guys from the Arts", "the Arts" being the school's short name). *Gadzarts* are organized in an association and perpetuate their own traditions and folklore, which comprise special clothing, language, songs, legends, related symbolism, and ceremonials. All these items reveal a strong and positive social identity. Traditional clothing includes a gray *biaude* (see Fig. 1, left), which is a sort of blouse that

Fig. 1. Example of a real customized coat (left) and a virtual one for avatars (right).

students have to customize. This coat is intended to mask socio-cultural origins of students and foster their *esprit de corps*, constituting "the emblematic sign of their fraternity" (Cuche, 1988, p. 52). In the present study, we used these coats as SIC for this population of engineering students (see Fig. 1).

3.2. Material

We used Second Life to create the virtual conditions. Avatars were extracted from the material of previous avatar research, in which a collection of avatars had been evaluated by 114 engineering students (Guegan et al., 2016). These judges had to assess each avatar along five items (e.g., *This character is attractive*; *This character could give innovative ideas*) or perform direct pairwise comparisons between avatars to choose the one who resembles most to an inventor (i.e., a creative figure for engineers). For the present study, we selected avatars that had been validated as unrelated to the concept of creativity and not resembling an inventor. Hence the avatars we used were not expected to be perceived as creative characters. We selected three male and one female avatars 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 ENSAM.

To provide a SIC to these avatars, we asked a research assistant belonging to the ingroup of *Gadzart* to design a virtual customized coat. He provided us with several proposals, and the final design was selected on the basis of the recommendations of 4 alumni members of the ingroup who were interviewed for the sake of the study. They commented on the shape, length, texture and realism of the coats. The final design was unanimously recognized as a *biaude* and likely to activate the target social identity.

3.3. Research design

In line with Hypotheses 1 and 2, we studied the performance of brainstorming groups in 2 (SIC: without vs. with) x 2 (Setting: face-to-face vs. virtual) brainstorming conditions (between-subject variables): in the face-to-face setting without SIC (Control condition, see Fig. 2 top left panel), in the face-to-face setting wearing their coat (Real + SIC condition, see Fig. 2 top right panel), in a virtual environment using avatars with neutral clothes (Virtual condition, see Fig. 2 bottom left panel) or in a virtual environment using avatars wearing coats (Virtual + SIC condition, see Fig. 2 bottom right panel). The groups were randomly assigned to the conditions, provided that sex of participants was balanced across all conditions.

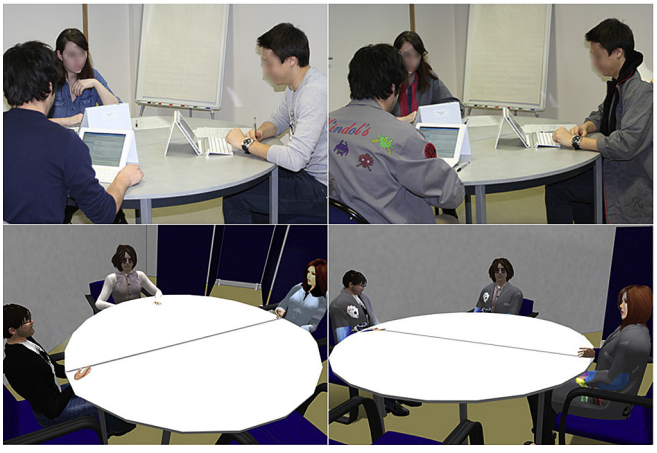

Fig. 2. Participants in the Control (top left), Face-to-face + SIC (top right), Virtual (bottom left) and Virtual + SIC (bottom right) condition.

3.4. Procedure

All groups worked in the same dedicated room: in face-to-face conditions, the participants gathered around a table, while in the virtual conditions, they were distributed in three isolated boxes equipped with computers and gathered around a virtual table using their avatars. Avatar attribution was randomized but accounted for users' sex: male participants were randomly attributed a male avatar and female participants were attributed the female avatar. In order to neutralize the effect of the environment, we created in Second Life a virtual room similar to the real room the experiment took place in. To limit the likelihood of friendship groups (Jehn & Shah, 1997), group members were recruited in different classes of the same engineering year. Moreover, to preserve anonymity in the virtual conditions, the participants 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; they also wore headphones for the entire duration of the experiment.

In all conditions, participants could only communicate textually in order to keep the mode of interaction constant (Postmes, Spears, & Lea, 2002) and to manipulate only the face-to-face vs. virtual nature of the setting: in face-to-face conditions, they were provided with tablets and keyboards (see Fig. 2) to access an instant messaging system and in virtual conditions they used the built-in Second Life chat. The virtual conditions began with a familiarization phase during which the participants had to take 1–2 min to observe their avatar in detail. They were also trained to move in the virtual room and communicate with each other. By doing this, the participants also discovered the avatars of all 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 a 15-min brainstorming session to imagine new transportations means.

At the end of the brainstorming, the participants filled out a questionnaire measuring their perceptions of the session and of their avatar (when relevant). The whole experiment lasted 35–40 min. Participants were then debriefed, which allowed us to check that they had not understood the goal of the research.

3.5. Measures

We collected two kinds of variables:

Creative performance: Creativity was assessed through Fluency and Uniqueness. Fluency 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 is an assessment of originality corresponding to the number of unique ideas with regard to all the ideas proposed by all the groups. This is a classical measure of divergent thinking (Torrance, 1966; Wallach & Kogan, 1965) providing an alternative measure to subjective ratings of originality when the creative corpus is composed of more than 15 sessions (Silvia et al., 2008). To find out unique ideas, semantic categories were manually annotated by a single judge. A second independent judge performed the same annotation on 10% of the corpus of ideas, with an inter-judge agreement of 81.2% on this subsample. Uniqueness was then decided within each semantic category, a given idea being considered as unique when appearing only once in its semantic category. Two independent judges, blind to the experimental conditions, annotated uniqueness with $K = 0.499$ ($p < .001$) inter-judge agreement.

Social identification: We used the Single Item Social Identification measure (Postmes, Haslam, & Jans, 2013) in all conditions: *I identified with my group*, with 7-point Likert scale.

4. Results

4.1. Level of analysis

Because participants worked in groups, we performed a multilevel analysis to know whether potentially non-independent data (group performance and social identification) should be analysed at the group or the individual level. A mixed model analysis was run, including the Environment (Real vs. Virtual) and the presence of SIC (With vs. Without) in the fixed part of the model, as well as Sex as a covariate. Sex was introduced in the analyses because belonging to a subgroup from a global counter-stereotypic field such as engineering (e.g., Smeding, 2012) may have an influence on female participants' social identification and performance. Groups were included in the random part of the model. This analysis resulted in non-significant improvements of the models for Fluency (χ^2 (1) = 1.09, p = 0.30) and Social identification scores (χ^2 (1) = 0, p = 1). Therefore we report in the following sections analyses conducted at the individual level, except for Uniqueness, which was processed at the group 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.

4.2. Creative performance

After cleaned up from off-task entries and duplicates, the corpus comprised 644 ideas, which corresponds to 26.8 ideas by group or 8.9 ideas by participant. Fluency was analysed with the same 2 (Setting: Face-to-face vs. Virtual) x 2 (SIC: Without vs. With) ANCOVA with Sex as a covariate. The effect of Sex was not significant (F (1, 67) = 0.355, p = 0.55, η^2_p = 0.005). In line with Hypothesis 1, we observed a significant main effect of the presence of SIC on Fluency (F (1, 67) = 4.75, p < .05, η^2_p = 0.066), showing that fluency was higher in the presence (M = 10.11, SD = 4.76) than in the absence of SIC (M = 7.78, SD = 4.04). The main effect of the Setting was not significant (F (1, 67) = 0.018, p = 0.89, η^2_p = 0.000): Fluency was not higher in the Virtual (M = 8.97, SD = 4.26) than in the Face-to-face setting (M = 8.92, SD = 4.85). The interaction effect between Setting and SIC was not significant either (F (1, 67) = 0.005, p = 0.94, η^2_p = 0.000), which does not support Hypothesis 2.

Uniqueness was analysed at the group level with a 2 (Setting: Face-to-face vs. Virtual) x 2 (SIC: with vs. without) ANCOVA with Sex balance in groups as a covariate. The effect of Sex balance proved non significant (F (1, 19) = 0.02, p = 0.883, η^2_p = 0.001). A significant main effect of SIC was observed (F (1, 19) = 7.54, p < .05, η^2_p = 0.284) with more unique ideas in the presence of SIC (M = 6.25, SD = 3.02) than in the absence of SIC (M = 3.25, SD = 2.01), which supports Hypothesis 1. The main effect of the Setting was not significant (F (1, 19) = 0.01, p = 0.940, η^2_p = 0.000) with the number of unique ideas not different in the Face-to-face (M = 4.75, SD = 3.57) and the Virtual environment (M = 4.75, SD = 2.30). Finally, Hypothesis 2 was not supported because the interaction effect between SIC and Setting was not significant (F (1, 19) = 1.04, p = 0.321, η^2_p = 0.052).

4.3. Social identification

To test Hypothesis 2, Social identification scores were analysed by means of a 2 (Setting: Face-to-face vs. Virtual) x 2 (SIC: With vs. Without) ANCOVA, including Sex as a covariate. The effect of Sex proved non significant (F (1, 67) = 0.23, p = 0.63, η^2_p = 0.003). We observed a significant main effect of the Setting (F (1, 67) = 5.06, p < .05, η^2_p = 0.07), showing that social identification was higher in the virtual (M = 5.00, SD = 1.41) than in the face-to-face setting (M = 4.31, SD = 1.45). The main effect of SIC was not significant (F (1, 67) = 2.87, p = 0.095, η^2_p = 0.04). The interaction effect between Setting and SIC proved significant (F (1, 67) = 10.79, p < .01, η^2_p = 0.14), showing that the simple effect of SIC in the face-to-face setting was not significant (F (1, 67) = 1.26, p = 0.26, η^2_p = 0.02) while the simple effect of SIC in the virtual setting was significant (F (1, 67) = 12.38, p < .001, η^2_p = 0.16, M = 5.77, SD = 1.00, with SIC M = 4.22, SD = 1.35 without SIC). This pattern of results supports Hypothesis 2 (see Fig. 3).

5. Discussion

The goal of this experiment was to implement a social identity approach to support groupwork both in face-to-face and virtual settings. To this end, we used existing Social Identity Cues (SIC) in a population of students and compared the effects of SIC worn by participants themselves or by avatars representing them. This research extends the SIDE framework to a new kind of, more complex (and maybe more ecological) SIC. We did not rely on avatar similarity but on different avatars sharing common meaningful SIC, and used animated avatars in a real-time full 3D virtual world. One of our goals was to complement previous SIDE results on the use of avatars for self-representation in social networks or instant messaging systems by investigating more realistic 3D avatars and environments. Moreover, current trends towards virtual reality (e.g., the recent acquisition of Oculus by Facebook) may foreshadow future virtualization of social interactions and professional communication.

Taken as a whole, our results reveal that SIC exert positive effects on performance: the presence of SIC led to an increased fluency and a higher number of unique ideas. The positive influence of SIC on group performance is a phenomenon that was rarely analysed in the literature, and the present study is the first one to investigate it while manipulating the real or virtual nature of SIC. However, this effect was not strengthened in the virtual environment. This result suggests that using an existing and powerful SIC such as the *biaude* induced high standards for performance in our

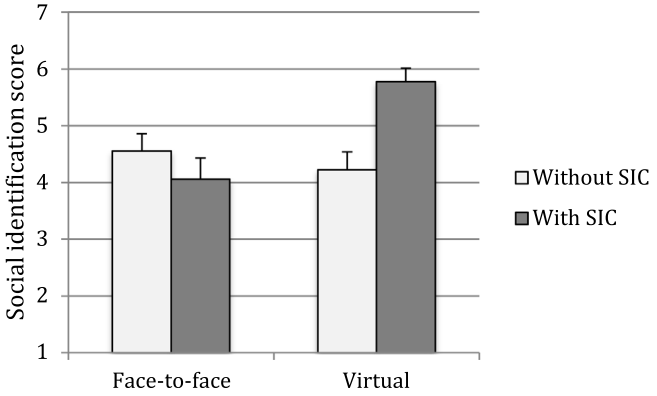

Fig. 3. Mean and standard error of Identification scores for the 2 (Setting: Face-to-face vs. Virtual) x 2 (SIC: Without vs. With) conditions.

experimental population, both in face-to-face and in the virtual environment. Greater than more neutral SIC (e.g., color shirts, group names) frequently used in the social identity framework, the customized coats we used influenced face-to-face performance despite the availability of individuating information and personal characteristics. Moreover, our results highlight that these meaningful SIC improved performance in the absence of out-group. This finding is interesting because it extends previous results (Worchel et al., 1998), showing that social identity outcomes on performance are not just about out-group presence, but also about relevance of SIC and accessibility of the related social category for the population involved.

Concerning group identification, our data show that SIC increased identification only in the virtual environment: the groups we observed did not feel stronger group identification in face-to-face when they were wearing their customized coats than when they were not wearing any particular SIC. Several lines of interpretation may account for this result. The first one considers that this experiment took place in a research laboratory within ENSAM, and that identification level in this environment was already high without SIC. In our study, the intragroup context of the school may not have been the most conducive to the impact of social identity cues: students within the institution enclosure may identify as in-group members even without their coat. Another line of interpretation considers the absence of out-group in our experimental setting. In accordance with previous interpretation, an out-group may create an intergroup context more conducive to identity salience and to the impact of social identity cues (Worchel et al., 1998). In this respect, one might reasonably expect that social identification of our participants wearing their coats would increase in an intergroup context involving (implicitly or explicitly) a relevant out-group. A comparison with students from other engineering schools may be a relevant way to investigate this assumption in future research.

The present study also had some limitations calling for further experiments to better understand to role of the environment in which groupwork takes place. In general, the environment may be likely to influence working situations and creativity (Ceylan, Dul, & Aytac, 2008; Guegan, Nelson, & Lubart, 2017; Stone, 1998): in the present study, we strived to neutralize such effects by using similar (but not exactly identical) real and virtual rooms, but we did not control for the environment features (contextual cues such as windows, indoor plants, color of walls). Furthermore, the environment itself could convey Social Identity Cues, which may open promising paths for further leveraging group performance. Indeed, virtual scenes representing emblematic places and/or include meaningful group symbols could be used to increase social identity salience. A complete virtual design may also allow the study of the differential influence of SIC when conveyed by avatars or by the environment.

Beyond the use of a simple synchronous communication interface, the use of avatars in electronic brainstorming may be efficient in many respects: conducting a task in a virtual environment may be fruitful to convey SIC and activate a group identity to enhance performance. Furthermore, the literature on behavioral impacts of avatar appearance potentially sheds a complementary light on this kind of collaboration situation. Indeed, the use of avatars may also involve the Proteus effect (Yee & Bailenson, 2007) and/or priming processes (Peña, Hancock, & Merola, 2009). Based on Self-Perception principles (Bem, 1972), research on the Proteus effect shows that the use of an avatar modulates user's behaviors congruently to the avatar's appearance. Alternatively, the appearance of avatars may prime concepts likely to impact the activity at hand (i.e., *behavioral assimilation*). Future research should therefore strive to measure the respective impacts of the appearance of individual avatars (e.g., Proteus effect) and of social identity processes related to groups of avatars (e.g., depersonalization). From a theoretical viewpoint, such analyses would be a major step in understanding the whole complexity of the processes involved in the use of avatars as self-representations.

6. Conclusion

This study shows the positive influence of SIC in a face-to-face setting, but also in a virtual environment, in a creative task, which may have important implications given the innovation challenges all economical sectors have to face. This effect is even more compelling because it was isolated from out-group presence. Moreover, in the virtual environment, such an effect was conveyed by the sole avatars' appearance, which in itself opens new avenues to design computer-mediated collaborative devices. Besides, to further enhance group identification and performance benefits, we could consider introducing an intergroup context through a different environment (e.g., outside the school), a different work situation (e.g., a competition) or the evocation of a relevant out-group (e.g., students of a concurrent school).

Finally, the findings of the current study could be extended to other populations and other kinds of social identity cues. For instance, the display of meaningful SIC on avatar clothes could be implemented in various professional contexts: avatars could wear sport team jerseys or clothes in the colors and logo of a company, and so on. In a Social Information Processing perspective (Walther, 1992), it could also be important to examine, in virtual settings, the effects of SIC in the long term and/or in a field study with actual teams. This may foster remote collaboration, but also improve collocated meetings. For example, occasionally conducting workshops through avatars is likely to infuse new dynamics, to promote a new viewpoint and change routines among regular coworkers (e.g., hierarchical asymmetry, interpersonal relations, leadership). Avatars sharing social identity cues may constitute a convenient tool to temporarily mask group members' identities, focus on team's issues and challenges, and enhance group performance. In sum, given its theoretical relevance and applied stakes, the social identity approach should be more strongly promoted to better understand computer-mediated teamwork and design more effective devices.

Acknowledgment

This research was carried out as part of project CREATIVENESS funded by French National Research Agency (ANR-12-SOIN-0005).

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