

SECTION IV

ORIGINAL RESEARCH

Health care is one of the areas that could be most dramatically reshaped by these new technologies.

Distributed communication media could become a significant enabler of consumer health initiatives. In fact they provide an increasingly accessible communications channel for a growing segment of the population.

Moreover, in comparison to traditional communication technologies, shared media offer greater interactivity and better tailoring of information to individual needs.

Wiederhold & Riva, 2004

The Sensorimotor Dimension of the Networked Flow: An Exploratory Study Using an Interactive Collaborative Platform

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Abstract. Joint action - the cooperation with other individuals to achieve a shared motor goal, is a crucial ability for human survival. This process takes place when actors are synchronized at a sensorimotor level. However, the experiential correlates of sensorimotor synchronization are not fully understood. The aim of this study was to investigate the relationship between the experience of flow and social presence in a sensorimotor collaborative task. 12 female couples (mean age = 22.33; S.D. = .815) and 12 male couples (mean age = 22.88; S.D. = .789) were involved in a tower-building task across 10 consecutive trials using the COLLEGO platform [1]. Couple members alternated their leader/follower role. Platform recorded time stamp (ms) and position of each selected object when it was picked/released, providing a measure of performance. Thereafter, participants' level of flow (Flow State Scale), an intrinsically motivating state of consciousness, and social presence (Networked Minds Social Presence Inventory), i.e., the feeling of being with other Selves in a real or virtual environment, were assessed. Flow and Social presence correlated positively at a global level. Having clear goals was negatively associated with performance, while awareness and merging with one's own actions correlated positively with performance. Task duration correlated negatively with attentive and behavioral dimensions of social presence, but positively with cognitive and emotional dimensions. Results are discussed according to the Networked Flow model assuming a positive correlation between social presence and flow at the base of the highest levels of collaborative performance.

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1. Introduction

Being able to coordinate with another individual is one of the key assets of human survival and progress. This basic ability is called “*joint action*“, which is deemed as “*any form of social interaction whereby two or more individuals coordinate their actions in space and time to bring about a change in the environment*” [2, 3]. The relevance of joint action is related to the possibility to affect the environment according to each partner’s intention, thus facilitating the emergence of a social unit [4]. A social unit emerges when individuals’ intentions are bound together to an extent that they perceive themselves as a part of the same coherent system and this status is called *entitativity* [4, 5]. One of the mechanisms underlying the emergence of such condition is interpersonal synchronization [6, 7] which can facilitate group performance [8]. The impact of synchronization on performance may be mediated by the emergence of a collective mind, which allows organizing individuals’ ability towards a shared goal and outcome [8]. In other words, people feel mutually and positively related, experiencing a feeling of mutual connectedness [4], global perceptual fluency and shared attention [9] when they are able to coordinate with the actions of another partner [9]. This, in turn, would increase group performance. Despite the relevance of experiential correlates of synchronization, their relationship with group performance is nearly unexplored. Recently, Gaggioli et al. [10-13] proposed the Networked Flow model (NF) that assumes a relationship between all these experiential dimensions and group highest performances. NF suggests that an increasing group synchronization, which embraces all levels of group collaboration, can contribute to the emergence of optimal group collaboration. To this aim, two conditions need to be established. First, the group should develop a shared intersubjective space in which all members’ intentions converge. Authors identified this space with the highest level of *Social Presence* [14-16]. Secondly, the complex experience of *group flow* takes a part in the emergence of the Networked Flow [17-19]. Group flow and highest levels of *Social Presence* can be deemed as high-level experiential correlates of interpersonal synchronization, supporting excellent group performances. To test these assumptions, we carried out a preliminary study in which we manipulated interpersonal synchronization through a joint-action task (i.e., the tower-building task) using the COLLEGO platform[†]. Interpersonal synchronization is a complex phenomenon that is difficult to capture in the lab. Therefore, we used the COLLEGO platform [1], that offers a valid and ecological tool to study correlates of synchronization (i.e., from the sensorimotor level to the experiential one) and their relationship with group performance.

2. Methodology

We included 24 couples of participants from Italy. 12 female couples (mean age = 22.33; S.D. = .815) and 12 male couples (mean age = 22.75; S.D. = .678) were involved in a

[†] COLLEGO project: <https://collego.wordpress.com/2016/10/21/collego/>

tower-building task across 10 consecutive trials using the COLLEGO platform for joint-action [20]. They were required to build a tower of colored wooden blocks using only one hand, and positioning a cube at a time. Each trial, the experimenter assigned the role of “leader” (i.e., the member who began the sequence of cubes) or “follower” (i.e., the member who had to follow the leader’s cube sequence). Participants had to alternate their leader/follower role to build the tower jointly, using 6 cubes each. Cubes were placed on a platform composed of two Arduino-sensitized block surfaces in front of each participant. When a cube was picked/released, time stamp (ms) and position of selected objects were recorded [figure 1]. Participants’ performance and degree of synchronization was continuously assessed by the platform. At the end of each session, experiential correlates of interpersonal synchronization were assessed. Specifically, participants were required to report their level of Flow (Flow State Scale- FSS) [21] and Social Presence (Networked Minds Social Presence Inventory- NMSPI) [14, 22] associated to the task.

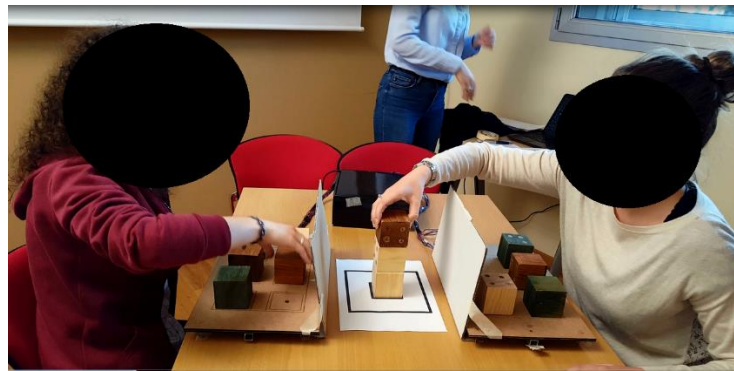


Figure 1. Two participant involved in the Tower-building task using the COLLEGO platform.

3. Results

Since the level of analysis of the variables is the group level, we aggregated individual scores of Flow, social presence and performance to the group level by calculating the average and standard deviation of individual scores for each pair. Further, we carried out correlation analyses to explore potential relationships among Flow, Social Presence and group performance. Performance was calculated from the timestamp computed with respect to the first cube that was lifted.

Findings showed that Flow and Social Presence correlated positively at a global level ($r = .428$; $p < .005$). Having clear goals ($r = .521$; $p < .05$) was negatively associated with performance, while feeling totally involved into the action was associated with a higher performance ($r = -.416$; $p < .05$). At the same time, task duration was negatively associated with cognitive (perceived attentional engagement in odd trials: $r = .515$ $p < .05$; perceived attentional engagement in even trials: $r = .421$; $p < .05$) and behavioral dimensions of social presence (perceived behavioral interdependence: $r = .497$; $p < .05$). Specifically, when individuals paid more attention to themselves than to their partner, their group performance decreased. At the same time, when members perceived to be dependent on the partner but that partner did not depend on them, their performance

decreased. On the other hand, when participants began the trial feeling emotionally connected with their partner, they performed better (perceived emotional contagion: $r = -.427$; $p < .05$).

Finally, the experience of mutual comprehension emerged as relevant for outperforming. Specifically, when participants felt that their partners were able to understand their intentions, the couple performed better (duration: $r = -.409$; $p < .05$).

4. Discussion and Conclusion

The ability of synchronizing with other partners is a driver of optimal performances and it seems to be mediated by different experiential outcomes [4]. However, the relationship between these outcomes, synchronization and performance is nearly unexplored. We carried out a preliminary study manipulating interpersonal synchronization through a joint-action task, assessing its experiential correlates, as well as their relationships with group performance. To this end, we used the COLLEGO sensitized platform in order to detect continuous performance and variations of interpersonal synchronization in an ecologically valid way. We discussed results considering the Networked Model of group collaboration, which assumes that high Social Presence and Flow experiences contribute to the emergence of optimal group performance. A progressive multi-level synchronization among members would act as a requirement for the emergence of Social Presence and Flow. Here, we manipulated the degree of low-level synchronization between members involved in a joint-action task, to investigate the impact on concurrent group experiences and performance. First, we found a positive correlation between Social Presence and Flow, supporting the main assumption of the model. More, at the performance level, the feeling of being totally aware of one's own actions was positively related to group performance. Being too concentrated on one's own task is negatively correlated with group outcomes. This is in line with previous findings on the role of attention on group performance [10]. However, when members perceived clear goals about the task, their performance decreased. Maybe they considered the task too easy to put more effort in it. At the behavioral level, members should not feel to be fully dependent from their partner to reach a better performance. It is possible that a lack of balance in terms of perceived behavioral dependence affected the general synchrony between partners. This would lead to a "break" in the information flow at a lower level affecting others higher levels [20, 23, 24]. Further, when members perceived that their partner could understand their intentions, they performed better. Indeed, it was noted that synchrony combined with shared intentionality produced the greatest level of cooperation [25]. Finally, the emotional component of interpersonal synchronization has been investigated widely [26], however, its relationship with group performance has to be clarified. In this study, we offered a preliminary evidence of a positive relationship between emotionality and performance.

This study proved that the NF model might offer a valid perspective on group collaboration. This model integrates the cognitive, emotional, and behavioral dimensions involved in the collaborative process from the lower sensorimotor level to the higher empathetic one. The Networked Flow represents a new integrative perspective on the relationship between low sensorimotor levels and high experiential levels of group collaboration.

Given the increasing relevance of interpersonal synchronization in several domains, such as in the clinical and therapeutic field [6, 9, 27, 28], these findings may support the use of this paradigm both as a diagnostic and intervention tool. It might be possible to plan a computational therapy based on this tools assessing the evolution of a therapeutic relationship. Alternatively, this paradigm could be used to monitor group performance in a team work by detecting which level of collaboration should be improved. In other words, this paradigm acts as a starting point for a new way of conceptualizing and treating human-computer (HC) and human to human (HH) interactions. This is crucial in a world in which humankind is dealing with interactive technologies in every moment of individuals' life.

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