Virtual Social Interactions During the COVID-19 Pandemic: The Effect of Interpersonal Motor Synchrony on Social Interactions in The Virtual Space

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Abstract

Although the link between synchrony and emotional contagion has been studied extensively during face-to-face interaction, the question of whether this association also exists in virtual settings has remained unanswered. Here, we examined whether this link exists during virtual social interactions and whether pro-social effects will be induced during those interactions. To this end, two strangers shared difficulties they have experienced due to the COVID-19 pandemic during a virtual social interaction. The findings revealed that spontaneous motor synchrony and emotional contagion can arise during a virtual social interaction between two strangers and that this kind of interaction has pro-social effects. It can thus be presumed that virtual social interactions may share similar characteristics and social effects with face-to-face interactions. Considering the tremendous changes COVID-19 epidemic has caused regarding social communication, these findings may provide grounds for developing new intervention protocols aiming at dealing with the consequences of social distancing.

Introduction

The Role of Motor Synchrony during Social Interactions

Motor synchrony serves as an integral part of human social behavior[1], and it can emerge both intentionally and spontaneously. Intentional motor synchrony occurs when two or more people purposely synchronize their motor movements. For example, dancers align their movements purposely to synchronize with one another[2]. Alternatively, spontaneous synchrony occurs when two or more people synchronize their body movements during daily interactions unintentionally and without awareness[3]. For example, walking steps and pace may spontaneously synchronize without awareness while taking a walk jointly with another person[4]. In fact, the mere visual exposure between two people may unconsciously lead to synchronized body postures[5]. Similarly, it is normally difficult not to smile back at a person smiling at us[6].

Synchrony is a basic process in human communication that takes place immediately after birth within mother-child interactions[7]. It has a crucial role in the process of forming interpersonal relationships[8,9] and serves as an integral part of our social behavior and cognition[1,10]. Specifically, motor synchrony facilitates pro-social behavior[11,12] as well as enhances liking[13–15], trust[16], and cohesion[13,17,18] between individuals interacting. Likewise, participants singing together in synchrony were found to report higher levels of similarity to the group than participants who did not sing in synchrony[19].

During social interactions, people tend to catch the emotions of others around them[20]. This tendency can occur both consciously or unconsciously, and is referred to as emotional contagion (i.e., emotional alignment). Emotional contagion is linked to motor synchrony, and they are both explained by a shared neural mechanism consisting of a three-component feedback loop: (a) an error-monitoring system that reacts to misalignment, (b) an alignment system, and (c) a reward system that is activated when alignment is achieved. Notably, it has been suggested that the activation of either motor synchrony or emotional contagion elicits the activation of the other by activating the feedback loop[21]. Supporting evidence has demonstrated that inhibition of motor synchrony between participants interferes with emotional contagion while listening to emotional vocalizations[22]. Moreover, motor synchrony and emotional contagion were found to adhere to similar principles. For instance, group membership affects both motor synchrony and emotional contagion; that is, people tend to synchronize [23] and catch the emotions [24] of ingroup rather than outgroup members. Additionally, both synchrony and emotional contagion were found to enhance feelings of closeness[25–27]. While this line of evidence supports the link between synchrony and emotional contagion during face-to-face interaction, the question of whether this association also exists in virtual settings has remained unanswered.

Modern technology has changed the way we socialize by incorporating virtual social interactions, such as messaging, voice, and video calls, into our daily life[28]. The outbreak of the COVID-19 virus has further changed the way people communicate with one another by forcing them to rely much more on technology for communication than ever before. With worldwide restrictions on face-to-face interactions, virtual social interactions provided a substitute for face-to-face interactions[29]. Thus, the COVID-19 era has stressed the need to investigate the nature of virtual social interaction and whether a core phenomenon such as the human tendency to spontaneously synchronize body movements and align emotions exists in virtual settings. In other words, could virtual social interactions satisfy our need for social connection and mitigate loneliness?

The Present Research

In the present research, we examined whether virtual social interactions that include both voice and video provide a similar opportunity for connectedness as face-to-face social interactions by using the Zoom software. In order to examine this question, we asked two strangers to share difficulties they have experienced due to the COVID-19 pandemic during a virtual social interaction. These instructions were aimed to motivate participants to share emotional experiences with one another. We expected that this shared experience will elicit both emotional contagion and spontaneous motor synchrony between the two strangers while interacting with each other. We used Motion Energy Analysis (MEA) – a computer-based tool that automatically and objectively quantifies motor synchrony during natural interactions[30]– to measure the level of interpersonal synchrony during the interaction. The MEA tool allows measuring dynamic movements between interaction partners under natural conditions[6], thus enabling subtle examination of synchrony under natural conditions, such as level of synchrony in therapist-patient dyads during actual therapy sessions[31].

Our first goal was to validate the new task; that is, to demonstrate that emotional contangion and motor synchrony may arise spontaneaously during virtual social interactions. Furthermore, we examined whether pro-social effects of synchrony that have been found during face-to-face interactions will also replicate in virtual settings. Specifically, we examined whether feelings of trust, liking, cohesion, self-other overlap, and perceived similarity increase following the interaction.

Methods

Participants

One-hundred and ninety-six male and female Hebrew-speaking students aged 19–30 years old were recruited for the study. All were students at Ariel University, who received credits that are required for their program. Registration for the experiment was made through a computerized system at Ariel University. Recruitment began after obtaining the necessary approvals from the Institutional Review Board at Ariel University. Participants were randomly assigned into ninety-eight dyads, while ensuring all dyads were made up of two same-sex strangers without previous encounters. Each dyad conducted a virtual social interaction via the Zoom application using their personal computers and webcams. All participants were encouraged to sit in a calm, distraction-free environment with a stable internet connection. Twenty-six dyads were excluded due to technical issues such as unstable internet connection or lag in audio and video that did not allow proper MEA analysis (see full description on MEA prerequisite: Ramseyer[32]). The final sample included 138 participants (22 males and 116 females) assigned in 69 dyads.

Measures

Motion Energy Analysis

The MEA is an automated method to calculate motion synchrony between individuals. This software allows us to convert pixels from digital videos of the interaction into their greyscale format. Each frame has a fixed number of pixels that represent the distribution of grey-scale values ranging from 0 (true black) to 255 (true white [33]. MEA, therefore, tracks the change in “energy”, which is defined as changes from one video frame to the next and stores the amount of change occurring in a defined ROI into a time-series representative of the movement that occurred in this ROI[34]. These time-related changes are indicators of movement within specific ROIs. The absolute changes in greyscale values in these ROIs will be detected and separately recorded, thus generating two continuous time series measuring the amount of total full-body movement of each participant (for full description see Ramseyer, 2020[32]).

To quantify automatically-coded synchrony, we used a readily accessible and well-documented program designed to conduct motion energy analysis (rMEA in the R package, for details see Ramseyer & Kleinbub[35]). The primary statistical analysis was based on a time-lagged cross-correlation algorithm (function MEAccf in rMEA, see Boker et al.[36]). Briefly, cross-lagged correlations were applied to quantify the synchrony of the preprocessed motion energy time series of the participants in each dyad. Correlations between the time series of each dyad were computed such that a lag zero correlation reflects simultaneous synchrony. We divided the time series into 60 s segments overlapping by 30 sec within the window of 5 sec. Cross correlations were then standardized (Fisher's Z) and their absolute values aggregated for every 60 sec segment, yielding one global value of simultaneous synchrony. These parameters were chosen according to the guidelines suggested by Ramseyer[32] and the nature of our data. Note that the use of absolute values, as suggested by Ramseyer and Tschacher[31], means that both positive and negative cross-correlations contributed positively to synchrony.

In order to control for the possibility that synchrony occurred by coincidence, we ran a pseudo-synchrony analysis (i.e., compared the real associations found in genuine dyads with chance associations produced by pseudo dyads). To create the pseudo interactions, we shuffled the original time series of each dyad, then aligned movement segments of different interaction partners that never actually occurred at the same time (i.e., 9660 pseudo dyads were created by pairing a participant from one dyad with a participant from another dyad). To calculate the level of pseudo dyadic synchrony, we used the same analysis as for real dyads, which yielded one global value of simultaneous synchrony for each pseudo dyad.

Self-Report Measures

Interpersonal Trust. The trust questionnaire is a 5-item measure developed by Murray et al.[37] based on a measure developed by Holmes et al.[38] It measures the degree of trust in the partner's continuing motivation to be responsive to one's needs on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (e.g., "When we are dealing with an issue that is important to me, I feel confident that my partner will put my feelings first," "I feel that I can trust my partner completely"). The internal consistency in our data was adequate before the interaction (α = 0.72) and following the interaction (α = 0.76).

Liking. The liking questionnaire is a 4-item measure developed by Mackinnon et al.[39]. It measures the degree of liking towards another person on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (e.g., "How friendly do you think the person would be if you met this person in real life?"). The internal consistency in our data was adequate before the interaction (α = 0.80) and following the interaction (α = 0.86).

Cohesion. The cohesion scale is a 5-item questionnaire previously used by Wiltermuth and Heath[19] and Cross et al.[40] It measures trust, mood and cohesion (closeness, connectedness and similarity). Since some of the items overlap with other questionnaires we used, we only included 3 items ("How similar do you feel to the other participant?", "How connected do you feel to the other participant?", "How much do you trust the other participant?"). Participants recorded their responses to each of these questions by marking continuum. This response scale was used to make it more likely to detect any changes after the movement manipulation and has been successfully used in a similar context by Lumsden et al.[9] The internal consistency in our data was adequate before the interaction (α = 0.87) and following the interaction (α = 0.93).

Self-Other Overlap. Self-other overlap was measured using the Inclusion of Other in Self (IOS), a single-item, pictorially measure developed by Aron et al.[41] It is intended to tap directly people's sense of interpersonal interconnectedness in a nonverbal way. In the IOS scale, respondents select the picture that best describes their relationship from a set of Venn-like diagrams, each representing different degrees of overlap between two circles. The figures were designed so that (a) the total area of each figure is constant (thus as the overlap of the circles increases, so does the diameter), and (b) the degree of overlap progresses linearly, creating a seven-step, interval-level scale. The IOS is a simple, well validated, and commonly used scale.

Positive and Negative Affect. The Positive and Negative Affect Schedule (PANAS) is a 20-item measure developed by Watson et al.[42] It is a reliable and valid tool for measuring the two different mood states (positive and negative affect) over different intervals of times ('today', 'during the past few days', 'during the past year', 'in general on an average', etc.). The internal consistency in our data was adequate for the PA subscale before the interaction ($\alpha = 0.87$) and following the interaction ($\alpha = 0.86$), as well for the NA subscale before the interaction ($\alpha = 0.83$) and following the interaction ($\alpha = 0.84$).

Perceived Similarity. Perceived similarity was measured using a perceived similarity questionnaire[43] which includes 25 items that are rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire is divided into two sub-scales – one examines similar background and includes 10 items, the second examines similar attitudes and includes 15 items. The internal consistency in our data was adequate before the interaction ($\alpha = 0.89$) and following the interaction ($\alpha = 0.89$).

Procedure

As shown in Figure 2, before the beginning of each session, each participant received an e-mail including: informed consent, subject's number, dyad's number, a link to the Zoom meeting, and lastly a questionnaire investigating demographic information and the positive and negative affect schedule questionnaire (PANAS), which had to be filled out before entering the Zoom meeting. Upon entering the Zoom meeting, the research assistant instructed participants to use the pin option in order to view their interaction partner on full screen and instructed participants to shortly introduce themselves to one another. This short introduction lasted no longer than 2 minutes. Afterwards, the research assistant instructed participants to turn off cameras and microphones while they fill out a questionnaire measuring trust, liking, perceived similarity, interpersonal attraction, self-other overlap, and cohesion. Next, the research assistant instructed participants to turn on cameras and microphones and instructed them to share difficulties they are experiencing with COVID-19 and how it affected their personal lives (see Figure 2). It is worth noting that the experiment took place between April 25th and May 9th 2021, a time in which many social distancing and quarantine restrictions were still enforced, such as remote-learning at universities. After five minutes, the research assistant stopped the interaction and instructed participants to turn off cameras and microphones while filling out the last questionnaire measuring trust, liking, perceived similarity, interpersonal attraction, self-other overlap, cohesion, and positive and negative affect (see Figure 2). To further analyze the films, we only chose those that met the MEA's basic criteria, such as a static background in the video, stable lighting, and a camera[32]. Due to the background noise in some videos, a few frames were manually eliminated. The resolution of all recorded interactions was standardized to 1920 x 1080 pixels at 30 frames per second. The virtual interaction was recorded via Zoom and transferred and saved to a private cloud. The video recordings were deleted after all analysis were completed.

Results

Task Validation

Virtual interaction induces motor synchrony

To validate our task, that indeed motor synchrony occurred during the virtual social interactions, we employed a two-tailed independent-samples t-test, with group (real dyads vs. pseudo dyads) as the independent variable and global value of simultaneous synchrony as the dependent variable. Results showed that synchrony in real dyads (M = 0.14, SD = 0.04) was significantly higher than synchrony in pseudo dyads (M = 0.04, SD = 0.02), (t (9727) = 39.92, p = .000), suggesting that participants spontaneously synchronized with each other during the virtual social interaction (see Figure 3 and 4).

Virtual social interaction induces emotional contagion

In order to determine whether participants experienced emotional contagion, we calculated similarity in negative emotions by extracting the absolute values of the difference between the two dyad member's negative emotions scores (i.e., similarity in negative emotions index). A similar index was calculated for the positive emotions scores (i.e., similarity in positive emotions index). Note that a lower score in similarity in these indexes reflects higher level of similarity in emotional state.

Next, to validate our task, that indeed emotional alignment occurred during the virtual social interactions, we employed a two two-tailed paired-sample t-test. One test with time (before interaction vs. after interaction) as the independent variable and similarity in positive emotions as the dependent variable. A second test was used with time (before interaction vs. after interaction) as the independent variable and similarity in negative emotions as the dependent variable. Similarity in negative emotions index before the interaction (M = 6.50, SD = 4.74) was significantly higher than the similarity in negative emotions index after the interaction (M = 4.01, SD = 4.39); t (68) = 4.12, p = .000 (see Figure 5), suggesting that the virtual interaction elicited emotional contagion between participants.

Synchrony's Pro-Social Effects

To examine whether synchrony induces pro-social effects during the virtual social interactions, we conducted repeated measures multivariate analysis of variance (MANOVA) with time (before and after the interaction) as a within-subjects factor. This analysis allowed us to determine whether a significant difference exists between the average pro-social scores (i.e., dyad average score on positive and negative affect, trust, liking, cohesion, self-other overlap, perceived similarity, and interpersonal attraction) before and after the interaction.

Within-subjects MANOVA results showed a significant difference between average dyad score on positive affect ($F(1, 68) = 32.82$, $p < .000$), negative affect ($F(1, 68) = 27.03$, $p = .000$), trust ($F(1, 68) = 45.25$, $p = .000$), liking ($F(1, 68) = 40.02$, $p = .000$), cohesion ($F(1, 68) = 107.4$, $p = .000$), self-other overlap ($F(1, 68) = 222.72$, $p = .000$), and perceived similarity ($F(1, 68) = 10.99$, $p = 0.001$) before and after the virtual interaction (see Table 1). Taken together, the MANOVA results suggest that similarly to face-to-face interactions, synchrony induces pro-social effects during virtual social interactions.

Table 1. *Descriptive statistics for composite average scores for each dyad on all questionnaires before and after interaction.*

	Before the Interaction		After the Interaction	
	M	SD	M	SD
Positive affect*	32.39	5.64	35.8	5.08
Negative affect*	11.88	3.09	9.8	2.76
Trust*	14.57	1.95	15.67	2.17
Liking*	16.92	1.76	17.86	1.9
Cohesion*	130.2	48.36	160.8	50.84
Self-other overlap*	41.43	17.16	57.43	15.75
Perceived similarity*	55.87	7.99	58.06	8.77

**p<0. 01*

Discussion

While the link between motor synchrony and emotional contagion has been studied extensively during face-to-face interactions, whether this link is also seen during virtual social interactions remains an understudied, but critical question. In our study, we found supporting evidence for the presence of a link between motor synchrony and emotional contagion during virtual social interactions. Moreover, we found that following the interaction participants reported a reduction in negative affect and an increase in positive affect, as well as greater feelings of liking, trust, perceived similarity, cohesiveness, and self-other overlap. Thus, these results underscore the possibility for humans to communicate remotely, as this virtual social interaction seems to provide the same opportunity for connectedness as real-life social interactions.

In the current study, we instructed participants to share personal difficulties with one another during a virtual social interaction in order to generate a shared emotional experience. Our results indicate that while participants were instructed to share difficult experiences with one another, the interaction was accompanied by a reduction in negative affect and an upswing in positive affect. It is thus suggested that although unpleasant experiences were shared, the interaction itself was pleasant. A previous study has found that the mere acknowledgment that someone is sharing an emotional experience with us, without even communicating, makes the experience more pleasant[44]. Taken together, these results indicate the powerful effect of sharing emotional experiences with others, even when the interaction is virtual. Similarly, it has been suggested, that digital technology may assist in reducing loneliness and mitigate the negative effects of social distancing[45,46]. For example, recent studies have shown that increased virtual social interactions with close others during the pandemic were linked to higher levels of wellbeing in both younger and older adults[47,48]. Moreover, the Zoom platform allowed forming and maintaining rapports between researcher and participant in a recent study[49]. Nonetheless, it is still unclear what causes this powerful effect of virtual social interactions.

To unravel this query and shed light on a question that is at the forefront of social psychologists today – that is, whether virtual social interactions provide the same opportunity for connectedness as real-life social interactions – we will take into consideration our first goal. As expected, our first goal (i.e., to demonstare that emotional contangion and motor synchrony can arise spontaneaously during virtual social interactions) received supporting evidence by our results. Given the important role motor synchrony and emotional contagion play in our social lives, having found these phenomena in virtual social interactions may assist in explaining the powerful effect of such interactions. Moreover, we found an increase in pro-social effects following synchronized virtual social interactions that is in accordance with previous findings, suggesting an increase in pro-social effects following synchronized face-to-face interactions[13,14,18,19,50–53]. Altogether, it seems that many social phenomena occurring in face-to-face interactions also occur in virtual social interactions. Therefore, we suggest that these phenomena may be the underlying mechanisms that explain the connection-promoting effect social virtual interactions have.

However, while our study found evidence for the possibility of virtual social interactions to promote connectedness, Towner et al.[54] did not find this effect. It has previously been suggested that virtual social interactions that include voice create stronger social bonds compared to interactions including only text[55]. In accordance with this suggestion, the disparity between our study and Towner et al.'s[54] study might be explained by the type of virtual social interactions used. Here, virtual social interactions were conducted via Zoom, therefore the interaction included both voice and video. In Towner et al.'s[54] study, virtual social interactions were examined spontaneously, and participants reported using mostly messaging/texting as their primary mode of virtual social interaction. Thus, it could be presumed that different methods of virtual social interactions provide different opportunities for connectedness. This hypothesis lines up with our suggestion regarding the underlying mechanism of the connection-promoting effect of virtual social interactions. That is, interactions including voice and video might generate more social phenomena (motor synchrony, emotional contagion, etc.) than interactions including text exclusively. Therefore, it could be hypothesized that different types of virtual social interactions provide different opportunities for social phenomena to occur. As such, the connection-promoting effect a virtual social interaction will have is dependent on the social phenomena elicited during the interaction.

Several limitations of the current study should be noted. First, this study did not have any kind of a comparison group, thus we cannot determine the similarities and differences between virtual settings and face-to-face settings. Furthermore, our study design does not allow establishing a casual relation between motor synchrony, emotional contagion, and the pro-social effects of the interaction. In addition, the demographics of our sample present a limitation due to lack of diversity in age, an unequal ratio between men and women, and the fact that all participants attend the same university in Israel. Another limitation in the current study was the narrow region we recorded for motor synchrony analysis. The video recordings included only the head and shoulder region and it is possible that examination of the entire body would have provided different results, although it was not relevant for this study since during the interaction participants only viewed this part of their interaction partner. Regardless of these limitations, the current study provides a basis for future studies investigating social interactions in a virtual environment.

In conclusion, the current study suggests that the link between synchrony and emotional contagion also exists in the virtual world. To our knowledge, this is the first study that has found evidence for this link during a virtual interaction. Moreover, similarly to synchrony during face-to-face interactions, results suggest that synchrony during virtual social interactions can induce pro-social effects. It could also be assumed that this interaction was pleasant for the participants since it raised their affect. Taken together, these findings may pave the way for developing new intervention protocols aiming at dealing with the consequences of social distancing. Using our findings, future research can try to design different types of virtual protocols and examine their therapeutic results as well as motor synchrony and emotional contagion during the interventions. Moreover, future studies may recreate our paradigm in different types of virtual social interactions and examine the different social phenomena each type of interaction elicits.

Declarations

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions

H.G., M.M., and L.E. conceived and designed the study; L.E. conducted the experiments; M.S performed MEA analysis; H.G. and L.E. performed all other analysis; H.G., L.E., M.S., and M.M. drafed or critically revised the manuscript. All authors approved the manuscript.

Competing interests

The authors declare no competing interests.

References

1. Reddish, P., Bulbulia, J. & Fischer, R. Does synchrony promote generalized prosociality? *Religion, Brain and Behavior* **4**, 3–19 (2014).

2. Reddish, P., Fischer, R. & Bulbulia, J. Let’s Dance Together: Synchrony, Shared Intentionality and Cooperation. *PLoS ONE* **8**, (2013).

3. Gvirts Problovski, H. Z. *et al.* Impairments of interpersonal synchrony evident in attention deficit hyperactivity disorder (ADHD). *Acta Psychologica* **212**, (2021).

4. Sylos-Labini, F., d’Avella, A., Lacquaniti, F. & Ivanenko, Y. Human-Human interaction forces and interlimb coordination during side-by-side walking with hand contact. *Frontiers in Physiology* **9**, (2018).

5. Varlet, M., Marin, L., Lagarde, J. & Bardy, B. G. Social Postural Coordination. *Journal of Experimental Psychology: Human Perception and Performance* **37**, 473–483 (2011).

6. Paulick, J. Nonverbal Synchrony in Psychotherapy Investigation of a New Approach with the Potential to Better Understand and Predict Therapeutic Success. (2018).

7. Rauchbauer, B. & Grosbras, M. H. Developmental trajectory of interpersonal motor alignment: Positive social effects and link to social cognition. *Neuroscience and Biobehavioral Reviews* vol. 118 411–425 Preprint at https://doi.org/10.1016/j.neubiorev.2020.07.032 (2020).

8. Cheng, M., Kato, M., Saunders, J. A. & Tseng, C. huei. Paired walkers with better first impression synchronize better. *PLoS ONE* **15**, (2020).

9. Lumsden, J., Miles, L. K. & Neil Macrae, C. Sync or sink? Interpersonal synchrony impacts self-esteem. *Frontiers in Psychology* **5**, (2014).

10. Cross, L., Atherton, G. & Sebanz, N. Intentional synchronisation affects automatic imitation and source memory. *Scientific Reports* **11**, (2021).

11. Tunçgenç, B. & Cohen, E. Interpersonal movement synchrony facilitates pro-social behavior in children’s peer-play. *Developmental Science* **21**, e12505 (2018).

12. Cross, L., Turgeon, M. & Atherton, G. How Moving Together Binds Us Together: The Social Consequences of Interpersonal Entrainment and Group Processes. *Open Psychology* **1**, (2019).

13. Hove, M. J. & Risen, J. L. It’s All in the Timing: Interpersonal Synchrony Increases Affiliation. *Social Cognition* **27**, (2009).

14. Lang, M. *et al.* Lost in the Rhythm: Effects of Rhythm on Subsequent Interpersonal Coordination. *Cognitive Science* **40**, (2016).

15. Miles, L. K., Griffiths, J. L., Richardson, M. J. & Macrae, C. N. Too late to coordinate: Contextual influences on behavioral synchrony. *European Journal of Social Psychology* **40**, 52–60 (2010).

16. Goldstein, P., Losin, E. A. R., Anderson, S. R., Schelkun, V. R. & Wager, T. D. Clinician-Patient Movement Synchrony Mediates Social Group Effects on Interpersonal Trust and Perceived Pain. *Journal of Pain* **21**, 1160–1174 (2020).

17. Jackson, J. C. *et al.* Synchrony and Physiological Arousal Increase Cohesion and Cooperation in Large Naturalistic Groups. *Scientific Reports* **8**, (2018).

18. Sebanz, N., Bekkering, H. & Knoblich, G. Joint action: Bodies and minds moving together. *Trends in Cognitive Sciences* vol. 10 70–76 Preprint at https://doi.org/10.1016/j.tics.2005.12.009 (2006).

19. Wiltermuth, S. S. & Heath, C. Synchrony and Cooperation. *Psychol Sci* **20**, 1–5 (2009).

20. Smirnov, D. *et al.* Emotions amplify speaker–listener neural alignment. *Human Brain Mapping* **40**, (2019).

21. Shamay-Tsoory, S. G., Saporta, N., Marton-Alper, I. Z. & Gvirts, H. Z. Herding Brains: A Core Neural Mechanism for Social Alignment. *Trends in Cognitive Sciences* vol. 23 174–186 Preprint at https://doi.org/10.1016/j.tics.2019.01.002 (2019).

22. Hawk, S. T., Fischer, A. H. & van Kleef, G. A. Face the noise: Embodied responses to nonverbal vocalizations of discrete emotions. *Journal of Personality and Social Psychology* **102**, 796–814 (2012).

23. Cirelli, L. K. How interpersonal synchrony facilitates early prosocial behavior. *Current Opinion in Psychology* **20**, (2018).

24. Han, S. Neurocognitive Basis of Racial Ingroup Bias in Empathy. *Trends in Cognitive Sciences* vol. 22 400–421 Preprint at https://doi.org/10.1016/j.tics.2018.02.013 (2018).

25. Tarr, B., Launay, J. & Dunbar, R. I. M. Silent disco: dancing in synchrony leads to elevated pain thresholds and social closeness. *Evolution and Human Behavior* **37**, 343–349 (2016).

26. Rabinowitch, T. C. & Knafo-Noam, A. Synchronous rhythmic interaction enhances children's perceived similarity and Closeness towards each other. *PLoS ONE* **10**, (2015).

27. Kühn, S. *et al.* Neural correlates of emotional synchrony. *Social Cognitive and Affective Neuroscience* **6**, 368–374 (2011).

28. Smith, A. & Anderson, M. Social Media Use in 2018. *Pew Research Center: Internet, Science & Tech* (2018).

29. Greenhow, C. & Chapman, A. Social distancing meet social media: digital tools for connecting students, teachers, and citizens in an emergency. *Information and Learning Science* vol. 121 331–342

Preprint at https://doi.org/10.1108/ILS-04-2020-0134 (2020).

30. Ramseyer, F. T. Exploring the evolution of nonverbal synchrony in psychotherapy: The idiographic perspective provides a different picture. *Psychotherapy Research* **30**, 622–634 (2020).

31. Ramseyer, F. & Tschacher, W. Nonverbal synchrony in psychotherapy: Coordinated body movement reflects relationship quality and outcome. *Journal of Consulting and Clinical Psychology* **79**, (2011).

32. Ramseyer, F. T. Motion energy analysis (MEA): A primer on the assessment of motion from video. *Journal of Counseling Psychology* **67**, (2020).

33. Ramseyer, F. & Tschacher, W. Synchrony in Dyadic Psychotherapy Sessions. *Simultaneity: Temporal structures and observer perspectives* 329–347 (2008).

34. Kupper, Z., Ramseyer, F., Hoffmann, H. & Tschacher, W. Nonverbal Synchrony in Social Interactions of Patients with Schizophrenia Indicates Socio-Communicative Deficits. *PLOS ONE* **10**, e0145882 (2015).

35. Kleinbub, J. R. & Ramseyer, F. rMEA: Synchrony in motion energy analysis (MEA) time-series. (2018).

36. Boker, S. M., Rotondo, J. L., Xu, M. & King, K. Windowed cross-correlation and peak picking for the analysis of variability in the association between behavioral time series. *Psychological Methods* **7**, (2002).

37. Murray, S. L., Holmes, J. G., Griffin, D. W. & Derrick, J. L. The equilibrium model of relationship maintenance. *Journal of Personality and Social Psychology* **108**, (2015).

38. Rempel, J. K., Holmes, J. G. & Zanna, M. P. Trust in close relationships. *Journal of Personality and Social Psychology* **49**, (1985).

39. Mackinnon, S. P., Jordan, C. H. & Wilson, A. E. Birds of a Feather Sit Together: Physical Similarity Predicts Seating Choice. *Personality and Social Psychology Bulletin* **37**, (2011).

40. Cross, L., Wilson, A. D. & Golonka, S. How moving together brings us together: When coordinated rhythmic movement affects cooperation. *Frontiers in Psychology* **7**, (2016).

41. Aron, A., Aron, E. N. & Smollan, D. Inclusion of Other in the Self Scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology* **63**, (1992).

42. Watson, D., Clark, L. A. & Tellegen, A. *Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales*. *Journal of Personality and Social Psychology* vol. 54 (1988).

43. McCroskey, J. C., Richmond, V. P. & Daly, J. A. The Development of a Measure of Percieved Homophily in Interpersonal Communication. *Human Communication Research* **1**, (1975).

44. Wagner, U. *et al.* Beautiful friendship: Social sharing of emotions improves subjective feelings and activates the neural reward circuitry. *Social Cognitive and Affective Neuroscience* **10**, 801–808 (2014).

45. Galea, S., Merchant, R. M. & Lurie, N. The Mental Health Consequences of COVID-19 and Physical Distancing: The Need for Prevention and Early Intervention. *JAMA Internal Medicine* vol. 180 817–818 Preprint at https://doi.org/10.1001/jamainternmed.2020.1562 (2020).

46. Orben, A., Tomova, L. & Blakemore, S.-J. The effects of social deprivation on adolescent development and mental health. *The Lancet Child & Adolescent Health* **4**, (2020).

47. Sahi, R. S., Schwyck, M. E., Parkinson, C. & Eisenberger, N. I. Having more virtual interaction partners during COVID-19 physical distancing measures may benefit mental health. *Scientific Reports* **11**, (2021).

48. Brown, G. & Greenfield, P. M. Staying connected during stay-at-home: Communication with family and friends and its association with well-being. *Human Behavior and Emerging Technologies* **3**, (2021).

49. Archibald, M. M., Ambagtsheer, R. C., Casey, M. G. & Lawless, M. Using Zoom Videoconferencing for Qualitative Data Collection: Perceptions and Experiences of Researchers and Participants. *International Journal of Qualitative Methods* **18**, (2019).

50. Miles, L. K., Griffiths, J. L., Richardson, M. J. & Macrae, C. N. Too late to coordinate: Contextual influences on behavioral synchrony. *European Journal of Social Psychology* (2009) doi:10.1002/ejsp.721.

51. Sommerville, J. A. & Decety, J. Weaving the fabric of social interaction: Articulating developmental psychology and cognitive neuroscience in the domain of motor cognition. *Psychonomic Bulletin & Review* **13**, (2006).

52. Tamborini, R. *et al.* The effect of behavioral synchrony with black or white virtual agents on outgroup trust. *Computers in Human Behavior* **83**, (2018).

53. Hove, M. J. Shared circuits, shared time, and interpersonal synchrony. *Behavioral and Brain Sciences* **31**, (2008).

54. Towner, E., Tomova, L., Ladensack, D., Chu, K. A. & Callaghan, B. Virtual Social Interaction and Loneliness Among Emerging Adults Amid the COVID-19 Pandemic. *PsyArXiv* (2021).

55. Kumar, A. & Epley, N. It's surprisingly nice to hear you: Misunderstanding the impact of communication media can lead to suboptimal choices of how to connect with others. *Journal of Experimental Psychology: General* **150**, (2021).

Figures

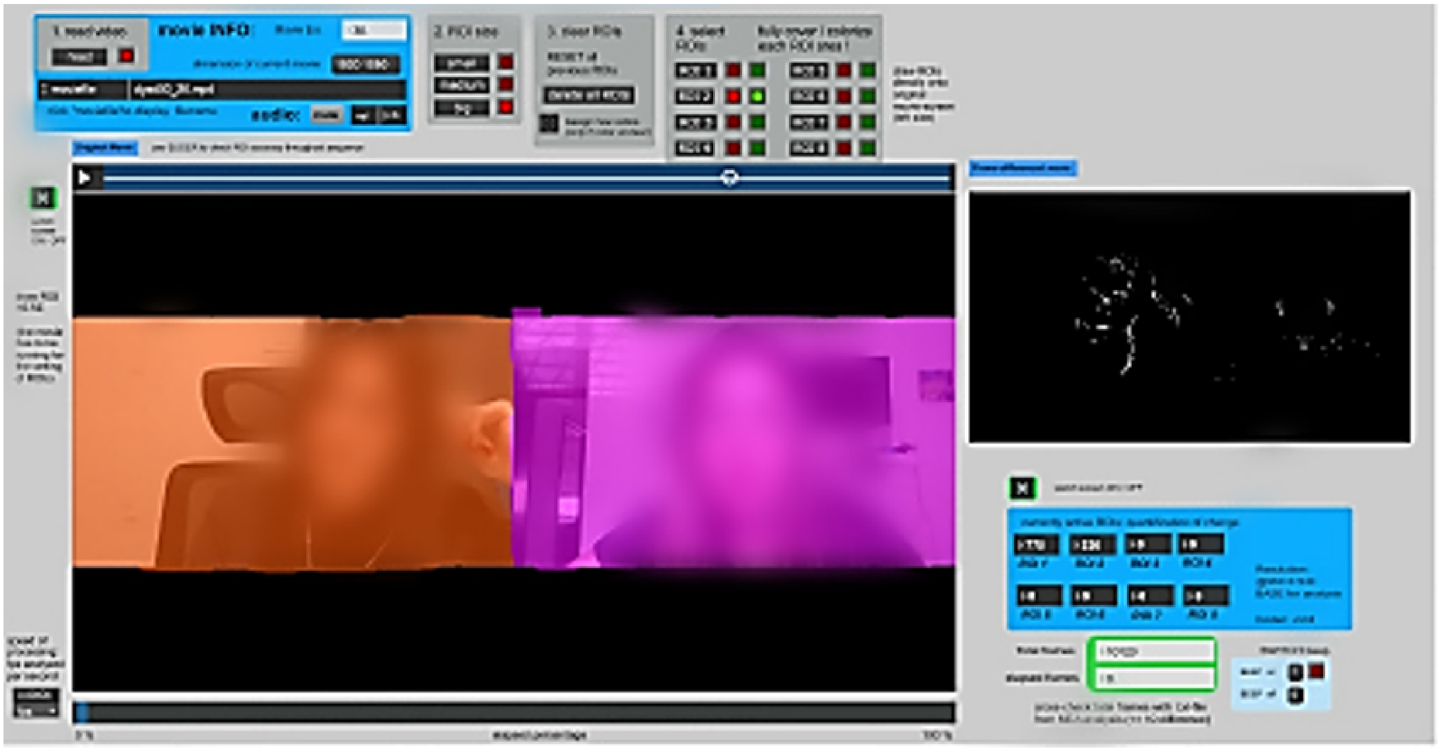

Figure 1

A snapshot of the MEA software, while analyzing one video of our collected data. The two predefined regions of intrest (ROI) apear in two different colors, each capturing the head and shoulder area of a single participant.

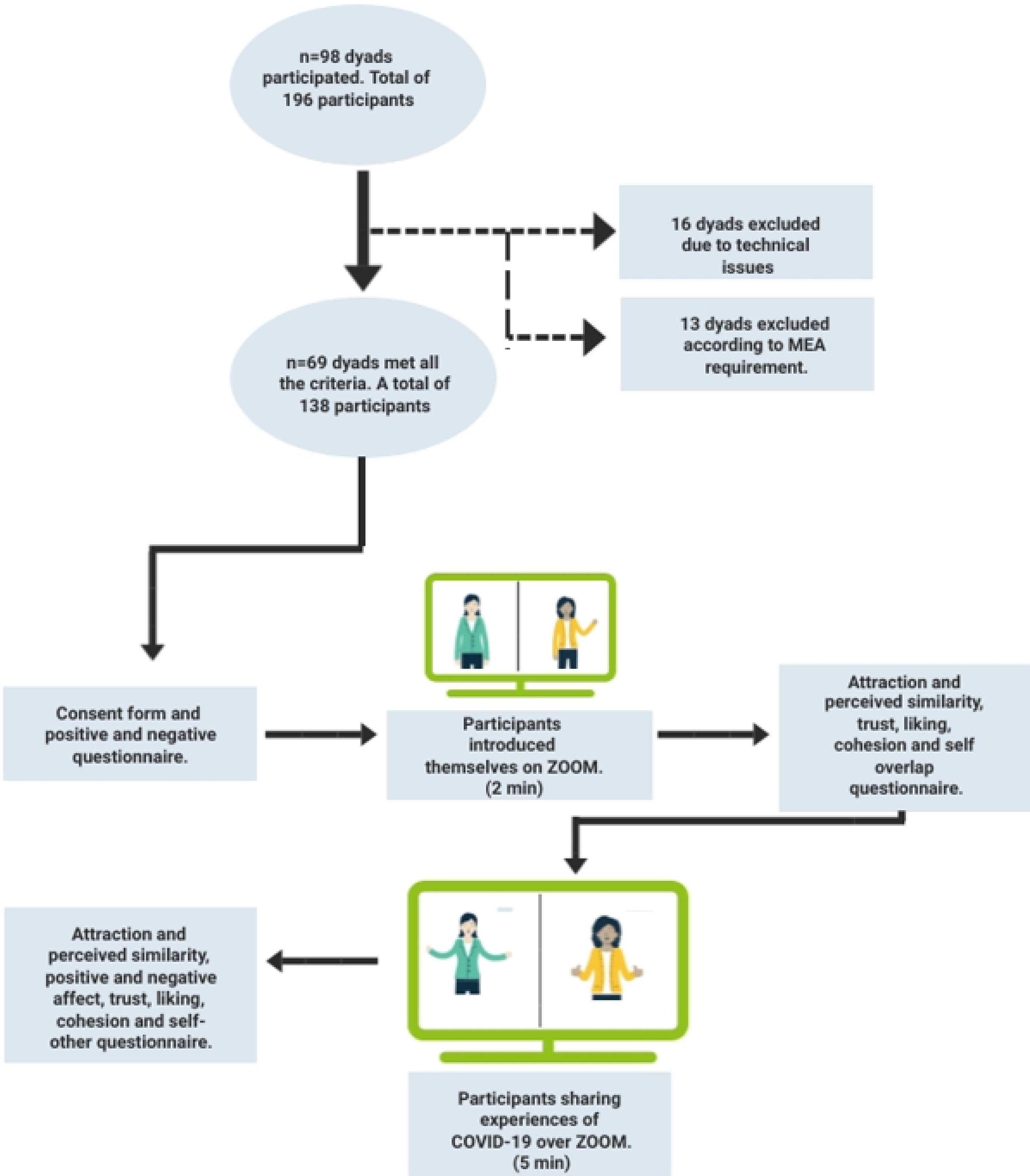

Figure 2

Experimental flowchart.

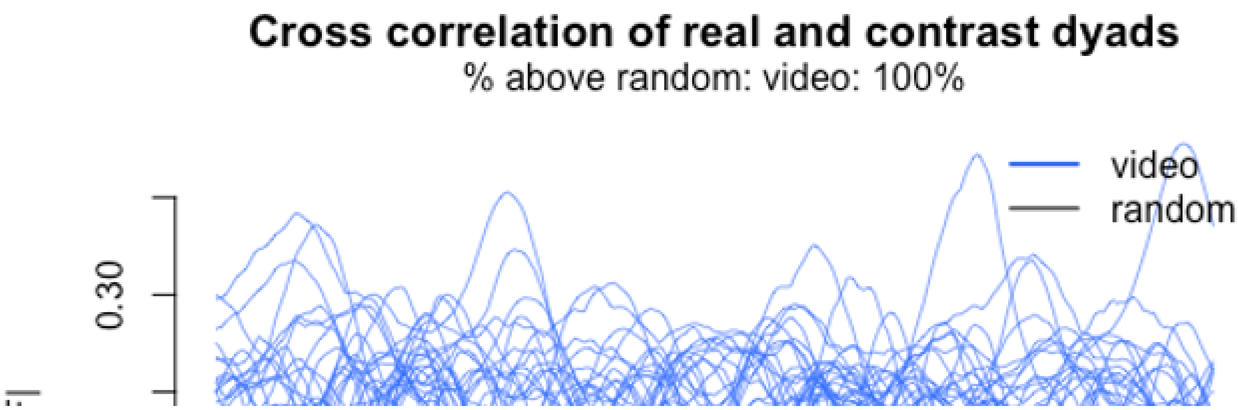

Figure 3

The lag-plot comparing real dyads and pseudo dyads (colored lines: real= blue and pseudo= grey line): Y axis= absolute cross-correlation (=synchrony), X axis = lags.

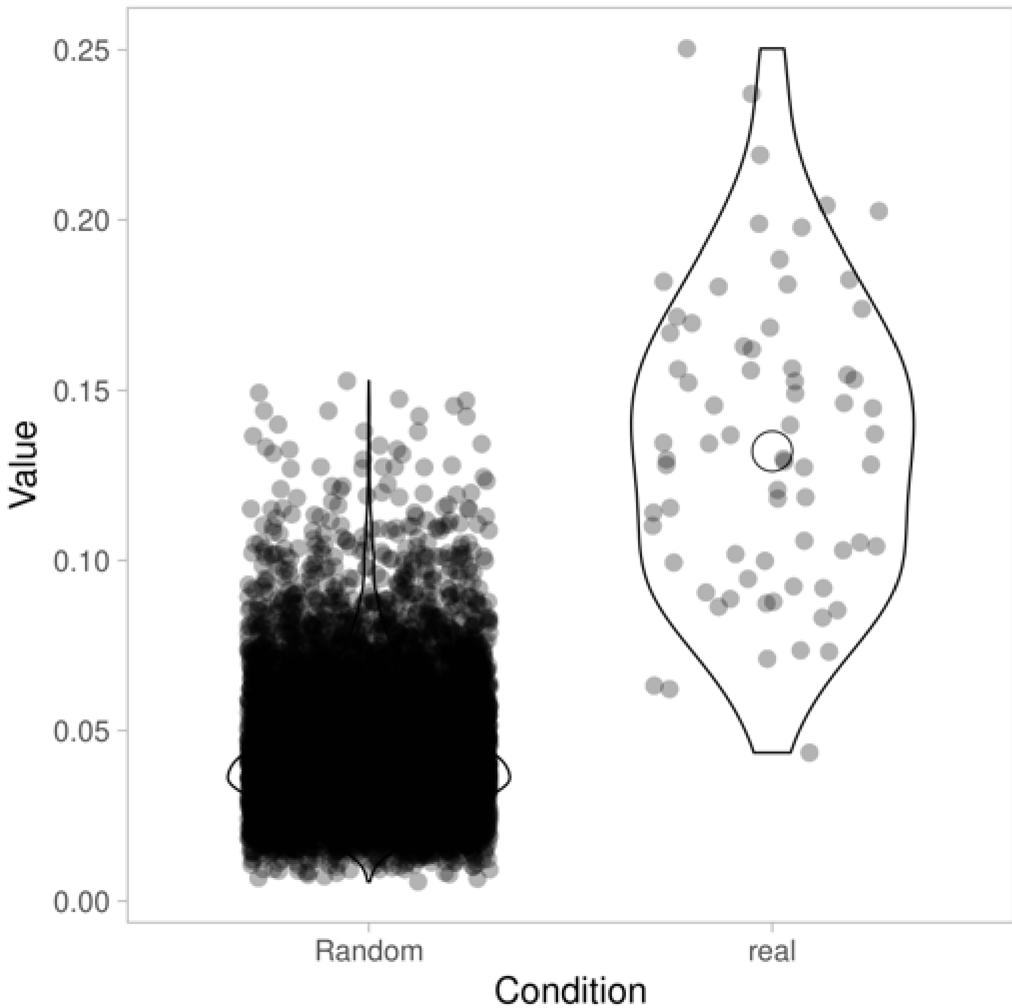

Figure 4

Shows a violin chart of the distribution of all dyadic synchronization levels within our data. On the right, we present the real data set (69 dyads) and on the left all pseduo-dyads (9660 shuffled dyads). As can be seen, the real data set comprises higher synchrony compared to the shuffled data, supporting the notion that synchrony as measured by the MEA emerged during virtual interaction. Spontaneous synchrony was significantly higher in real dyads than in pseudo-dyads, suggesting that synchrony is due to the dyadic interaction and not spurious.

Figure 5

The difference before and after the interaction for similarity in positive emotions index is shown on the left and for similarity in negative emotions index on the right. Composite scores were calculated by the difference between reports of each participant and his interaction partner. Composite scores were calculated seperately for negative affect and positive affect both before and after the interaction.