EM FOCO

PARTICIPATORY SENSE-MAKING IN DANCE IMPROVISATION

Criação de sentido participativo na improvisação em dança

Creación de sentido participativo en improvisación en danza

LOCHLAN WALSH
PAIGE WHITEHEAD
REBECCA TODD

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ABSTRACT

Participatory sense-making (PSM) provides a rich theoretical framework for theories in social cognition, providing a base for hypotheses that remain to be experimentally tested. Particularly, we are interested in exploring when synchrony arises between participating agents in social interactions. Additionally, we aim to see if altering the perceptual experiences of agents influences their ability to coordinate their intentions and behaviours. We propose a behavioural experiment that makes use of an existing dance improvisation paradigm to obtain measures of spontaneously arising coordinated behaviour. Then, we propose analysis methods, including instantaneous phase synchrony, to translate the behavioural observations into meaningful measures of coordination. We then present our expected results and discuss how they may contribute to the existing knowledge in social cognition. Additionally, we explore the implications of results that do not support our hypothesis, providing suggestions for future directions in testing hypotheses proposed by PSM.

Keywords: social cognition; behavioural synchrony; participatory sense-making; dance improvisation.

RESUMO

A criação de sentido participativo (PSM) fornece uma rica estrutura teórica para teorias em cognição social, fornecendo uma base para hipóteses que ainda precisam ser testadas experimentalmente. Particularmente, interessa explorar o momento em que surge a sincronia entre os agentes participantes em interações sociais. Além disso, pretende-se observar se a alteração das experiências perceptivas dos agentes influencia em sua capacidade de coordenar suas intenções e comportamentos. Propõe-se um experimento comportamental que faça uso de um paradigma existente de improvisação em dança para obter medidas de comportamento coordenado surgido espontaneamente. Em seguida, propõe-se métodos de análise, incluindo sincronia instantânea de fase, para traduzir as observações comportamentais em medidas de coordenação significativas. Então, apresentam-se os resultados esperados e discutem-se como eles podem contribuir para o conhecimento existente em cognição social. Além disso, exploram-se as implicações de resultados que não dão suporte à hipótese, fornecendo sugestões para direções futuras no teste de hipóteses propostas pelo PSM.

Palavras-chave: cognição social; sincronia comportamental; criação de sentido participativo; improvisação em dança.

RESUMEN

La creación participativa de sentido (PSM) proporciona un rico marco teórico para las teorías de la cognición social, proporcionando una base para las hipótesis que todavía no fueran probadas experimentalmente. Particularmente, nos interesa explorar cuándo surge la sincronía entre los agentes participantes en las interacciones sociales. Además, nuestro objetivo es ver si la alteración de las experiencias perceptivas de los agentes influye en su capacidad para coordinar sus intenciones y comportamientos. Proponemos un experimento comportamental que hace uso de un paradigma existente de improvisación en danza para obtener medidas de comportamiento coordinado surgidos espontáneamente. Luego, proponemos métodos de análisis, incluyendo la sincronía de fase instantánea, para traducir las observaciones de comportamiento en medidas significativas de coordinación. Después, presentamos nuestros resultados y discutimos cómo pueden contribuir al conocimiento existente en la cognición social. Además, exploramos las implicaciones de los resultados que no respaldan nuestra hipótesis, trayendo sugerencias para direcciones futuras en la prueba de hipótesis propuestas por PSM.

Palabras clave: cognición social; sincronía comportamental; sentido participativo; improvisación en danza.

INTRODUCTION

IN VARIOUS TYPES of social interactions, synchronized behaviours can spontaneously arise between individuals. During these interactions, it seems that we often find ourselves performing correlated behaviours with a social partner, regardless of whether we intended to do so. (DE JAEGHER; DI PAOLO, 2007) Perhaps the most familiar example of this is the synchronization of footsteps that can occur when walking with a partner. When these behaviours are performed with common or shared intentionality, we can say that they are coordinated. (DE JAEGHER; DI PAOLO, 2007) Coordinated behaviours can include small-scale exchanges such as hugging or shaking hands, as well as larger interactions such as choir singing or protest marching. Participatory sense making (PSM), a theory of coordinated social cognition proposed by De Jaegher e Di Paolo (2007), provides a theoretical basis for measuring and analyzing the rise and fall of coordinated behaviour between interacting agents. PSM describes dynamic interactions such that the coordination of participating agents' behaviours influences their interaction, and that the interaction in turn affects the extent to which they maintain it. For example, consider the interaction that arises when two individuals walking in opposite directions confront each other in a narrow hallway. This scenario is frequently accompanied by a form of coordinated behaviour, whereby the two individuals, in an effort to pass one another, end up shifting laterally such that they mirror one another's position – often resulting in a sequence of these mirrored movements. This common scenario demonstrates

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how the coordinated movements of the agents affects the interaction (insofar as they serve its continuation), as well as how the interaction process itself tends to encourage these coordinated movements. (DE JAEGHER; DI PAOLO, 2007) Most importantly, PSM proposes that when interacting agents coordinate intentional activity, they can contribute new information to both the interaction process and their partner. Here, they participate in mutual “sensemaking” where their intentions both influence and are influenced by the interaction in an ongoing and dynamic way. As such, this interaction process is able to provide cognitive and perceptual experiences that would otherwise be unavailable to the agents in isolation. In other words, it is a dynamic, emergent system that contains more information than the sum of the individual agents alone, and when these agents are actively involved with such a system, they demonstrate behavioural coordination. Although PSM provides a rich theoretical framework for understanding social cognition, many hypotheses that arise from it have yet to be tested.

From a social cognition standpoint, it could be that such patterns of coordination described by PSM accomplish things such as aiding in the connection with others, mediating the process of social bonding, improving cooperation, or experiencing similar cognitive states. (DE JAEGHER; DI PAOLO, 2007; LYRE, 2018; WHEATLEY et al., 2012; WHEATLEY et al., 2019) However, the amount of coordination present in an interaction, as well as how this coordination manifests and impacts processes of social bonding, can be influenced by contextual information. To illustrate the influence of context, De Jaegher e Di Paolo (2007) ask us to imagine a situation where two individuals coming from cultures that traditionally greet others by kissing cheeks are introduced to one another in America, a society that doesn’t typically display this greeting customary. They may hesitate, unsure as to what the other interactor will do. Eventually, from subtle behavioural cues, some kind of coordination is likely to emerge, and the two individuals will engage in a coordinated greeting, whether that be a kiss or something else. In this scenario, the immediate context influences not only the development of coordination, but also the type of coordinated behaviour that is manifested. Context also influences the cognitive and perceptual state(s) of an agent. In our previous example, the context (i.e. being in a culture that doesn’t greet with kissing cheeks) influences the agent to alter their behaviour, adjusting to what they think would be appropriate given their current situation. In addition, the agents may focus more on the body language of

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their partner through perceptual awareness to determine the best action, which they may not have done in a different context. In extension, it remains to be tested whether an agent's cognitive and/or perceptual state influences coordination with a partner. If so, how is this coordination affected, and to what extent?

At the level of the human brain, there is evidence that the brain rests in a state of 'metastability', where neural circuits continuously switch between different states of activity. (TOGNOLI et al., 2020) Some of these states involve phase-locking, where neural circuits exhibit cyclical, symmetrical phases of coordinated firing in temporal patterns. (TOGNOLI et al., 2020; TOGNOLI; KELSO, 2015; WOHLTJEN; WHEATLEY, 2020) One such case of this neural phase-locking is in the anticipation of motor actions, where sub-groups of (pre)motor neurons demonstrate coordinated synchronized firing in advance of a motor command being carried out. (ENGEL; FRIES; SINGER, 2001) In these groups, neurons exhibited synchronous oscillations in preparation of a motor response, and an accompanying breakdown in phase-locking during and after the response was executed. (ENGEL; FRIES; SINGER, 2001)

The concept of phase-locking is not restricted to brain activity, as it occurs on many observable scales in everyday life. Consider two friends walking alongside one another on a sidewalk. As they walk, they continuously adjust their gait to remain next to their friend. Consciously, one may not be thinking about the appropriate step distance and speed to do this, but observable patterns within this behaviour still arise. For example, there may be periods where both friends are stepping at the same time with the same foot, resembling symmetrical phase-locked coordination. However, without deliberate effort to maintain this coordination, the phase-locking quickly breaks down as they begin to walk out-of-step again due to small differences in step distance and speed. These in- and out-phase periods of walking are analogous to the metastability of brain circuits, where they may fall into phase-locked patterns for periods of time before breaking off.

Phase-locking can occur in the brain at both a local and global level across various frequency bands, and has been shown to correlate with observable synchronous behaviours. (TOGNOLI; KELSO, 2015; TOGNOLI et al., 2020; WOHLTJEN; WHEATLEY, 2020) Circuits exhibiting activity indicative of such a state (i.e., sharing a coordinated temporal firing pattern with other circuits) has been suggested to be a result of spontaneous neural activity combined with the influence of one's perceptual and cognitive state. (TOGNOLI; KELSO, 2015) Notably, correlations have been demonstrated between this pattern of neural activity and synchronous social behaviour such as dyadic conversations. (TOGNOLI; KELSO, 2015; WOHLTJEN; WHEATLEY, 2021) Namely, during periods of a conversation where participants made eye contact with their partners, measurements of neural activity using EEG exhibited accompanying neural synchrony between partners at those same points in time. (WOHLTJEN; WHEATLEY, 2021) In this case, the rise and fall of behavioural synchrony (e.g., eye contact) between two partners coincided with the production and breakdown of phase-locked neural circuits between subjects (HIRSCH et al., 2017); see also (WOHLTJEN; WHEATLEY, 2021). In other words, the rise of synchrony in a conversation was seen to be related to synchronous phase-locked EEG patterns, while synchrony diminished as the phase-locked EEG patterns dispersed (HIRSCH et al., 2017); see also (WOHLTJEN; WHEATLEY, 2021).

Much of the previous literature aiming to understand the neural correlates related to social synchrony has focused on dyadic eye contact as an interaction type, involving measurements of the time(s) that two interacting partners establish eye contact. (HIRSCH et al., 2017; KELLEY et al., 2021; KOIKE et al., 2019; NOAH et al., 2020; WOHLTJEN; WHEATLEY, 2021) However, social interactions can take on a wide array of forms in variable settings, suggesting that studying other interaction types may be of use to furthering our knowledge of how behavioural synchrony arises, as well as its functionality. Dance improvisation serves as an example of a dynamic interaction that is continuously 'updated' by the participating dancers. In relation to sense-making, the agents engage with the interaction as it unfolds over time, influencing the form it takes, as well as movements of themselves and their partner. In this form of movement, dancers are often given a prompt or idea that guides them to make certain types of decisions leading to relevant movements, but often without a predetermined set of movements. This requires them to adjust their movements in response to perceptual experiences (e.g. seeing what a partner or their own body part is doing) and cognitive states (e.g. their current intention relevant to the interaction). Furthermore, it has been suggested that interacting agents engage in 'perceptual flow', where they establish a connection with their partner through perceptual mediums, such as vision, to maintain the interaction. (TOGNOLI; KELSO, 2015; WHEATLEY et al., 2019) This involves the agents sharing and collecting information relevant to the interaction, such as what one's body is doing or whether one is becoming disinterested in a conversation, allowing them to modify their behaviours as the interaction unfolds. However, this flow depends on the agents' perceptual states, such as whether they can perceive what their interaction partner is doing. As such, varying the perceptual state of these interacting agents would likely alter the information they have access to in the interaction process, resulting in different patterns of behavioural coordination. If two partners were attempting to mirror each other's movements, and then both closed their eyes, they would lose access to some perceptual information necessary to maintain the interaction. As a result of perceptual flow being interrupted, we may see a loss of coordination between the two. Conversely, it's likely that coordination is greatest between two agents that can establish perceptual flow, as they have continuous access to information shared in the interaction process.

Using the PSM framework, this study aims to obtain a measure of behavioural coordination through the synchrony of partnered improvising dancers. Particularly, we aim to investigate whether periods of coordinated activity that arise between partners reflect phase-locking, and if so, at what point(s) during an interaction will such phases occurs?

THE PRESENT STUDY

In this study, we will examine synchrony between partners through spontaneously formed coordinated patterns of movement. To do so, we will use an experimental design that includes the following: two dancers will be seated at a table next to one another, improvising with their arms placed on the table. Throughout the improvisation period, one or both partners will be instructed to open/close their eyes during specific time intervals. Video recordings of the improvisation will be analyzed using movement analysis software (PEÑA et al., 2013) to obtain measures of their movement trajectories. Over time, the velocities of their movements will rise and fall as they adjust their behaviours during the interaction. As such, we expect to see the formation of phase-locking patterns in these velocities, as well as their periodic breakdown throughout. For instance, there may be periods

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where one dancer begins quickly moving their hands, possibly being joined by their partner. The symmetry in their velocities would be indicative of phase-locking, breaking apart when one dancer alters their behaviour. Moreover, we aim to see whether altering the dancers' perceptual experiences (e.g., opening/closing one's eyes during improvisation) will affect this synchrony, and acquire measures of how much the alteration of such experiences affects it.

Ultimately, we hypothesize that partnered improvising dancers will enter collective states of phase-locking, demonstrating movement patterns similar to weakly-coupled oscillations. In periods where a dancer has their eyes open, we expect that they will couple their movements to that of their partner. Consequently, periods where both dancers have their eyes open will likely demonstrate the greatest behavioural synchrony when compared to other intervals. In contrast, we expect that a dancer with their eyes closed will lose access to new perceptual information in the interaction, constraining the sensitivity of their actions by the most recently available perceptual information. As a result, we expect that periods where one dancer has their eyes closed will exhibit lower behavioural synchrony when compared to periods where both dancers have their eyes open. Similarly, periods where both dancers have their eyes closed are expected to display the lowest behavioural synchrony of all the improvisation intervals.

METHODS

The experimental protocol that will be used to test our hypotheses was created by Santana, Miranda e Ramos (2021).

PARTICIPANTS

Participants will be dancers who have at least five years of dance experience, preferably in improvisation performance. In addition, they must be at least 19 years of

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age and able to improvise with their arms in the presence of a partner for a period of 15 minutes. They will be recruited via advertisement at a local drop-in dance facility.

EXPERIMENTAL SETUP

The setup for this experiment involves two dancers seated at a table placed in a quiet, open space (e.g., dance studio). The dancers will be seated perpendicularly such that both face inwards towards the table, but at a 90-degree angle to one another. Here, the table will be covered with a white tablecloth or other fabric covering to provide a contrasting background with the dancers' arms and the floor. Contact stickers ('markers') will be adhered to the top and bottom of both dancers' wrists, totalling four stickers per dancer.

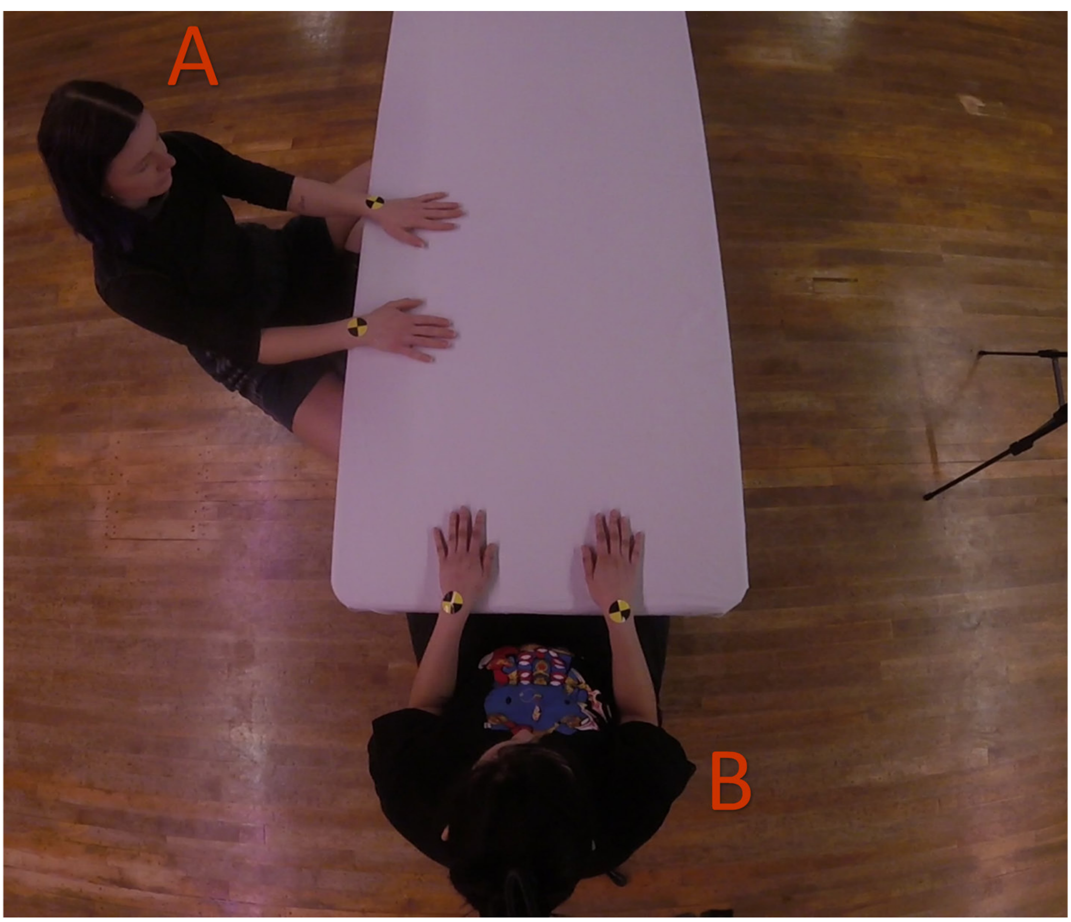

Figure 1 – Experimental setup. The participants, labelled here with their respective referent's "A" and "B", are seated perpendicular to one another at a table. Markers (yellow and black stickers) are placed on each of their wrists for post-experiment motion analysis using CvMob 3.6 (open-source movement analysis software)
Source: experiment archive image.
Team collection.

These stickers will allow trajectories (velocity) of the dancers' hands to be measured through movement analysis of video recordings taken during this experiment. To acquire these video recordings, a GoPro camera (HERO + LCD, 1080p, 60fps) will be set up using a tripod to capture the dancers' movements.

PROCEDURE

The experimental task involves dance improvisation focusing on the hands and lower arms. At the beginning of the experiment, a short warm-up sequence will be led by a researcher to prepare the dancers' bodies and bring awareness to their movements. The participants will then be read a statement by the researcher. The statement will outline the relevant practical guidelines of the improvisation, as well as provide the participants with a prompt to guide their improvisation. This prompt asks the participants to imagine that the table surface is magnetic and that their hands are attracted to its surface such that they are unable to remove them throughout the improvisation. Following this, and before the partnered section of the experiment, each dancer will complete a two-minute calibration period alone at the table. Participants will be asked to open their eyes for the first minute of improvisation and to close their eyes for the remaining minute. This calibration allows dancers to familiarize themselves with the table, the markers, and improvising with their hands on the table. Additionally, it provides a test run to ensure the video recordings are being captured, and that the analysis software can appropriately track the markers on each dancer's wrists.

After the calibration period is complete, both dancers will be seated at the table. The task will last a total of 15 minutes, with a voice recording indicating time intervals with specific conditions. There will be a total of five intervals, each lasting a total of three minutes. The dancers will begin with both of their eyes closed during the first interval of the experiment. During the second interval, both partners will have their eyes open. In the third interval, participant A (referents "A" and "B" will be assigned at the beginning of the experiment) will be told to open their eyes while participant B closes their eyes. Following this, the partners switch who has their eyes open/closed. The remaining intervals will require both partners to open their eyes. All instructions will be indicated by the recording.

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Figure 2 – QR code linking to demonstration of the experimental protocol. Two participants improvising during the A-__ B-__ task block
Source: experiment archive image. Team collection.

Using the CvMob 3.6 software, we will extract time-series data corresponding to the velocity of the dancers' hands throughout the 15-minute task. To do so, we calibrate the software to track the markers on the dancers' hands throughout the videos. Then, the velocities can be recorded as continuous data points throughout the task for both participants. The data points collected will correspond to the frames per second captured by the camera (60fps). Upon gathering this time-series data, we will measure the instantaneous phase synchrony between the velocities of the two partners (Figure 3). If the movements of the dancers oscillate as predicted in the introduction, we should be able to measure phase synchrony over time with noticeable variation between intervals. (CHEONG, 2020)

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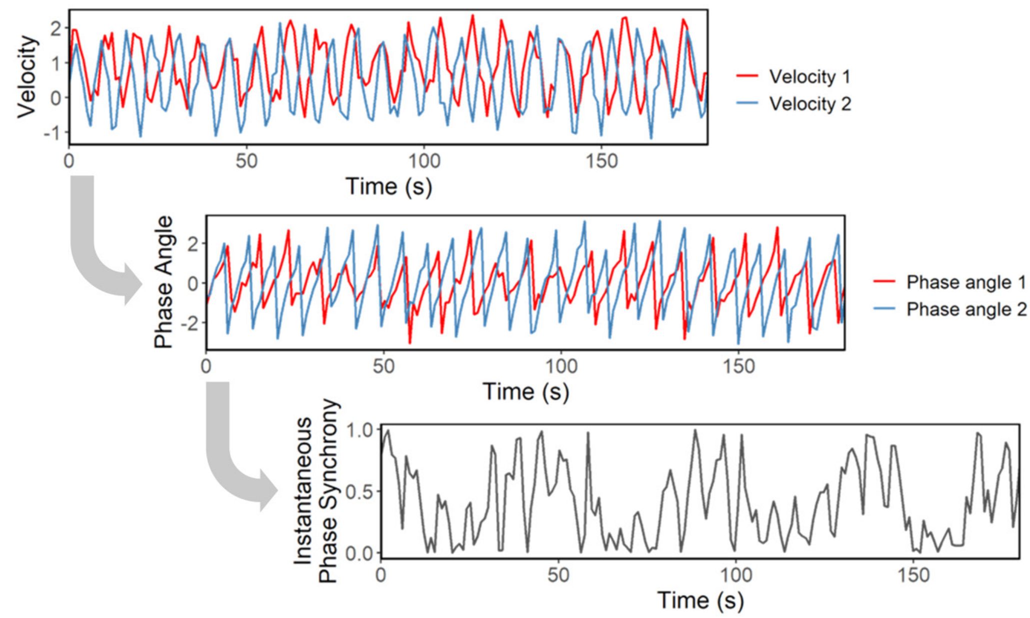

Figure 3 –Velocity to phase synchrony transformation. This figure illustrates the steps required to calculate phase synchrony between two signals, based on hypothetical, simulated data. Phase synchrony (bottom panel) is derived from the difference between phase angles (middle panel), which is calculated by taking the "Hilbert" transformation of velocities plotted over time (top panel)
Source: experiment archive image. Team collection.

Further analysis will make use of time lagged cross correlation (TLCC), where the synchrony of the data can be analyzed to infer leader-follower roles across the entire interaction. (CHEONG, 2020) To observe these correlated dynamics during specific intervals, we will perform a windowed time lagged cross correlation (WTLCC). Both analyses provide quantitative measures of which participant is leading/following in the interaction, but as they are correlations, we would be limited to making inferences on such patterns.

DISCUSSION

Based on the previously discussed literature, coordinated synchrony clearly arises in different types of social interactions. However, these studies often make use

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of interactions with predefined goals, such as maintaining a conversation regarding specified topics. In this study, dance improvisation serves as a medium for observing how coordination can arise spontaneously in interactions that lack a specified output or result between partners. This aims to show a more 'naturalistic' formation of coordinated synchrony, without rigid constraints on how the interaction should unfold.

The expected results supporting our hypothesis would be consistent with perceptual flow. Participating agents would adjust their behaviours and intentions to maintain an effective connection with their partner based on available perceptual information (Figure 4).

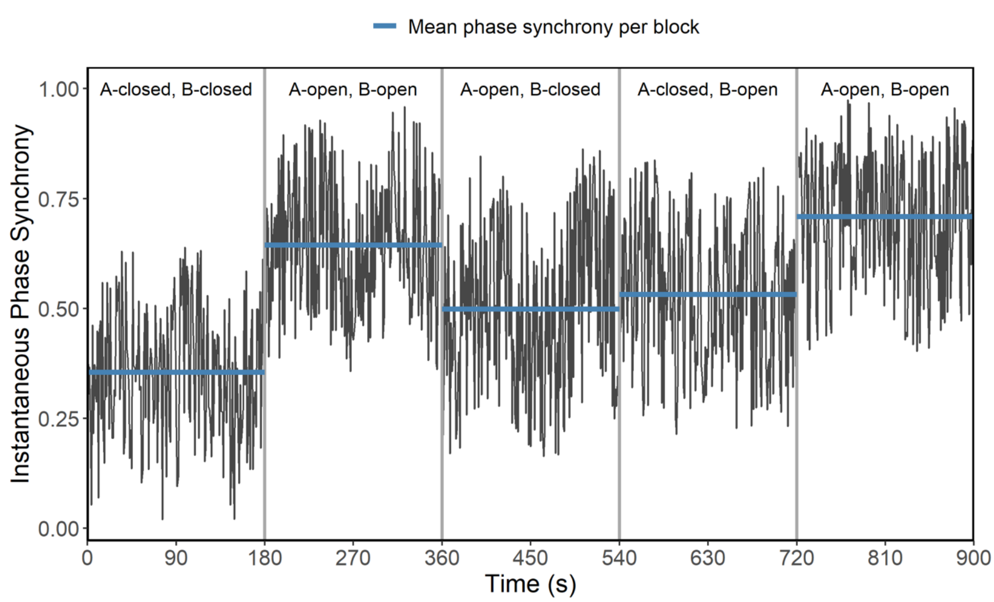

Figure 4 – Hypothetical predicted phase synchrony between two participants based on simulated data across five task blocks. The synchrony profile illustrated here would provide support for the current hypothesis that behavioural synchrony will be greatest when joint perceptual information is greatest (i.e. when both participants have their eyes open), intermediate when joint perceptual information is limited (i.e. only one participant has their eyes open), and lowest when joint perceptual information is eliminated (i.e. when both participants have their eyes closed). Blue lines indicate mean phase synchrony in each task block, showing highest synchrony during A-open B-open, intermediate synchrony in A-open B-closed and A-closed B-open, and lowest synchrony in A-closed B-closed
Source: created by the authors.

As they lose access to current perceptual information, it may be that their ability to adjust their behaviours and intentions is constrained to that of the most

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recent information obtained from the interaction. (TOGNOLI; KELSO, 2015) Due to random movements and autonomous thought, there may be brief, unintentional moments of synchrony shared between dancers. But, with respect to the PSM framework, we would only expect to see significant periods of coordinated phase-locking when at least one agent is actively participating in the interaction process and has access to the information it provides. So, PSM may function through perceptual flow by allowing participating agents to coordinate their intentions and sense making. In this case, perceptual information seems necessary to allow agents to coordinate during a social interaction.

These findings may subtly hint at the importance of perceptual state in distantly related fields, such as the realm of body-oriented psychotherapy. It has been shown that interactional synchrony, where therapists aim to coordinate their movements with that of their patients, can have a positive effect on reducing the severity of negative schizophrenia symptoms. (GALBUSERA; FINN; FUCHS, 2016) However, these interactions rely on the in-person presence of both the therapist and the patient, allowing them constant perceptual access to one another during a session. As suggested by PSM and our expected results, a loss of perceptual access is likely to negatively impact the synchrony that can be established between partners, and in this case, prevent patient symptoms from easing. With online therapy, a session over video or text chat may not allow enough perceptual information to establish coordinated synchrony between a patient and therapist, body-oriented or not. As such, it seems that certain forms of psychotherapy could maximally benefit from emphasizing in-person sessions that aim to establish therapist-patient synchrony.

Contrarily, observing coordination patterns that do not support our hypothesis comes with interesting implications. If synchrony is nonzero and has little variation between intervals (Figure 5), it may be that perceptual state, or access to continuous perceptual information, is not necessary to establish intentional coordination (or behaviour that resembles it).

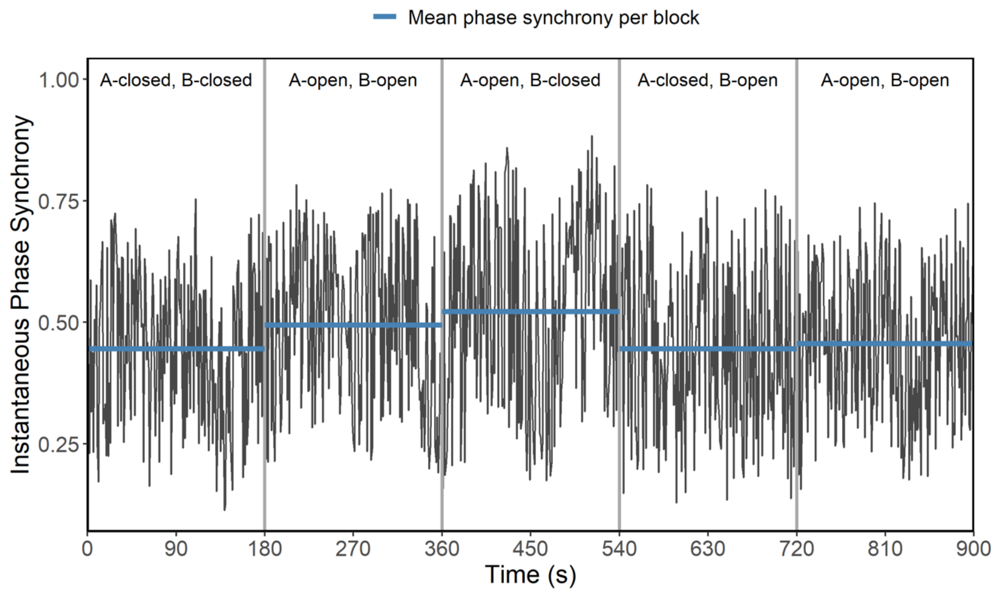

Figure 5 – Hypothetical null result – the phase synchrony between two participants based on simulated data across five task blocks if perceptual information does not play an important role in behavioural synchrony. Blue lines indicate mean phase synchrony in each task block, showing insignificant variation between task blocks. These results would contradict the current hypothesis that behavioural synchrony will be correlated with the degree of joint perceptual information
Source: created by the authors.

An explanation for this may be that the context of the interaction constrains the type of goals one can make and the behaviours they can perform, resulting in the formation of independent, but similarly relevant, intentions. These similar intentions would shift the behaviours of the agents such that they are coordinated enough to reflect continuous synchrony throughout the intervals, regardless of whether an agent has access to the information provided by their partner. In extension, such results may suggest that individuals who need to coordinate with others to accomplish tasks, such as in an office setting, may not require constant perceptual access to their partner(s). With respect to PSM, the hypotheses proposed by this framework do not predict ongoing coordination when both agents lose access to the interaction. So, when two dancers have their eyes closed, observing consistent phase-locked synchrony may suggest that some other aspect of the interaction process, such as context-dependent goals, are mediating the interaction, rather than perceptual information. Or, it may be the case that in various forms of interactions, synchrony tends to steadily increase over time as the agents become more situated in the process.

LIMITATIONS

There are some limitations to obtaining a measure of behavioural synchrony through dance improvisation. Despite a lack of music or rhythmic stimulus, dancers may be able to use other cues, such as breathing or sounds of friction against the table, to coordinate their movements with one another. These potential confounds are challenging to completely eliminate from an experimental setting but could hopefully be mediated by using a smooth table surface that minimizes the sounds of friction. To mediate dancers' breath as an auditory cue, participants could be asked to avoid moving with exaggerated breaths. However, this solution may come with the cost of the improvisation feeling unnatural.

Methodologically, there may be some benefit to randomizing the order in which each interval appears throughout the trial. Participant expectations or adaptation to the trial order may influence the behaviours they perform during each interval, affecting the resulting patterns. Similarly, using randomized intervals could instead allow us to see whether synchrony naturally tends to increase over time if interval order has no effect.

Lastly, while results supporting our hypothesis may be useful in understanding how dancers tend to coordinate with a partner, they may not be as easily applied to the general population. It may be that because dancers with improvisation experience are familiar with the general 'process' of an improvisation session, they have prior knowledge of the types of movement or coordination patterns one can make. If we were to attempt this study with non-dancers, we might find a lower degree of overall synchrony, or an inability to establish phase-locked coordination, due to unfamiliarity with this type of interaction. Such possibilities warrant further study using methodologies such as this.

FUTURE DIRECTIONS

Moving forward, it has been suggested that social neuroscience should shift the research focus towards the transitions to and from coordinated periods, aiming to understand what drives them. (DI PAOLO; DE JAEGHER, 2012) Using our methodology, further analyses would attempt to provide insight into these transitions, analyzing the behavioural patterns preceding and following periods of coordination. To do so, we would use WTLCC to identify periods where patterns indicative of leader-follower roles appear. Certain role relationships may occur in response to the different intervals, such as A-leader B-follower during the A-closed B-open section, changing in the following interval(s). This could suggest that role formation and reversal are what drive variation in coordination during an interaction. Or, it may be that changes in behavioural coordination precede these role adjustments, suggesting that roles update to reflect the flow of perceptual information in an interaction. Both are interesting possibilities for further tests of the hypotheses proposed by PSM.

CONCLUSION

In this paper we've proposed a methodological framework that makes use of an existing dance improvisation paradigm to further test the hypotheses laid out by PSM. We expect that perceptual state will alter the degree to which coordinated movements can be established between dancers, suggesting that such information is an essential component of social interactions. The overall goal of this experiment is to further contribute to our understanding of social interactions – how they form, how they adjust over time, and the mechanisms behind them. Future directions have been laid out for additional analyses that can be conducted with this paradigm, aiming to provide insight into the 'roles' that we take during interactions, and how they are linked to the transitions between periods of coordination.

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WALSH, Lochlan, Lochlan Walsh: was a professional hip-hop and contemporary dancer, actively training with various companies across Canada. He graduated from UBC with a BSc Cognitive Systems and is now studying coordinated behaviours in the MSc Animal Behaviour at the University of St Andrews.

WHITEHEAD, Paige: is a former dance artist interested in studying the relations between the situated body and cognition. She's completing her bachelor's in Cognitive systems at the University of British Columbia and hopes to one day incorporate her knowledge into a clinical practice.

TODD, Rebecca: was a contemporary dance choreographer probing relationships between embodiment, mental imagery, affect, and memory before turning to the tools of cognitive science to investigate the same themes. She is currently an Associate Professor in cognitive science in the University of British Columbia in the Department of Psychology.