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Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 46(0)

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Publication Date

2024

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Movement coordination as a measure of togetherness in improvised dance duets

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Abstract

The study focuses on the mechanisms through which dance brings people together. We recorded 7 improvised dance duets and asked 5 skilled improvisers to rate the perceived togetherness in the recorded dances. Subsequently, we employed pose tracking techniques and developed a quantitative measure of the stability of interpersonal movement coordination between dancers, demonstrating that it strongly correlates with experts' togetherness ratings. Based on follow-up interviews, we revealed that experts' understanding of togetherness converges to a stable construct, involving a state of responsive, mindful attention. This construct can be grounded in the objective properties of movement coordination. These properties can be framed within the context of dynamical systems, suggesting potential systemic organization principles, such as moment-to-moment adaptation, that promote togetherness. Our mixed-methods research has implications for various fields, including psychology, cognitive science, and art studies.

Keywords: togetherness; co-regulation; dance; contact improvisation; interpersonal coordination; recurrence quantification analysis; interpersonal synergies

Introduction

In recent years, dance has attracted interest as a cultural practice that offers holistic benefits, addressing the physical, psychological, and social needs, as well as providing creative expression for participants (Christensen et al., 2021). A recent literature review identified belonging – understood as a sense of togetherness, being in a relationship, bonding, experiencing support and solidarity, social connection, and shared culture or cultural identity – as one of the key factors contributing to dance's impact on health and well-being (Chappell et al., 2021). However, the majority of this evidence comes from self-reflections of practitioners and participants rather than experimental research, and the mechanisms behind the feeling of togetherness are rarely investigated.

We view being together with someone as a skill that is very much connected with the ability to communicate with another person, not just verbally, but in terms of emotional understanding, coordinated joint attention, and rhythms of engagement with each other and with the world. Naturally, it transcends dance and is applicable across all sorts of everyday interactions. We know that people instinctively coordinate with others in a blink of an eye, which is important for their effective collaboration and performing joint actions together (Valdesolo, Ouyang, & DeSteno, 2010), and on longer timescales for co-regulation of their emotions (Feldman, Magori-Cohen, Galili, Singer, & Louzoun, 2011; Koole & Tschacher, 2016). This fosters trust and social harmony (Goldstein, Losin, Anderson, Schelkun, & Wager, 2020) and builds affiliation (Hove & Risen, 2009; Lakens & Stel, 2011). Dance, particularly in the form of improvisation practices, provides a unique training environment for developing such relational skills that are further transferable to other social contexts (Lakes et al., 2016; Kronsted & Gallagher, 2021).

In the research domain, embodied cognition theorists often turn to dance as a compelling illustration of the inherent complexity of social interactions (Sheets-Johnstone, 2011; Flakne, 2019; Noë, 2021). Improvised dance, characterized by the seamless integration of "process" and creative "product," offers a particularly fitting context (Łucznik, 2015). The examination of dance improvisation not only serves to validate theoretical frameworks but also positions dancers as experts in embodiment, who may contribute to our understanding of social skills (Kimmel, Hristova, & Kussmaul, 2018). Among various dance forms, contact improvisation (CI) emerges as a particularly compelling open-ended format, which was previously successfully employed as a research frame in the studies of interpersonal coordination (Himberg, Laroche, Bigé, Buchkowski, & Bachrach, 2018; Torrents, Hristovski, Coterón, & Ric, 2016), embodied creativity (Torrents, Castañer, Dinušová, & Anguera, 2010; Kimmel et al., 2018; Goldman, Thomas, & Sajda, 2021) and attention skills (Little, 2014; Deans & Pini, 2022).

Motivated by the above-mentioned considerations, we decided to investigate togetherness in CI duets in a semi-naturalistic setting. We recorded dance duets where togetherness was intentionally established and sustained through the dance. We employed pose tracking techniques and developed a quantitative measure of the stability of interpersonal movement coordination, which strongly correlated with togetherness ratings of expert improvisers. Then, we conducted further interviews to elucidate how togetherness in dance is understood and perceived. Our mixed-methods approach fills the gap between dance studies and interpersonal coordination studies employing pose tracking, integrating various methods of inquiry.

Studying togetherness in dance

Conducting experimental research within the realm of dance presents inherent challenges due to the intricate interplay of

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physical, relational, social, and cultural dimensions. These aspects often intersect in a multifaceted manner (compare Christensen et al. (2021). As a result, researchers often employ dance-inspired, yet simplified, experimental frameworks to mitigate certain variables while preserving the core essence of the dance phenomenon. This strategy allows for a more controlled investigation into specific aspects of interest; however, it can be too reductive to fully understand the complexity of the phenomenon in question.

In a laboratory setting, Noy, Levit-Binun, and Golland (2015) investigated the emergence of togetherness during joint improvisation. Pairs of participants were tasked with moving handles along parallel 1D tracks, with instructions to create a "synchronized and interesting motion" collaboratively. The recorded performances were later retroactively rated by the participants on a scale of felt togetherness during the interaction. The study revealed a strong correlation between subjective ratings of togetherness and stable movement synchronization. However, an in-depth examination of physiological markers, such as cardiovascular arousal and synchronicity, suggested that felt togetherness is not merely a consequence of aligned movement. Unsurprisingly, a meta-analysis of synchrony's effects (Mogan, Fischer, & Bulbulia, 2017) indicated only a small-to-medium-sized positive influence on perceived social bonding, understood as affective and affiliative interaction ratings.

Himberg et al. (2018) introduced protocols for investigating togetherness within groups. These protocols engaged participants in simple ensemble movement improvisation tasks, such as a 4-player mirror game and rhythm battles. The study compared measures of movement synchronization with participants' subjective ratings and self-reports on their perceived connectedness with others. However, the study's findings also suggested that togetherness is not solely determined by synchronicity. Additionally, the researchers observed that achieving a state of shared agency and togetherness, characterized by spontaneous movement without explicit leadership, was attainable only by experienced dancers.

Kimmel and Hristova (2021) analysed contact improvisation duet exchanges through the lens of micro-genetic analysis, zooming into micro-structures and unraveling dancers' perceptions, actions, imagery, and anticipations of a single moment in great detail. They found that at the sub-second scale the co-creation of dance is result of skillful embodied communication, a continuous "give and take" exchange between partners, fine embodied tuning rather than mere imitation or following of partners' cues.

In our approach, we also adopt a more naturalistic examination of authentic improvised dance interactions in their full complexity. We are interested in the dynamics of the ongoing process, not just the end results. By involving professional dancers, we sought to capture their virtuoso skills of relating with others through movement, and learn from their expertise. We asked what skills and predispositions are needed for building a bond and maintaining togetherness, and how it emerges in interaction. While our investigation is grounded in a dance context, we aspire to extrapolate our findings beyond the confines of a controlled laboratory environment and a field-specific examination, fostering broader applicability to real-life interactions.

Methods

Study design This study focused on observing CI duets in a semi-naturalistic setting. Contact improvisation is a form of performance practice and social dance that originated from 1970s postmodern dance experiments. Over the past 50 years, CI has heavily influenced the contemporary dance scene and become a worldwide movement with jams (community meetings), workshops, and festivals held on all continents and in most countries. The CI originators described it as "the improvised dance form based on the communication between two moving bodies that are in physical contact and their combined relationship to the physical laws that govern their motion—gravity, momentum, inertia. (...) Practice includes rolling, falling, being upside down, following a physical point of contact, supporting and giving weight to a partner" (Paxton, 1979).

To collect video materials, we invited pairs of dancers to a studio and asked them to engage in a very open dance score (task): "You have 3 minutes for your personal warm-up in the space. After that, you will hear a bell signaling the start of an improvised duet lasting 5 minutes. The end of this time will be marked with another bell. You don't need to immediately transition into a duet; find your natural timing. Additionally, you don't have to remain in the duet all the time if it doesn't make sense for you. This is just a general frame for this dance". Both the warm-up and the dance were recorded on a video camera.[1] These recordings were later annotated by experts on the dimension of perceived togetherness of the duets and analyzed using a pose tracking approach to extract quantitative, movement-based measures of togetherness.

Participants Dance recordings: We recorded seven duets during the Warsaw CI Flow Festival 2021. A total of 14 dancers (8 female, 4 male, 2 of undisclosed gender; age 22-48) participated in the study. All participants were experienced dancers, but their experience with CI as a specific dance form ranged from a few months to 24 years of practice. Ten participants had Polish nationality, while the rest came from other countries (Portugal, France, USA). The level of familiarity between partners in the duets varied: some were meeting for the first time, while others were good friends or life partners. All participants signed explicit consent forms to participate in the study. Basic information about participants is given by Table 1.

[1]These recordings were collected as a part of a more extensive investigation into first-person narratives of creative and interpersonal processes in CI, which included video-cued interviews with performing dancers. The analysis of that material is beyond the scope of this paper.

Duet	Gender	Age	CI expertise	Partner familiarity
1	female	39	8 years	acquaintance
1	female	25	2 years	acquaintance
2	female	32	5 years	life partner
2	male	38	5 years	life partner
3	female	24	few months	acquaintance
3	female	38	10 years	acquaintance
4	female	22	1-2 years	acquaintance
4	female	23	irregular	acquaintance
5	male	37	12 years	friend
5	female	26	7 years	friend
6	-	34	13 years	stranger
6	male	48	24 years	stranger
7	-	39	12 years	friend
7	male	38	5 years	friend

Table 1: Basic information about participants. Some participants did not disclose their gender.

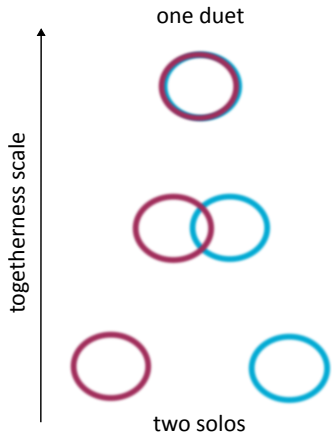

Figure 1: Graphical representation of the togetherness scale in experts' rating.

Experts' ratings: 5 experts (3 female, 2 male) were recruited based on their extended experience in CI as teachers, facilitators, and performance artists (at least five years of teaching CI). They all were members of the Polish CI community.

Experts' ratings Experts rated the perceived togetherness of the duets using a continuous rating tool, where one is asked to move a mouse on the scale between the top (one duet) and the bottom of the screen (two solos) while watching the recorded video. We did not provide them with a definition of *togetherness*, relying on their expertise with the dance form, similarly to consensual assessment technique commonly used in creativity studies (Amabile, 1982). However, we marked the screen with the graphical representation of the scale (Figure 1) similar to Inclusion of Other in the Self (Aron, Aron, & Smollan, 1992). Continuous ratings produced by individual experts were averaged to obtain a single togetherness score for each video recording. Inter-rater reliability, expressed by Cronbach's α, was high and varied from .94 to .99 for different duets.

Furthermore, just after the assessment, we conducted interviews with experts, inquiring about the definition and indicators of togetherness that they utilized in their ratings. We synthesized these using *qualitative content analysis* (Gläser & Laudel, 2013).

Pose tracking and movement statistics Dance duets were recorded in 1920x1080 resolution with 30 fps. The video recordings were processed using YOLOv8 pose detection model (x version with 69.4 million parameters) (Jocher, Chaurasia, & Qiu, 2023). This resulted in time series of x-y coordinates of detected body part keypoints for the two dancers. Gaps in pose detection occurred when the pose was untypical and not detected by the model or due to occlusion by other dancer. Gaps smaller than 15 frames were filled in using linear interpolation. We decided to keep only frames where both dancers were tracked correctly. This resulted in 13% to 40% of missing data.

Analyses focused on the movement of hip center position (close to the center of mass), as this point is sensitive to full body motion and weight sharing characteristic for contact improvisation. We calculated the hip center as an average between the right and left hips tracked by YOLOv8 model. Time series were smoothed using a running window median filter with a window size of 11 to filter out noise. To transform the absolute hip position within the video frame into information on relative movement, we employed a standard deviation estimator on a running window. Let us define $SD_i^w(s)$ as the standard deviation of a subsample of length w of series s starting at index i:

$$SD_i^w(s) = \sqrt{\frac{1}{w-1}\sum_j^w \left(s_{i+j} - \frac{1}{w}\left(\sum_l^w s_{i+l}\right)\right)}$$

Then, obtained time series with tracked hip center position were processed as follows:

$$h_i = \frac{SD_i^w(x) + SD_i^w(y)}{SD_i^W\,(SD_i^w(x) + SD_i^w(y))}$$

where $w = 30$, $W = 90$, and x, y are time series of individual coordinates. The intuitive interpretation of these statistics is as follows: $SD_i^w(x)$ represents the variability of hip center x position in a short time window, which serves as a proxy for the overall amount of movement, regardless of direction. Smooth, continuous movements with large displacement results in larger values of the $SD_i^w(x)$ statistics. To create a univariate signal, the variability along the two dimensions is added together. This univariate signal is then normalized by dividing it by its standard deviation over a larger time window (SD_i^W). This ensures that the amount of movement is always relative to the context in which its occurs. For example, there are fragments of dance when dancers explore subtle qualities

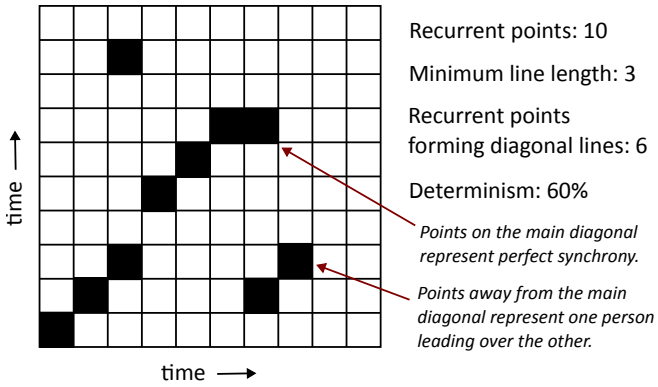

Figure 2: An example of a cross-recurrence matrix with recurrent points marking the moments in time when the two systems are in the same state (diagonals of the matrix correspond to specific time lags). Determinism is defined as a fraction of recurrent points forming diagonal lines longer than the minimum length.

and their movements are minimal; while later, they start vigorous dancing with lifts and jumps. Our normalized statistic makes both situations comparable.

Interpersonal coordination analysis In order to analyze coordination between dancers, we employ the recurrence quantification analysis (RQA) technique (Marwan, Romano, Thiel, & Kurths, 2007). This method enables us to characterize properties of coupled dynamical systems, such as the strength, stability, and complexity of coupling, based on measured time series data. It has been successfully applied previously to examine psychological aspects of interpersonal interactions based on movement (Białek, Zubek, Jackiewicz-Kawka, Adamik, & Białecka-Pikul, 2022; Abney, Paxton, Dale, & Kello, 2015).

The first step of RQA analysis is to apply time-delayed embedding to reconstruct a multidimensional space in which the system attractor exists from a univariate signal (as described by Taken's theorem (Takens, 1981)). Let $\mathbf{h}_i = \left[h_i^1, \ldots, h_i^D\right]$ denote a D-dimensional vector representing reconstructed signal at time point i. The elements of this vector are time-delayed values from the original time series: $h_i^k = h_{i-(k-1)d}$, where d is the chosen delay value. Then, cross-recurrence analysis compares the values of two time series by calculating Euclidean distances between all pairs $\mathbf{h}_i^A$, $\mathbf{h}_j^B$, where $i, j = 1, \ldots, N$. If the distance is less than a predetermined threshold, element $\mathbf{R}_{ij}$ of the recurrence matrix $\mathbf{R}$ is set to 1; otherwise it is set to 0. The properties of coupling between the two systems are quantified based on the structures that emerge in the recurrence matrix. Overall coupling strength is measured by recurrence rate – the fraction of non-zero points in the matrix (these are called recurrent points). The standard measure of coupling stability is determinism, which is defined as the fraction of recurrence points that form diagonal lines of length greater than a specified minimum value. A graphical explanation of how this measure is calculated from a recurrence matrix can be found in Figure 2.

In our analysis, we use a delay of 15 frames (0.5 seconds) to add one extra embedding dimension into the original time series. We select recurrence threshold values as 0.25 of the mean value for two analyzed time series combined. We conduct cRQA analysis in a sliding window of length 150 frames (5 seconds) with a shift of 3 frames (0.1 second), and compute RQA recurrence rate and determinism for each window individually (taking minimum line length of 10, which corresponds to 0.33 seconds). This generates new time series depicting oscillations of hip-to-hip coordination recurrence rate and determinism throughout the entire interaction with 10Hz frequency. Finally, we smooth recurrence rate and determinism time series using a running median filter with a window size of 401 (40.1 seconds).

Results

Defining togetherness We purposefully left the concept of togetherness open-ended, allowing our experts to define it according to their expertise. In post-rating interviews, the experts underscored the importance of togetherness in improvised duets. They consistently associated togetherness with a state characterized by responsive, mindful attention, and a connection between dancers where ideas naturally arise within the interaction rather than being individually proposed. Identifying crucial elements for fostering and sustaining togetherness, they emphasized close listening of dancers to each other and to the relation in-between themselves, sensitivity to the space and movement qualities, shared curiosity, and precise timing. Notably, they observed that the quality of connection extended beyond mere physical technique, yet some aspects, such as shared gaze and breathing rhythm, played a supportive role, particularly in cultivating togetherness. Such together interactions were described as complementary rather than relying on mirroring or an action-response sequence. Togetherness manifested through a sense of coherence and clarity of intentions in the duet. Significantly, many experts recognized this togetherness through their own embodied experiences of satisfaction and pleasure.

Measuring togetherness We hypothesized that high determinism of interpersonal movement coordination would be one of the most overt characteristics of the stable connection between dancers, facilitating bidirectional communication. As a results, it should visibly correlate with togetherness ratings produced by experts. To confirm this, we analyzed each dance duet separately. We conducted windowed cRQA and calculated local determinism values over time as described in the Methods section. Togetherness ratings by different experts were averaged to obtain a mean togetherness score.

Figure 3 presents an analysis of a single duet. There are two larger gaps in movement data (top panel) resulting from the occlusion of one of the dancers. The mean togetherness

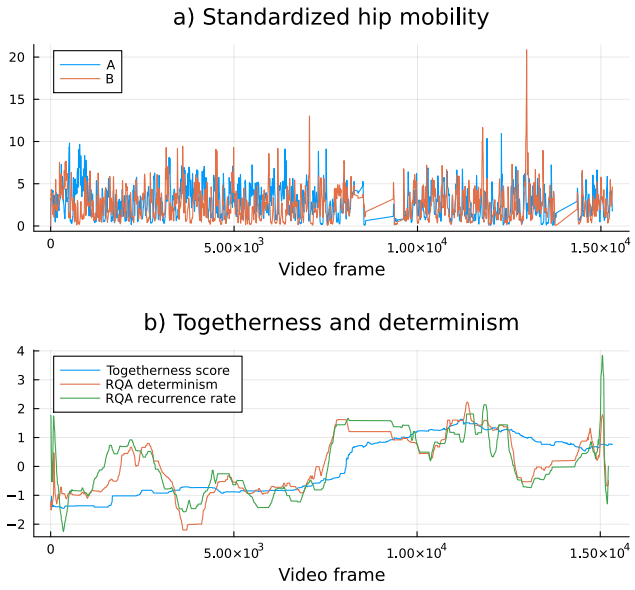

Figure 3: a) Standardized hip mobility signal for dancers A and B and b) cRQA determinism vs mean togetherness score (both normalized).

score remains low during the initial part of the interaction (solo warm-up). As the proper duet begins, the mean togetherness score increases sharply subsequently attains its maximum values. Towards end, it gradually decreases. A similar pattern is observed in recurrence rate and determinism; however, the oscillations are more pronounced.

We wanted quantify the difference in recurrence rate and determinism between warm-up and dance in each duet. For this purpose, we extracted segments corresponding to warm-up (up to three minutes of the recording) and dance (after four minutes) and averaged measures within these segments. We compared distributions of averaged recurrence rate and determinism scores between warm-up and dance using repeated measures Student's t-tests. We concluded that for both measures difference were very prominent (statistics for recurrence rate: $t = -6.76$, $DF = 6$, $p = 0.0005$, for determinism: $t = -9.98$, $DF = 6$, $p < 0.0001$).

In order to quantify the relation between togetherness and determinism, we conducted a Pearson's correlation test for each duet separately. The results are presented in Table 2. The average correlation coefficient for recurrence rate was .54 and for determinism .62, with some variation between duets. We were quite certain that the relation between togetherness and RQA measures exists. However, its strength cannot be easily assessed using standard statistical tests because of the auto-correlations and non-stationarity of time series. High correlation coefficients may result from the overall pattern of togetherness being low in the warm-up phase and high during the dance.

We wanted to verify whether RQA measures are able to explain local togetherness fluctuations within each duet that

duet	N	r_{RR}	r_{DET}
1	4293	.58	.70
2	3506	.75	.53
3	2425	.74	.75
4	4540	.51	.34
5	4306	.57	.77
6	3245	.33	.70
7	3300	.29	.51
average		.54	.62

Table 2: Pearson's correlations between togetherness ratings and recurrence rate and determinism of hip–to–hip coordination for full 8 minutes interactions (warm-up and dance). N – number of data points, r_{RR} – correlation coefficient for recurrence rate, r_{DET} – correlation coefficient for determinism.

duet	N	r_{RR}	p_{RR}	r_{DET}	p_{DET}
1	4293	.01	.45	.08	$< .024$
2	3506	.46	$< .024$	.34	$< .024$
3	2425	-.01	.14	-.06	$< .024$
4	4540	.10	$< .024$	.09	$< .024$
5	4306	-.24	$< .024$	-.06	$< .024$
6	3245	.25	$< .024$	.17	$< .024$
7	3300	.53	$< .024$	.22	$< .024$

Table 3: Pearson's correlations between differences in togetherness ratings, recurrence rate and determinism of hip-to-hip coordination. Obtained correlations were compared against false pairs correlations to estimate p-values. N – number of data points, r_{RR} – correlation coefficient for recurrence rate, p_{RR} – estimated p-value for recurrence rate, r_{DET} – correlation coefficient for determinism, p_{DET} – estimated p-value for determinism.

were independent from the overall warm-up vs dance pattern. In order to do this, we took raw (not smoothed) values of RQA measures. We calculated point-to-point differences in togetherness score, recurrence rate, and determinism (this is a common technique in time series analysis to make the signal stationary). Then, we calculated correlations between the resulting time series. In order to quantify correlations strength we performed a simple randomization test: we randomly paired togetherness ratings from one duet with RQA measures from another and calculated correlations for such artificial data sets. Artificial correlations for recurrence rate were all in range $[-.02, 0.01]$ and for determinism in range $[-.03, 0.02]$, which means that after signal differencing no stable patterns persist across duets. P-values were estimated by comparing values of real correlations with random correlations (due to the small number of pairs the smallest p-value possible to achieve was .024).

Table 3 presents correlations between differences in togetherness ratings, recurrence rate and determinism for all duets along with estimated p-values. In all cases except for r_{RR} of duet 1 and duet 3 real correlation values are more extreme than values obtained through the randomization test. This

suggests that RQA measures are able to explain local fluctuations of togetherness on the level of a single duet. For duets 3 and 5 correlations are negative, which contradicts our expectations. At present, we have no plausible explanation for this.

Discussion

Our study started from the premise that contact improvisation, as a dance form, is particularly suitable for studying embodied social interactions and emerging togetherness between individuals (Flakne, 2019). Dance improvisation training fosters empathetic, relatedness abilities, as well as critical reflection skills, allowing dancers to access their experiences in detail (Kronsted & Gallagher, 2021). Therefore, experienced dancers should be proficient in recognizing various dimensions of togetherness in a physical interaction.

Indeed, our experts displayed remarkable consistency in their ratings and descriptions of the concept of togetherness. In a similar study by Tseng et al. (2021a, 2021b), where togetherness was rated by naïve participants, consistency was lower, which – among other things – may testify to the importance of expertise in assessing qualities of interpersonal interactions. All our experts stressed that togetherness involves responsiveness, attentive listening, and goes beyond simple synchrony.

We demonstrated for some CI dance duets togetherness ratings of strongly correlated with cRQA recurrence rate and determinism of dancers' hip movements. Recurrence rate represents strength of the coupling between individuals, and determinism is a measure of coupling strength. Determinism can be interpreted in terms of predictability: the behavior of the system with large determinism is easier to predict. This interpretation aligns well with a cognitively rich approach to joint-action, which postulates that predicting or simulating partner's actions is necessary to coordinate with them (Sebanz & Knoblich, 2009). However, here, we propose a different interpretation. What makes the interaction more predictable from the perspective of an external observer does not necessarily mean that people involved in the interaction explicitly engage in predictions of each other's behavior. We argue that the most important skill for establishing a meaningful collaboration is the ability to listen and adapt to dynamic changes in the system's organization. This view is supported by our expert's claim that togetherness is a state of responsive, mindful attention characterized by close listening to each other and to the relation emerging in-between dancers. Similarly, Łucznik (2015) showed that in successful improvised collaborations, dancers focus on supporting each other's actions physically as well as conceptually on a moment-to-moment basis, but without explicitly predicting what will happen next. Skilful collaboration in dance does not concern simple movement synchrony but rather skillful co-regulation of movements within an interpersonal synergy (Riley, Richardson, Shockley, & Ramenzoni, 2011), where individual actions may be complementary in nature or asynchronous. We propose that determinism of interpersonal movement coordination might be a sign of emerging synergies of the kind described by Kimmel (2021), and attentive listening is a strategy dancers employ to maintain these synergies.

RQA determinism has emerged as a promising measure that captures deeper features of interpersonal coordination than the commonly used lagged cross-correlations (Schoenherr et al., 2019). The principle of synergistic motion between individuals as a foundation of togetherness may apply not only to dance, but also to all sorts of interactions occurring "in the wild". For example, Zubek et al. (2022) demonstrated that determinism of head movements differs between video-mediated and face-to-face conversations, presumably indicating different forms of engagement between interlocutors. Coordination-based measures of interpersonal connection are of great interest in the context of psychotherapy, for predicting the relationship between a therapist and a client or for assessing therapeutic outcomes (Ramseyer & Tschacher, 2011; Wiltshire, Philipsen, Trasmundi, Jensen, & Steffensen, 2020; Feniger-Schaal, Schönherr, Altmann, & Strauss, 2021).

Our dynamic measure enables us to view the interaction as a process in which togetherness waxes and wanes. In the future, we intend to utilize this automatic measure for identifying moments in the interaction that are interesting in terms of fluctuations in togetherness and then analyze them further using more qualitative methods. We hope that this mixed-methods approach will provide us with a deeper understanding of the micro-dynamics of togetherness and the concrete, embodied strategies people use to foster it.

Conclusions

In this paper, our objective was to showcase that dance may serve as a frame for exploring diverse facets of human nature, particularly the interpersonal dynamics of togetherness. The holistic and expressive nature of dance positions it as an ideal medium for unraveling the intricacies of the human experience.

We presented here a methodology and a movement-based coordination measure, which can be potentially employed across diverse interactive settings that are not restricted to dance alone. For example, it may pave the way for creating non-verbal metrics that gauge the effectiveness of interpersonal interactions mediated or facilitated by various technological devices.

Our study exemplifies the synergistic relationship between quantitative and qualitative methodologies in exploring interpersonal interactions. This integrated approach allows us to interpret analytical measures of movement coordination by incorporating the rich perspectives of human experience and the associated underlying meaning.

Acknowledgments

This work has been funded by the "Excellence Initiative – Research University" programme at the University of Warsaw

(New Ideas 3A in Priority Research Area IV, "Experiencing interaction in improvised dance – intersubjective narrations and movement analysis").

The authors are grateful to Michał Gacka for his help in video annotation.

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