



# A Case for Playful Engagement: Synchrony and Interaction Quality During Mirroring in ASD. Conceptual Framework and Case Study

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Accepted: 12 April 2022 / Published online: 1 June 2022  
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## Abstract

The social challenges in autism spectrum disorders (ASD) can present as qualitative differences in interactions that make individuals on the autism spectrum appear less engaged with others. Limited interactional synchrony and other nonverbal movement patterns may contribute to these qualitative differences. This article uses the case of Hans, an adult on the autism spectrum, to describe patterns of synchrony and interaction quality during mirroring activities in dance/movement therapy. Raters scored videos of Hans and his partners on *affective engagement*, *flow of the interaction*, and *interpersonal synchrony*. They also qualitatively described his movements and interactions. Hans consistently participated in mirroring, but showed different patterns of attention and engagement when leading, following, interacting, or dancing in an open-ended dance. Hans was able to move in synchrony with partners, showed positive affect, and increased his movement repertoire by returning to others' movements in later sessions. He was the most engaged when following a playful movement theme with a dance/movement therapy student partner. His affective engagement increased, but only in the less structured open-ended dance and only across the five sessions with this same dance/movement therapy student partner, and not when the sessions with his other partners, including others on the autism spectrum, were included. This points to a potential need to have dance/movement therapists model developing a movement relationship using flexible and playful contexts to emotionally engage the individual and reflect the complexity of everyday social situations. We present clinical recommendations and suggestions for future studies.

**Keywords** Interpersonal synchrony · Interaction quality · Dance/movement therapy · Mirroring · Autism spectrum disorder · Movement qualities

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## Introduction

Dance/movement therapists have a history of using nonverbal attunement and mirroring to promote social engagement in individuals on the autism spectrum (Adler, 1968; Samaritter & Payne, 2017; Takahashi et al., 2019). The phrase “individual on the autism spectrum” will be used in this paper because individuals on the autism spectrum generally consider this phrase less offensive than “person with autism” (Botha et al., 2021). Individuals on the autism spectrum show restricted or repetitive behaviors and social communication challenges starting from a very young age and continuing throughout life (American Psychiatric Association, 2013). These symptoms occur on broad spectrum, with impacts varying from limited verbal communication to high verbal skill with qualitative differences in the social aspects of communication and varying degrees of inflexibility around their interests or behaviors. Qualitative differences in interactions remain even when individuals on the autism spectrum speak fluently and can perform distinct social skills. For example, in a study which used raters’ overall subjective assessment of the participants’ emotional connection to the interviewer and the flow of the interview, two raters blind to participants’ diagnoses scored teens on the autism spectrum as significantly less affectively engaged with a less smooth flow of interaction than matched teens with intellectual disability (Garcia-Perez et al., 2007). Despite this difference in the perceived quality of interpersonal relatedness, counts of the nonverbal behaviors in the videos showed that both groups smiled, looked at the other, and used head nods/shakes at the same frequency except for the one context of nodding the head less when the interviewer was speaking. To improve interventions, it may be useful to better understand the nature of these qualitative differences in the interaction. Given the complexity of social interactions, and the prevalence of sensory-motor challenges in individuals with autism spectrum disorders (Kaur et al., 2018), a creative embodied relational approach such as dance/movement therapy (DMT) may be useful to address these differences.

Differences in interactional synchrony, “the matching of behavior, affective states, and biological rhythms between [individuals] that together form a single relational unit” (Feldman, 2007, p. 329), might explain some of these qualitative differences in social interactions by individuals on the autism spectrum. Delayed processing, motor coordination challenges, or limited social attention are all commonly found in individuals on the autism spectrum and may reduce interactional synchrony (Kaur et al., 2018). Various aspects of interactional synchrony have been explored at different timeframes. One form of interactional synchrony involves the timing of responses to the other person within a few seconds. This describes the rhythmic flow of a back-and-forth exchange, which can be subjectively experienced as flowing smoothly or being more disjointed or halting, one potentially common qualitative difference in interactions. Another aspect of interactional synchrony is interpersonal movement synchrony. Moving in time with others typically increases prosocial behavior, group cohesion, cooperation, and feelings of liking between individuals (Kinsbourne & Helt, 2011; Mogan et al.,

2017), and supports increased rapport and improved clinical outcomes in psychotherapy (Ramseyer & Tschacher, 2011). This form of synchrony can occur out of conscious awareness, such as when two people walking together step together, or consciously such as through coordinated actions, or dance to music. Differences between the use of interactional synchrony by individuals on the autism spectrum and control groups depend on the context and specific type of synchrony measured (McNaughton & Redcay, 2020). These differences have been observed at both at the millisecond level (for example, children engaging in less automatic movement synchrony when rocking with a parent; Marsh et al., 2013), and, depending on what is measured, at the level of responsive interactions (such as, in the types of responses by parents and children within 3 s of the other's action; Saint-Georges et al., 2011). Millisecond delays in intrapersonal synchrony (between one's own gestures and speech) in individuals on the autism spectrum have also been found to be correlated with others rating their stories as less engaging (de Marchena & Eigsti, 2010).

The distinction between exact movement synchrony and following may be important to interaction quality as Fraenkel (1983) observed that in counseling sessions and conversations with friends, echoing, rather than synchrony, was related to either cognitive or emotional empathy depending on the length of the delay between when the first and second person moved. Fitzpatrick et al. (2018) found different associations between synchrony and other social measures dependent on the use of "intentional" or "spontaneous" synchrony. Meaning that different social measures correlated with the degree to which individuals on the autism spectrum accurately synchronized their movements with a partner when they were instructed to move in time with the partner (intentional synchrony) or they synchronized their movements without being told to coordinate their movement in time with the partner (spontaneous synchrony). Eberhard-Kaechele (2012) proposes seven developmental stages of mirroring others with related modes of thinking that may help further differentiate aspects of interactional synchrony. This includes earlier developmental forms such as "oceanic mirroring" or exactly synchronous movements that Eberhard-Kaechele relates to merging with others, self-exploration and control. Later stages increasingly differentiate the roles of the two individuals with "modal mirroring" describing close but not exactly shared movements which she relates to affect attunement and exploring the social world. Another stage of "counter movement" or "anti-phasic coordination of cyclic movements, e.g. open-close vs. close-open" (Eberhard-Kaechele, 2012, p. 282) she relates to perspective taking. More complex developmental stages include "deferred imitation," "contrasting," "variation," and "complementary interaction." Investigating these as different aspects of interactional synchrony can help describe specific qualitative differences in interpersonal interactions with individuals on the autism spectrum and identify areas for intervention.

Dance/movement therapists follow the client's lead and adopt creative responses in the moment in contrast to many common behaviorally based interventions for autism spectrum disorders (ASD). Interventions based on Applied Behavioral Analysis (ABA) employ a more directive teaching approach to social skills. Different interventions may also differ in their views on the nature of the diagnosis and mechanisms of change in therapy. The generally predominant view is still that autism

spectrum disorders are cognitive disorders due to a deficit of Theory of Mind (ToM; Baron-Cohen, 2000), or the ability to predict the other's perspective when observing a situation using cognitive processes to represent the other's perspective. Research from enactive and phenomenological perspectives challenges this view and proposes that autism spectrum disorders may reflect atypical patterns of embodied interaction and intersubjectivity (see for example De Jaegher, 2013; Fuchs, 2015). As explained by Koch and Fischman (2011), "embodiment approaches assume that cognition and affect are grounded in sensorimotor processes" (p. 60). The enactive perspective proposes that the process of embodied understanding, or sense-making, is situated in actions and interactions with objects and people in the environment. De Jaegher (2013) states that "in the social realm, the interactive coordination of embodied sense-making activities with others lets us participate in each other's sense-making (social understanding = participatory sense-making)" (p. 1). From this perspective, differences in embodiment, coordination with others, and in the engagement in interactive processes themselves could cause disruptions in shared sense-making between individuals and account for the social challenges in individuals on the autism spectrum.

Some studies of DMT for individuals on the autism spectrum have investigated the effectiveness of attunement and mirroring-based interventions on social skills (Takahashi et al., 2019). In attuning one matches aspects of another's movement, cognitive state, or affect, incorporating both an awareness of these parts of the other's state and reflecting them back in the interaction (Jerak et al., 2018). Mirroring as a technique in DMT incorporates kinesthetic attunement through instructions to reflect back the other's movement while emphasizing the qualities of the movement without needing to be an exact imitation of the movement (Mastrominico et al., 2018). This is expected to support the client in feeling seen and to support the developing relationship. Different approaches to mirroring as described by Eberhard-Kaechele (2012; listed above) include different amounts of movement synchrony or otherwise attuned responses. A few studies of DMT for adolescents or adults on the autism spectrum focused on developing empathy with others through mirroring (Mastrominico et al., 2018) or other activities that promote going in and out of synchrony (Koehne et al., 2016). While these studies did not find significant changes in their primary measures of empathy, Koehne et al. (2016) found significant increases in emotion inference, synchronization, and movement reciprocity. In looking at outcomes before and after several weeks of therapy, these studies investigated change to each of their measures, but did not explore the process for a deeper understanding of any moment-to-moment impact of synchrony within the interaction itself.

In this article, we present an in-depth description of a single case from a study of mirroring activities in group DMT with teens and adults on the autism spectrum (Mastrominico et al., 2018). In another recent paper, we explored the relationship between synchrony and interaction quality within 30-s video clips of five individuals on the autism spectrum mirroring with a partner, looked for change over the sessions, and explored other movement qualities that might be relevant to their interactions (Manders et al., 2021). Participants changed partners in different sessions and these partners were clearly described as having their own impact on the interaction. While most participants spent most weeks partnered with other participants on the

autism spectrum or psychology research assistants without training in dance movement therapy skills, one participant was partnered with the same dance movement therapy student for five of the ten sessions. We are extracting this particularly interesting case for description in this paper. Through the example of this particular case, we can discuss the difference between mirroring with those training in dance movement therapy skills in contrast to untrained partners, focus on observers' descriptions of movement and movement qualities in the videos, and suggest what clinical implications this may have for dance/movement therapists.

## Methods

### The Larger Studies

The data for this case stem from DMT groups of a larger multisite parent study (Mastrominico et al., 2018). These DMT groups for adolescents and adults on the autism spectrum consisted of 10 weeks of one-hour-long sessions based on mirroring following a consistent structure: (a) a warm-up, (b) partnered mirroring including a time for each participant to lead, follow, and then continue with their partner in an open-ended dance, for which they were instructed to “stay in contact with your partner, but you do not need to lead or follow,” (c) mirroring in a circle in the group, and d) closing reflection (for a more complete description see Koch et al., 2015; Mastrominico et al., 2018). The primary outcome measure was empathy and participants were recruited from therapy centers and programs for individuals on the autism spectrum in southwestern Germany. The groups were conducted at three different sites, led by different dance/movement therapists, and supported by student research assistants. The parent study received informed consent of all participants with ethics approval from the Medical Faculty of the University of Heidelberg ethics board (Ethikkommission). The case of Hans presented here was analyzed as part of a mixed methods secondary analysis of videos of five participants in these DMT groups (Manders et al., 2021). This secondary analysis received further ethical approval by the Drexel university IRB with an exemption from further informed consent due to the use of video data from the parent study with no further participation of the participants.

### Participant in this Case Study: Hans

This paper presents an analysis of the case of Hans (pseudonym). Hans attended all 10 weeks of the DMT group, with video available for eight of the sessions. In the recorded sessions, Hans was twice partnered with others on the autism spectrum and once with a male research assistant. For five sessions, his partner was a female DMT student, who will be called Carina for this article. Hans was the only participant of the secondary analysis with more than two sessions with the same partner, thus it was possible to look at change in Hans over time without concern over the impact of different partners on the interaction. As this partner was also studying

dance movement therapy, it is useful to look at what she was doing within the mirroring to support any change and the clinical implications of this. Carina used her developing DMT skills to attend to his responses and expand on a movement phrase that she repeated and varied over the sessions, increasing his laughter and affective engagement over each repetition.

Hans was a Caucasian German male in his 40 s who was living semi-independently. He attended the DMT group sessions at a training center for individuals on the autism spectrum in a small town in Southwestern Germany. He engaged in conversation when spoken to, but did not initiate interactions with other group members. He followed instructions throughout the sessions, showing a cooperativeness and willingness to both lead and follow in the partnered mirroring as well as group mirroring, warm-up, and reflection. During pauses between activities or pieces of music, Hans would stop moving and stand still without engaging with others. Hans tended to lead slow and repetitive arm movements and regularly appeared to look around the room for ideas for movements. He held substantial tension in his body and had difficulty coordinating moving both his arms and legs at the same time. A rater described that Hans “has very little movement in torso, spine, neck area, and pelvic floor are not moving and show stiffness.” In the last two sessions, Hans led a somewhat greater variety of movements and his coordination seemed to improve slightly.

### Data and Scoring for the Secondary Analysis of Video

The video of Hans was prepared by taking a 30-s video clip from the middle of each of the weekly partnered mirroring dances (leading, following, doing the open-ended dance) and one 30-s clip per session that was selected to show when Hans was engaged in the most interactive behaviors. Out of the eight sessions with video of Hans engaged in partnered mirroring, the first session was missing the open-ended dance due to videographer error, leaving a total of 31 video clips (eight leading, eight following, seven open-ended dance, eight with more interactive behaviors).

The videos were watched by two sets of raters who described the videos and scored them on either synchrony or interaction quality. The order of the videos was randomized so that all raters were blind to the session number when they watched the video. Psychology student raters scored the videos for *interaction quality* using two 5-point Likert scales describing *affective engagement* and *flow of the interaction* (Garcia-Perez et al., 2007). Each scale had descriptions for the five levels. Affective engagement was rated on a scale from *no emotional connection* to *strongly connected* with descriptions including qualities such as “responsive to emotional signals expressed by the partner,” “displays very little emotional expression,” and “may appear ‘robotic’ or seem to want to be elsewhere” (R.P. Hobson, personal communication, March 12, 2012). The flow of the interaction was used to describe the extent to which the participant played a part in a flowing interaction with interactions described from *minimum to no dialogue* to *very smooth*. These descriptions were originally written to refer to a verbal conversation, but raters were instructed to include nonverbal communication and turn taking in movement in the interpretation

of these descriptions such as “overall impression is of a dialogue that flows in a mutually rewarding manner,” “the [participant] requires the occasional prompt to stay on track,” and “The [interaction] seems to move in ‘fits-and-starts’” (R.P. Hobson, personal communication, March 12, 2012). These raters also scored the amount of *distraction* and *restrictive/sensory seeking movements* on three-point scales to provide context about the participants’ attention to the task.

Dance/movement therapy MA students scored the videos for different aspects of interpersonal movement synchrony using 5-point Likert scales describing the amount of the video during which Hans and his partner were moving in synchrony with each other (see Table 1 for definitions and discussion of the reliability and challenges of each of the forms of synchrony measured in this study). They scored each of these on a scale ranging from *does not occur* to *occurs 76–100% of the time*, with a number of seconds provided for each timeframe. The DMT student raters did not have time to rate all of the videos, therefore pairs of raters were assigned to each participant with one primary rater scoring all of the videos and a second rater scoring at least twenty percent of the videos.

After scoring interaction quality or synchrony, all of the raters briefly described the movement and interaction they observed in each video clip. In addition to these brief general observations, the DMT students, who had just completed classwork in Laban Movement Analysis (LMA) and the Kestenberg Movement Profile (KMP; Kestenberg Amighi et al., 2018), were asked to also note the use or lack of certain movement qualities. Given the raters time restraints, this additional information was only requested for the open-ended dance and interactive video clips. This included sections for body attitude, coordination of body parts, kinesphere, and use of planes, pre-efforts, efforts, and shape flow. These students had completed two courses of movement observation and were specifically trained to use the selected categories for the purposes of this study, but were not certified in LMA or KMP. For this paper the KMP terms and spellings will be used when these differ between KMP and LMA for the same concept.

## Data Analysis

The first step in the quantitative analysis was to graph Hans’ synchrony and interaction quality scores over time so that they could be visually inspected for trends. This was done to explore the hypothesis that his scores would increase over ten sessions of DMT. Rhythmic synchrony and interaction quality were then correlated using Spearman’s Rho to test for any relationship between synchrony with his partner and affective engagement or flow of the interaction. These correlations were conducted to investigate the hypothesis that there would be a relationship between synchrony and interaction quality.

The first author, Manders, examined the qualitative descriptions of Hans’ movement and interaction in each clip for patterns in the movement and interaction. The goal of this qualitative descriptive analysis was to discover any characteristics of the movement that appeared to observers to be relevant to interaction during partnered mirroring. The quantitative and qualitative strands were further compared for

**Table 1** Definitions of synchrony measured in this study along with reliability and challenges in measurement

Scale	Definition	Reliability and challenges
Rhythmic synchrony	“Simultaneous movement of like or unlike body parts which ... begin and end simultaneously, and ... move at the same rate” (Fraenkel, 1983, p. 38), including single changes of direction of the movement, as well as longer sequences of movement that occur at identical rates	Strong inter-rater reliability
Exact spatial synchrony	When the partners match the shape of each other’s movements including “movements of like body parts, in the same direction, with the same point(s) of change, and of equal duration (Adler, 1968). Movements begin and end at equivalent locations” (Fraenkel, 1983, p. 38)	Strong inter-rater reliability, but lower than rhythmic synchrony, and the two scales were very highly correlated Some raters seemed to conflate rhythmic synchrony and exact spatial synchrony
Approximate spatial synchrony	When the partners nearly match the shape of each other’s movements involving “movements of like body parts in the same direction ... These movements must be similar, but not identical” (Fraenkel, 1983, p. 38). For this study, this also includes moments when the participant appears to be attempting to imitate, but is unsuccessful in creating the identical shape in space	Low inter-rater reliability The raters at times disagreed about rating something as exact or approximate spatial synchrony. Raters also varied between scoring this or not counting any synchrony at all
Effort synchrony	When the partners use the same effort qualities in their movements. The shape of the movements need not match. Effort synchrony occurs “when the same [effort] quality ... is used anywhere in the body” (Woodring, 1987, p. 22)	Fair inter-rater reliability May require longer rater training
Counter spatial synchrony	Simultaneous movements of like body parts, in the opposite direction, with similar distance and equal duration. Counter movement in stages of mirroring by Eberhard-Kaechele, (2012): “anti-phasic coordination of cyclic movements e.g. open-close vs. close-open, up-down vs. down-up” (p. 282)	Dropped early in the study as this became difficult to define when the partners were standing next to each other or in other spatial relationships than directly facing each other
Following	Continuous echoing of movements with echoed movements being similar movements by two people with the second person’s movement starting at a slight delay from the first (Fraenkel, 1983, with a delay of less than five seconds (Ramseyer & Tschacher, 2011)	Low inter-rater reliability It was revealed in interviews that the raters varied in when they scored close to synchronous movements as synchrony or following



similarities and differences to clarify and explain the results and lead to questions for further research. (For a more extensive description of the methods see (Manders et al., 2021).

## Results

### Hans's Overall Engagement in Mirroring

Hans followed the instructions to lead and follow, while often simultaneously appearing to the raters to be not very emotionally engaged. The raters described his relationship to his partners differently in the different roles: more attentive to his partner when following, regularly looking around the room for movement inspiration while leading, and at times turning away and disengaged from his partner during the open dance segments (see Table 2). There were, however, moments when he appeared to be more emotionally engaged with his partner and responsive in his movement, particularly when he smiled and laughed during variations on a movement theme led by Carina, his usual DMT student partner.

### Inter-rater Reliability

There was strong inter-rater reliability between the three raters who scored affective engagement  $ICC(2,3)=0.833$ , 95% CI [0.777, 0.877] and flow of the interaction  $ICC(2,3)=0.808$ , 95% CI [0.711, 0.876]. For the secondary scales, there was moderate to strong agreement between the two raters for distraction  $ICC(2,2)=0.713$ , 95% CI [0.595, 0.796] and restrictive/sensory seeking movements  $ICC(2,2)=0.663$ , 95% CI [0.525, 0.761]. The two DMT student raters for Hans' videos had strong inter-rater reliability for rhythmic synchrony:  $ICC(2,20)=0.862$ , 95% CI [0.642, 0.947], all other forms of synchrony were dropped prior to final analyses (see Table 1).

### Attention, Distraction, and Sensory Seeking Behavior Scales

Hans was scored as distracted or briefly distracted in several of the videos of him leading and all of the open-ended dance videos. When following or engaged in interactive behaviors, Hans was only scored as briefly or possibly distracted a few times. In the qualitative descriptions, the raters described more nuances in his attention and distraction by discriminating between engagement in movement and attention to the partner and how this impacted the interaction. This will be discussed in more detail below. Hans was not seen to use repetitive/sensory seeking movements.

**Table 2** Description of Hans' process through the different mirroring tasks and change over the DMT sessions

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Hans' engagement in mirroring by type of video segment

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## Following

Hans tended to be highly attentive and followed almost all of his partners' movements, facing his partners and looking toward their bodies or faces throughout the video clips. In the early sessions, the raters described his manner as serious, concentrated, and unenthusiastic. Then for the next few sessions, he remained attentive and concentrated on following his partner, with relatively few facial expressions. In the last two weeks, he smiled and was described as more emotionally engaged as his partners' motions sped up

## Leading

Hans continued moving throughout most of the time he was assigned to lead, but appeared less attentive to his partners, less responsive, and less emotionally engaged in the partnership than when he was following. For example, raters several times described Hans as leading movements in a wooden or mechanical way that seemed to fulfill the task of leading but not engaging with his partner. He frequently seemed to look at other people in the room for inspiration. In the last two weeks, he led novel (to him) movements and themes using the movements and concepts his partners had led in prior dances or sessions, although he continued to appear to concentrate on the movement with limited emotional engagement with the partner

## Open-ended dance

In the open-ended dance segments, Hans tended to move independently from his partner and was generally less attentive to his partners than he was in other types of segments. In some sessions, Hans did not face his partner and instead appeared to follow other people across the room. In later sessions, Hans followed Carina's lead during the open-ended dance segments and was more engaged with her, although not as much as when he was assigned to follow. Hans appeared less able to engage without a task directive, although increased attention to his partners did appear to support increased engagement, even in these segments

## Videos selected for more interaction

In the segments selected for interactive behaviors, Hans was described as highly attentive to his partners and rated higher in affective engagement and flow in the interaction. In many of these segments, Hans briefly smiled, showed emotions, or seemed relaxed, although this included little back-and-forth interaction. These segments were almost all selected from times when Hans was following his partner or when Hans and his partners briefly communicated about switching leadership

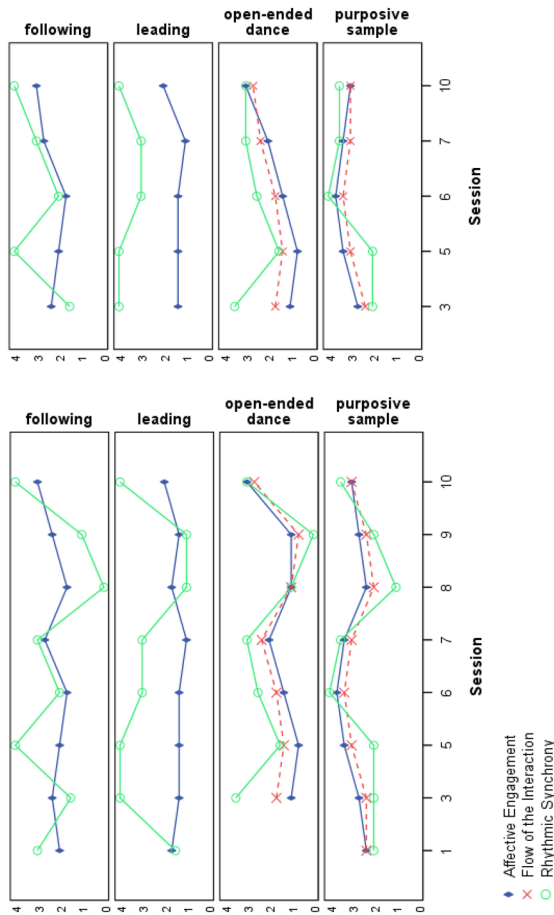
## Engaging in the repeated movement theme with Carina, his usual DMT student partner

In their second session together, Carina led a simple playful movement theme of opening and closing her hands at different tempos. She expanded on this in later sessions with further changes to the tempo, direction, and extension of her arms. Hans responded with smiles, laughter, and attention as he attempted to keep up and match her movement. As one rater described it, "When [Carina] begins to play with the motions (hands opening and closing), [Hans] smiles broadly. As she makes it more complicated he laughs so that his body shakes. [Hans] seems to be enjoying himself and enjoying the challenge." By the last session, Hans seemed to incorporate some of this theme into his own leading and briefly appeared to challenge Carina as well

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## Change Over Time

Graphs of Hans's scores over the eight recorded sessions, show no obvious change to interaction quality or synchrony (see Fig. 1). However, if the graph is drawn to include only the five sessions when Hans was partnered with his usual partner, Carina, almost all the curves are smoother with less session-by-session variation.



**Fig. 1** Hans' synchrony and interaction quality scores over time. *Note* The left graph depicts all videotaped sessions while the right graph depicts just the sessions with his usual partner, Carina. Each graph is divided into four parts: the uppermost box shows Hans' scores when he was following his partner's movements; the second box shows his scores when he was leading the mirroring activity; the third box shows his scores during a song when he was given open-ended instructions to remain in contact with his partner while moving as he wished; and the bottom box "purposive sample" shows his scores during a videoclip that the researcher selected for his most interactive behaviors during any of these activities. The y-axis indicates his score on the scale with each of the scales scored from 0 to 4 with 4 indicating the most synchrony, affective engagement, or flow of the interaction. The x-axis is labeled with the session number. The open-ended dance segment was missing for the first session due to videographer error and no video was available on sessions 2 and 4. Flow of the interaction was not scored in the leading and following videos. Flow of the interaction and affective engagement show similar scores and trajectories when both were rated. There is less variation in the scores when looking at only the sessions he was partnered with Carina and a slight upward trend in the open-ended dance of these sessions only

When Hans was leading, there was a stark difference in the synchrony scores depending on the partner, with high synchrony scores in his sessions with Carina and low synchrony scores in sessions with all other partners. The synchrony in the leading videos was created largely by the one following, and Carina, with her DMT training, followed closely while Hans' other partners were often not as good at mirroring his movements, or had a time lag when following him. This difference in skill with mirroring between Carina and Hans' other partners may also be reflected in the greater variation in scores in the other dances, but there the specific role of the partner is less clear. The fluctuating scores and qualitative descriptions of the partnerships suggest that movement and interpersonal style of the different partners may have obscured any change over time across the full ten weeks, therefore change over time was also examined over just the weeks Hans was partnered with Carina.

Visual inspection of the graphs for just the weeks he was partnered with Carina shows a slight upward trend in affective engagement, flow of the interaction, and synchrony in the open dance segments over time. Each of these scales was tested for correlation between the session number and score on the scale by segment type for the five sessions with Carina only (see Table 3). For the open-ended dance sessions with Carina only, Hans showed a statistically significant increase in affective engagement over time and a high, but non-significant, increase in flow of the interaction over time. There were no significant correlations when the sessions with the other partners were included.

### Different Partners, Different Levels of Success

The different partners played a major role in the interactions and movement in the partnered dances with Hans. Qualitative descriptions of patterns of movement, attention, or engagement reoccurred across video clips with the same partners. Raters at times explicitly described an aspect of the interaction or movement by stating “as with other clips with this partner.” The raters' descriptions suggest that the increased interaction quality in the open dance segments with Carina may be connected with the development of a movement relationship with the use of a shared movement theme, which did not exist with the other partners. The raters saw signs of trust and responsivity in Hans' videos with Carina. This started with a mention of trust in

**Table 3** Hans change in synchrony and interaction quality with Carina, his usual partner

	Segment type <sup>a</sup>			
	Following	Leading	Open dance	Interactive
Rhythmic synchrony	.564	– .289	– .051	.632
Affective engagement	.600	.224	.900*	.205
Flow of the interaction			.821	.447

Flow of the interaction was not scored in the following and leading segments. All scales were correlated to session number using Spearman's Rho

\* $p < .05$ , <sup>a</sup>  $n = 5$  for all correlations

one of the raters' descriptions of their first session together and increased with more mentions of trust and a stronger affective connection by session seven.

### Correlations Between Synchrony and Interaction Quality

To investigate the relationship between Hans' synchrony and interaction quality, his scores were correlated and the qualitative descriptions were examined for discussion of this topic. These correlations were run with the videos of him leading and following grouped together and separately the videos of him engaged in the open-ended dance and more interactive videos. The decision was made to run the correlations this way because of the small sample size and the contrasting descriptions of the different patterns of engagement in the more structured mirroring tasks compared to the open-ended dance and interactive clips. The flow of the interaction was not scored in the leading and following video clips as the descriptions of the levels did not make sense when only following or only leading. There was a strong and significant positive correlation between affective engagement and flow of the interaction showing a strong relationship between these variables (see Table 4). There was a moderate to strong positive correlation between synchrony and flow of the interaction for the videos of the open-ended dance and interactive behaviors. There was a significant positive correlation between synchrony and affective engagement when the less structured open-ended dance and videos selected for interaction were combined, but not for the more structured following or leading segments. Few of the qualitative descriptions described the synchrony between Hans and his partners. In only one session did a rater link Hans' movement synchrony to affective engagement, stating that: the "partners seem to be in synchrony also at an emotional level, interaction seems to have the [peak] level at the same time, crescendo in excitement."

**Table 4** Correlations between synchrony and interaction quality for Hans

	Video segment type					
	Combined structured leading and following			Combined less structured open dance and interactions		
	Correlation	n	Sig	Correlation	n	Sig
Synchrony to affective engagement	.039	16	.885	.551*	15	.033
Synchrony to flow of interaction				.698**	15	.004
Affective engagement to flow of the interaction				.953**	15	> .001

Correlations between Hans' scores on the different scales were calculated using Spearman's Rho. Flow of the interaction was not scored in the following and leading segments. n = number of video clips. All video clips of Hans are included in this case analysis unlike in the analysis of the five participants in which some segments were randomly assigned to his participant partner (Manders et al., 2021)

\* $p < .05$ , \*\* $p < .01$

## **Contrasts Between His Attention, Engagement in Movement Tasks, and Social Interactions**

Overall, Hans consistently followed the instructions to lead and follow and continued moving with only brief pauses during the open-ended dance. The quantitative ratings of attention showed that Hans was generally attentive when following and interacting, and his attention shifted more when he was leading or doing the open-ended dance. The raters often referenced attention or distraction when discussing the interaction quality or synchrony between Hans and his partners. He was more often described as attentive than distracted, but distraction did occasionally cause delays in his following: “Carina then moves to a reaching type motion, but Hans stays with the former motion for a few seconds before realizing she has changed (he is distracted).” The qualitative descriptions suggest that even when attentive, he often mirrored with minimal outward expression and little emotional engagement except when Carina led their playful movement phrase. One rater described Hans’ following in the first session: “he does not seem terribly enthusiastic, but is paying attention to the direction of the motions and does a good job of imitating them.” In the less directive open-ended dance segments, with the instructions to move as they liked while staying in contact with the partner, Hans often seemed cooperative but somewhat lost, not very creative or enthusiastic in his movements, and even more disengaged from his partners. Any break in a social connection appeared to end the interaction, without Hans initiating anything to continue the engagement. For example, during the open-ended dance, a couple of his other partners sometimes looked away or did their own thing while Hans was looking at them. Rather than waiting for these partners to look back or initiating something himself, Hans responded by disengaging and doing his own movements, becoming unavailable to reconnect when the partner returned and tried to re-engage him.

In later sessions, Hans did socially and emotionally engage in some more short interactions with his partners. These interactions, however, appeared to mostly be led by his partners, especially Carina, and he rarely added anything to develop the theme or interaction further himself. In his eighth session, some raters thought that Hans may have attempted to recapture the attention of another partner through the use of clear slow movements. This interpretation was not shared by all of the raters and Hans did not speak to her or add other nonverbal cues to further support reengaging her, although he did continue to look in her direction. His partner Carina, in contrast, was repeatedly able to capture Hans’ attention and engagement through the playful movement theme she introduced in session 5 and they consistently both laughed when she tricked him by varying the tempo. In their last session together, Hans lead some elements of this game, but only for a very short time and he appeared less emotionally engaged than when he followed her.

### **Hans’ Movement Patterns and Movement in the Partnership**

Hans’ movements were described by student raters and not individuals certified in movement observation. This included psychology students who described their

observations without any training in movement observation tools and DMT students after two courses in LMA and KMP and rater training for this study.

Hans' coordination, movement repertoire, and ability to follow his partners' movements all seemed somewhat improved in the final two weeks of the intervention (see Table 5). Despite his difficulty with performing some movements, Hans attempted to follow almost every movement his partners led. Hans appeared to have difficulty following movements that were: (a) fast, (b) continuous, since he tended to make abrupt transitions, or (c) involved moving the arms and legs together, as he seemed to need more time to figure out how to follow these. Hans's coordination did seem to improve slightly over the intervention as he showed better coordination between his arms and legs in the final session than at any other time. By the last two sessions, however, Hans seemed more confident in following a variety of movements and appeared to have more enjoyment in following movements that were moderately challenging.

Several weeks of following his partners' movements seemed to support Hans in expanding his own movement repertoire. After weeks of leading mostly slow arm movements while standing in place and holding his neck and torso stiff, Hans appeared to start to integrate a few movements from others into his own dancing. Some of the raters noted an increase his movement repertoire in the last two weeks.

While all the raters described times when Hans and his partners had matched or mismatched movement qualities, the two sets of raters used different language to describe this. The raters for the interaction quality scales, described differences in the dyad's movement qualities in terms of relative enthusiasm, size, or intensity. The DMT student raters, described differences in movement qualities using more specific terms from either LMA or KMP. A word search showed that the DMT student raters never used the word enthusiasm, while the raters for the interaction scales used the word enthusiasm or enthusiastic 15 times. In the videos when Hans was following or engaged in the open-ended dance, the raters sometimes found Hans "less graceful," "less enthusiastic," not as "exuberant" or "joyful" as his partner. In the videos selected for interactions, there were generally more descriptions of Hans and his partners matching movement qualities than mismatching movement qualities. The DMT student raters frequently listed occurrences of matching and mismatching movement qualities between Hans and his partners using LMA or KMP terms, but without enough context, description, or duration to understand how this might have influenced the interaction. In one session, the raters described that Hans did not stretch to use as large a kinesphere as his partner and that he was less grounded when he shifted his weight. Hans and his first partner's movement qualities were very similar, with each leading similar slow arm movements using bound neutral flow. In the sessions with Carina, the raters listed that Hans and this partner sometimes shared: direct or indirect movements, moments of acceleration and/or deceleration and sometimes moments of lightness. They rarely described Hans as using strength (see Table 6).

**Table 5** Hans' coordination and movement repertoire when leading over the course of the intervention

Sessions	Movement repertoire when leading	Coordination, tension, motor skill
Beginning: Weeks 1 and 3	Mostly simple bound flow arm movements while standing in place or stepping side-to-side, and holding torso still “Up, down, across, sideways, simple movements are used, wide kinesphere Only moving arms, not integrated to the torso. Neutral bound flow.” “shows a very repetitive and restricted movement repertoire, even bound flow: movement as well as interaction seems mechanical, just fulfilling a task”	Hans “has difficulties to mirror when he shall move legs and arms together. His face shows a narrowing. He has no difficulties to mirror her as she moves only the arms.” “Doesn't show a good coordination of lower part of the body with upper part while shifting weight from side to side” Hans “has very little movement in torso, spine, neck area.”
Middle: Weeks 5 to 8	Continues leading mostly simple arm movements in vertical plane, occasional stepping side-to-side “Vertical plane, small and large Kinesphere, Hans moves only the arms.”	It “seems that the process of recognizing which part of the body is moving in [his partner] in order to transfer movement into his own body is demanding and slow.” “The movement of the arms and legs are not connected and not really coordinated, because the body is too stiff through the high tension.”
End: Weeks 9 and 10	The movements he leads are described as somewhat complicated, a bit more complex, novel (touching various body parts), or using more of his body Hans “increasingly moves more of his body than just the arms, he also starts involving the whole body for example by bending down.”	Improved coordination between body parts For a “short moment (arms up) you can see a connection through the whole body from the arms, over the torso, to the legs.” “Arms move separately and disconnected from torso, coordinates lower part of the body with upper part but range of movement is rather small”



**Table 6** Discussion of movement qualities across a larger sample of participants

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Movement qualities observed in the rest of the study participants

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As individuals on the autism spectrum vary greatly, we believe that the readers of this journal may be interested in a short summary of the movement patterns observed across the slightly larger sample of all five participants of the secondary video analysis that included Hans. These five participants were from 14–42 years old, three males and two females, and they varied greatly in their motor skills, movement repertoires, and movement preferences

The five participants' movement repertoires ranged from a limited expressive range as shown by leading many similar movements to using a large variety of movement patterns and qualities. Some participants, like Hans, generally led repetitions of the same basic movements or structures in each session. One participant created novel movement phrases throughout her mirroring dances with little repetition. All five participants attempted to follow most of the movements led by their partners, although some participants had more difficulty than others in mirroring the specific movements or movement qualities presented by their partners

A few potential challenges with movement were observed in multiple individuals in the study. Three of the participants were described as having difficulty coordinating their upper and lower bodies. Four of the five participants were described at times as lacking grounding or nearly losing their balance. The raters described limited integration of movement through the torso and/or a lack of breath support for several of the participants. Each of the five participants was at times described as having a somewhat stiff torso. In one video, for example a rater described that a participant and his partner "both moved side to side like wooden puppets with fixed and stiff trunk." Many of the participants at times used neutral flow or the raters noted that they used few effort qualities; some of these times, the participants were described as appearing distant or uncaring about their partners due to this excessive neutral flow or deadened movement. However, there were other times when these participants used efforts or matched the partner's efforts and were still described as appearing disengaged from their partners. While there were fewer times the raters described seeing deceleration, acceleration, or strength than the other effort qualities, the participants were seen using all effort qualities

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## Discussion

### Hans's Case

The case of Hans provides a specific example of many of the themes discovered in a secondary mixed methods video analysis of movement and interactions of individuals on the autism spectrum during partnered mirroring (Manders et al., 2021). Hans, like all of the participants in the secondary analysis, showed different patterns of engagement in the different mirroring tasks and with different partners, showing the contribution of the partner in this shared activity. Out of the participants analyzed, Hans' case was particularly interesting as he was partnered with the same DMT student partner, Carina, for five sessions. We could therefore look at change over time for Hans over just the sessions with this partner, removing the impact of the different partners. We found that Hans showed increased affective engagement in the open-ended dance segments of these five sessions only. As he had distinct patterns of engagement in the different mirroring tasks, it is meaningful that a mirroring-based DMT intervention led to change in his engagement during the open-ended dance since individuals on the autism spectrum generally struggle the most in complex and less predictable situations. The positive correlations found between synchrony and interaction quality in the less structured open-ended dance and interactive videos, but not in the more structured leading and following videos, point to further

possible differences in the social meaning of engagement in the different tasks. Hans was described as participating in moving throughout, but varying in his attention to his partner dependent on the task: attending primarily when following or interacting and giving less direct attention to his partner when he was leading or in the open-ended dance. Even when he was attentive, he showed limited affective engagement except when engaged in a playful movement theme with his usual partner Carina. As Carina was a DMT student, we can use this example to explore possible clinical implications of having participants on the autism spectrum work with partners who have training in nonverbal attunement and other DMT techniques. Carina's DMT training may have helped her adapt her movements to support his social connection. She later reported that she intentionally encouraged affective engagement and responsiveness in him by returning to a movement game that made him smile and adding variations that required his attention but were within his motor capacities. Hans' movement repertoire appeared to increase by the final sessions. While limitations in the data weakened our ability to explore links between movement qualities and the interpersonal interaction, limited coordination, integration of movement throughout the body, breath support, shape flow, and a stiffly held torso may be relevant for further study.

## Clinical Implications

While this study was small, it highlights a few points to consider in group DMT for individuals on the autism spectrum. Importantly for dance/movement therapists, it appears that teaching synchrony or specific movement patterns may not be sufficient to improve nonverbal interaction. Hans, and other participants in the secondary analysis, were able to lead and follow movement, be in synchrony, and at times adapt to their partners movements, or use efforts without this necessarily supporting increased affective engagement. The initial use of a clear structure such as leading and following may be useful to teach basic skills and create safety for individuals on the autism spectrum who seek routines, but this must then be developed to be responsive to others in an open-ended social context. This may relate to Fitzpatrick et al.'s (2018) finding that "intentional" and "spontaneous" synchrony relate to different social competencies (Theory of Mind, attention, and social responsiveness), suggesting that dance/movement therapists may want to create opportunities for clients to develop their tendency to use spontaneous synchrony in interactions. This is an area, where DMT could distinguish itself from a more behavioral approach: by starting where the client is at with the need for structure, while modelling playful and creative responses in the moment, dance/movement therapists can help clients practice their skills in more complex, creative, and flexible social contexts.

Hans' most successful interactions occurred when Carina led playfully challenging movements that required his close attention while remaining close to an established movement phrase. In returning to this movement theme, Carina picked up on Hans' nonverbal cues of enjoyment, changed one quality at a time to remain close to his known capacities and avoid overwhelming him. She continued to keep his interest and expand his movement repertoire through introducing variations, playing with the

element of surprise in the improvisational movement theme. Hans' responsiveness to Carina suggested that he could show more affective engagement when he was guided by someone who was responsive to his nonverbal cues and motor skills. When Hans appeared distracted, the raters observed that Carina made choices, which appeared to be intended to recapture his attention or engagement through the following actions: looking and smiling at him; using slow, clear, and repetitive movements that were easy for him to join; and incorporating playful elements into her movements. As one of the raters noted, her repeated movement theme mimicked an icebreaker in its relatively simple, lighthearted, and non-threatening structure and Hans was able to find enjoyment and laugh at the play within that structure. Carina initiated this movement theme, as a group leader would do with an actual icebreaker. However, rather than this "icebreaker" leading to a mutual exchange, Hans disengaged when the structured theme came to a close. In the final session he did appear to briefly initiate a movement challenge for his partner using a similar theme, suggesting that *he may have needed more time to incorporate this* into his own engagements or extend this for longer. While it is useful for people on the autism spectrum to eventually be able to themselves initiate and sustain nonverbal interactions, it appeared that Hans needed more support at first. Carina provided a model for Hans to experience being attuned to and engaging with another person in a movement-based interaction. This included creative movement improvisation with moment-by-moment adaptations to adjust to each other's responses to keep the interaction flowing and interesting to each individual. These moments likely also strengthened the feeling of connection between Hans and Carina as they were both emotionally engaged (with laughter) while moving together in this shared movement theme, showing the development of a movement relationship between them. Hans did not engage in this way with his other partners. It may be useful to start with smaller groups, or individual sessions, in which individuals on the autism spectrum can experience *mirroring with a skilled partner prior to attempting to partner with each other*.

Hans showed an increased *movement repertoire* in the last two of the ten sessions including the use of more full body movements and movements previously modelled by his partners. This included both elements from the shared movement phrase with Carina and other movements led by Carina and other members of the group. This suggests that while structured mirroring may not be sufficient to supporting affective engagement through intentionally synchronous movements, it may well support individuals on the autism spectrum in building skills such as an increased movement repertoire that can then be applied in their own expressive movement or less structured settings such as the open-ended dance.

A focus on the breath, coordination, and integration of full body movements may be warranted in DMT work with this population given that Hans and most of the other participants of the secondary analysis appeared to have difficulties with grounding and balance, stiff torsos with limited integration of movement throughout their bodies, and/or coordination difficulties. This is not surprising given that studies of motor skill have found that individuals on the autism spectrum tend to have more limited postural stability and perform more poorly on tasks that require them to coordinate their movement across multiple limbs, or their full bodies, at once (Fournier et al., 2010; Kaur et al., 2018). Even with a limited number of descriptions

linking movement features to the quality of the interaction, these issues of coordination, use of the breath and shape flow, and integration of the movement appeared relevant to interpretations of engagement with the partner. The seemingly high amounts of neutral flow may have contributed to the appearance of less affective engagement and matches prior predictions for individuals on the autism spectrum (Sossin, 2007). Dance/movement therapists working with this population may therefore want to use their clinical expertise to assess their clients and consider addressing these topics in DMT sessions.

## Limitations

The findings and conclusions in this article are limited in the small size of the study, with a single case presented here, and only five individuals in the entire secondary analysis. While some of the correlations were significant, it would be useful to test this on a larger sample to confirm that these findings would also apply to other individuals on the autism spectrum. It would be useful to have data from more individuals who partnered with consistent partners, including trained dance/movement therapists. As Carina was still a student in the midst of her training, it may be that an experienced therapist would have a stronger influence on the synchrony or interaction quality. It would be interesting to compare results for individuals partnered others on the autism spectrum, dance/movement therapists, and other research assistants without DMT training, to investigate whether the changes observed in Hans might occur when participants build familiarity with any partner, or whether it is important to have a partner with training in attuning through movement to scaffold the engagement.

This study was further limited due to the use of secondary data, with inconsistent availability of video. As a secondary analysis this study had limited access to background information about the participants and no ability to collect baseline data on Hans' synchrony and interaction quality prior to the start of the intervention. There was no video of Hans mirroring for two of the sessions he attended. The use of 30-s videos from the middle of each of the mirroring tasks resulted in relatively few videos with clear interaction between the partners, leading the first author (EM) to select an additional sample of videos with the most interactive behaviors. While EM used a predefined list of behaviors, and such purposive sampling is appropriate for answering qualitative research questions, these videos were analyzed using both quantitative scales and qualitative descriptions and this may have influenced the resulting assessments of change and correlational analyses. While the raters were blind to the session number when they were watching the videos, EM was neither blind to the order of the videos when selecting the interactive videos, nor when analyzing the qualitative data, potentially unintentionally leading to a focus on more positive outcomes in coding the final weeks.

The assessment of movement features in the interaction was limited by *the format of the movement observations* in which raters frequently listed the presence or absence of certain movement characteristics and generally did not describe when and how these occurred in the interaction, so that little further meaning could be derived from them beyond determining that none of these movement qualities were

completely missing. Without a normative sample or typically developing control group, it is difficult to determine how the relative frequencies of the various movement qualities might compare with a group of individuals not on the autism spectrum. The movement analysis was also limited in the use of *DMT students* with little experience in using LMA or KMP beyond their classwork. The descriptions of the participant's use of various movement qualities from the LMA or KMP perspectives should therefore be corroborated by individuals certified in these tools for reliability in these observations. The limited time for rater training on the various synchrony measures led to challenges with most of the synchrony measures, so that only rhythmic synchrony was used (see further discussion of these measures below). While there was high interrater reliability on the flow of the interaction scale, the fact that it was designed for verbal interviews and did not make sense in the context of leading and following without a back-and-forth exchange, limited its usefulness. The first author, Manders, did attempt to rephrase some of the descriptions to fit a movement-based interaction and added a movement and mirroring focused description for the coding of qualitative data, but this would require more testing to support its use.

This article is limited in only having a third person perspective on the movement and interaction. This excludes the perspectives of the participants and their partners on their own sense of their affective engagement and the flow of their interaction or any other additional meaningful features of their interaction or movement.

## Future Research Directions, Scale and Measurement Improvements

This study explored a few different forms of synchrony, however several of these scales may require longer rater training or clearer definitions for use in future research (See Table 1). Future studies should emphasize training on the distinction between synchrony and echoing/following to support raters in making consistent decisions on the cut off between these two. Rather than simply measuring the amount of following, measurements of the time of the delay may also be useful, to both reduce the confusion in a cut-off between synchrony and following and in exploring if different timeframes may relate to different aspects of social relatedness as suggested by Fraenkel (1983). It was predicted that limited matching of efforts with a partner might contribute to a sense of limited affective engagement in the interaction, but the reliability on the effort synchrony scale was low. Measuring effort synchrony might need longer rater training and more experienced raters certified in movement analysis as follow-up interviews did not reveal a specific reason for the difference between the raters.

Hans showed an increased movement repertoire after several weeks of mirroring, but it is unclear whether this would also start to support an increased quality of the interaction if the intervention had continued longer. Longer studies with larger samples could explore the idea of subgroups based on motor skill and coordination or change in interactions over time in relation to increases in movement repertoire. To further explore specific movement qualities that may impact the interaction quality, future studies should include non-autistic control groups and

may want to explore topics such as torso stiffness, lack of integration of movement throughout the body, grounding, lack of breath support, and motor coordination.

Further research with a larger sample is needed to better explore the relationship between synchrony and affective engagement during interactions and the less structured open-ended dance task. Since Hans showed increased affective engagement across the sessions with Carina only, studies with more consistent partners could explore the impact of partnering with a dance/movement therapist in comparison with consistent peer partners. As Hans and the other participants approached the open-ended dance task differently, larger studies could look at patterns to determine if this correlation was found because of the manner in which participants approached the open-ended dance, or if synchrony generally supports affective engagement in a more flexible task. This could include investigation into the stages of mirroring used by the participants to see which stages they use, and test if these show different relationships with affective engagement. In the last week, Hans started to lead Carina in their shared movement game, but did not appear as engaged as when he followed her. This showed an attempt to draw on their established connection through movement, but with less complexity and for only a brief time. This raises the question of whether it is possible to *teach nonverbal attunement* to a partner in a more complex and responsive way and if this is directly related to emotional coordination.

With this case of Hans we investigated interactional synchrony and interaction quality during mirroring with an individual on the autism spectrum. He was observed to engage differently with his different partners as well as in the different mirroring tasks. There was a positive correlation between his synchrony with his partners and the flow of the interaction as well as between synchrony and his affective engagement, but only in the less structured open-ended dance and videos of interactions. Synchrony was not correlated with affective engagement in the structured leading and following dances. He was also observed to be most engaged during videos when his usual partner Carina led him in variations on the same movement phrase which required attention for him to follow her varied timing. By the end he attempted to lead this same movement phrase once for her and also increased his movement repertoire when leading by incorporating other's movements. As seen with Hans and Carina, the use of attuned playful improvisational movement in mirroring during DMT may support moments of affective engagement in connection with interpersonal synchrony within a movement relationship.

**Acknowledgements** The authors would like to acknowledge the researchers, dance/movement therapists, research assistants, and participants of the parent study. The first author would like to acknowledge the other committee members on her dissertation from which this case study came, Dr. Sherry Goodill, Dr. Marcia Polansky, Dr. Kathleen Fisher, and Dr. Ellen Giarelli. This study was funded by a grant from the Marian Chace Foundation of the American Dance Therapy Association and fellowship support for the first author by Fulbright and the Germanistic Society of America/Quadrille Ball. The parent study was funded by the European Union (FP7-PEOPLE-2010-ITN, 264828; Thomas Fuchs/Ezequiel DePaolo).

**Author Contributions** E.M. conducted the secondary analysis as part of her dissertation and wrote the first draft of the paper; S.C.K. advised on the secondary analysis and made significant contributions to the writing of this paper; T.F. acquired funding for the parent study; T.F. and S.C.K. designed and conducted the parent study.

**Funding** Open Access funding enabled and organized by Projekt DEAL. This study was funded by a grant from the Marian Chace Foundation of the American Dance Therapy Association and fellowship support for the first author by Fulbright and the Germanistic Society of America/Quadrille Ball. The parent study was funded by the European Union (FP7-PEOPLE-2010-ITN, 264828; Thomas Fuchs/Ezequiel DePaolo).

## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethics Approval** This study was performed in line with the principles of the Declaration of Helsinki. The parent study, conducted at the University of Heidelberg by Thomas Fuchs as part of the Marie Curie Initial Training Network “TESIS: Toward an Embodied Science of InterSubjectivity,” was approved by the ethics board of the Medical Faculty of the University of Heidelberg (Ethikkommission). This secondary analysis of data received further approval by the Drexel University Institutional Review Board with an exemption from further informed consent due to the use of secondary video data only.

**Informed Consent** The parent study received informed consent from all participants for participation in the research study and secondary analyses of these data performed within the timeframe of the study. For minor participants, the parent study received informed consent from parents/guardians as well as assent from the minor participant. This secondary analysis received an exemption from further informed consent due to the use of secondary video data only.

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**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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