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Running head: Measuring flow in dance

Measuring individual and group flow in collaborative improvisational dance

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Abstract

This study investigated flow experience during group collaborations of creative dance improvisation, where group flow was defined as periods when most members of a group reported a flow experience. Sixteen dancers took part in the experimental sessions, performing improvisational tasks in groups of four. We chose two different types of dance task, hypothesising that dancers' external focus upon the group's shared surroundings and awareness of others might facilitate group flow experience; while an internal focus upon one's own mental imagery might inhibit it. A novel, video-stimulated recall method to assess flow experience was used to track time patterns and shared characteristics of flow experience within the group. We also used the Flow Short Scale (FSS); thinking aloud recall; and consensual assessment of creative outcomes of activity. Our findings showed that group flow was rather rare and was more likely when a group had worked together for longer. Consequently, external focus tasks facilitated group flow only in the latter part of the session. Dancers' reports revealed that a group in a high-flow state engaged with a task in a more complex way: sharing, transforming and supporting each other's ideas, while low-flow moments were characterised by simpler creative tools, such as mimicry. As expected, flow was positively related to the creative outcomes of the group activity.

Keywords: flow, group creativity, dance, improvisation

Measuring individual and group flow in collaborative improvisational dance

Introduction

Flow is a state of being fully absorbed and experiencing feelings of energised focus, deep involvement, and success in the process of doing things (Csikszentmihalyi, 1990). Flow plays a vital role in innovation and creativity, as all such processes require high intrinsic motivation to break through to a new level of complexity of thoughts and ideas, while the social environment rarely provides sufficient extrinsic rewards to motivate people to extensive creative work (Csikszentmihalyi, 1988). Meanwhile, the vast majority of creative activities have a primarily social character: e.g. theatre making, music, and dancing. Thus, group flow became central in group creativity research (Sawyer, 2003, 2007; MacDonald, Byrne and Carlton, 2006).

Group flow shares many aspects with individual flow, but inevitably has differences, due to its collaborative nature. In this study, we compare individual and group flow in dance improvisation, to explore the cognitive processes and strategies underlying group improvisation and their relation to flow experience; in particular, those that might support the aspects of group flow that are dependent upon understanding the other group members' states and intentions.

Individual and Group Flow

Flow usually occurs within goal-directed activities. It requires that perceived challenges or opportunities for action, stretch but do not overreach one's skills, and that clear goals and immediate feedback about progress being made allow complete focus on the activity itself (Csikszentmihalyi, 1990). Under these conditions, a person enters a subjective state that is characterised by: concentration on the task at hand;

action-awareness merging; loss of self-consciousness; a sense of control; a transformation of time; and, finally, intrinsic reward (Csikszentmihalyi, 1988a; Jackson, 1995; Massimini & Carli, 1988). As individuals experiencing flow are highly concentrated and optimally challenged while being in control of the action, some researchers have equated flow to optimal experience (Csikszentmihalyi & LeFevre, 1989), peak experience (Privette, 1983), and the state of peak performance (Eklund, 1994).

In comparison, Sawyer (2007) described group flow as a collective state of mind that is experienced by an improvising group. Group flow, a typical component of peak performance across many domains - such as team sports, collective art projects, consulting companies and teams of engineers - is also named *combined* or *shared* flow and refers to group activities such as 'hot grouping', defined as absorbing engagement, undertaken by vital and hard-working interactive teams or task forces (Lipman-Bluman, Leavitt, 1999).

Group flow theory, similarly to the phenomenology of individual flow, describes a set of conditions for, and characteristics of, the highly creative team (Sawyer, 2003, p. 167). Group flow is facilitated by: a common group goal that provides a focus for a team and gives a cue if they move closer to a solution but which is open-ended enough for various creative solutions to emerge; complete concentration on the group activity; good communication and listening skills of the group members; felt autonomy and competence; mutual connections and equal participation in the creation; blending of egos, i.e. experiencing the loss of self-consciousness as each person's idea builds on those contributed by others; deep familiarity with each other and shared creative language; and, finally, the potential for failure of the project, meaning an activity takes place beyond limiting 'safe boundaries' (Sawyer, 2007).

Although Sawyer defines his concept of group flow as a phenomenon distinct from individual flow, as an emergent property of the group unit, both theories share many similarities: They both refer to optimal experience (performance), in which a person or a group reaches their peak fulfilment of abilities, is highly creative, productive, and successful. They both emphasise as requirements for entering flow: the importance of a clear goal, challenges that match personal skills, and high concentration on the task. While Csikszentmihalyi (1975) defines his theory in terms of requiring a skills/ challenges balance to enter the flow state, Sawyer (2007) emphasises the importance of (felt) personal competence within the group activity. Individual flow is associated with a sense of control. For group flow, the sense of members' autonomy when participating in the group activity is equally required. Both researchers include the 'blending egos' phenomenon, the absence of sense of a self separated from the surrounding world (or group).

The differences between theories arise with Sawyer's focus on the qualities of group processes, which naturally are absent in the individual model of flow. Group flow is more likely when everyone is fully engaged in 'deep listening' to the group. At such times, members of the group do not plan ahead, rather they react and respond to what they hear at a particular moment. Such an unplanned approach to collaboration is characteristic of an improvisational setting – in music, dance, theatre or any other improvisational art, game or activity (Sawyer, 2007, p.46).

It is not surprising that in a qualitative study of a music jam session Hart and Di Blasi (2013) found that combined flow experience shared almost all the characteristics of individual flow experience. They stated that the development of *empathic feeling* among group members of a jazz ensemble was a key characteristic for a combined flow experience, allowing musicians to feel not only the high points in

a collaboration, but also the low points of experience. Hart and Di Blasi (2013) concluded that such empathic relationships marked a difference between individual and combined flow experiences. Further studies linked development of group empathic connection between group members with the optimal performance of the group (Myers and White, 2012; Waddington, 2013). Therefore, the empathic abilities of the group members might be central for group flow to appear.

Measuring group flow

Although group flow shares many aspects with individual flow (as the basic conditions for flow for individuals must be first met), it is inevitably different because of its collaborative nature. For this reason, many researchers use qualitative methods: mainly observational studies (Sawyer, 2003) and in-depth interviews (Hart & Di Blasi, 2013). Macdonald et al. (2006) provide an example of a quantitative approach: to investigate the link between flow and musical creativity, they used an Experience Sampling Form (Csikszentmihalyi & Csikszentmihalyi, 1988) as a measure of individual flow experience. Group flow was then defined as an average of individual scores among all group members. A similar strategy was chosen by Salanova et al. (2014) in their study on collective flow experience among workgroups. To assess collective flow they used aggregated measures of individual ratings on a *group task absorption* scale and a *group task enjoyment* scale. Items on these scales addressed the collective, shared experience of the group, such as “When the group is working, we forget everything else around us”. Although, each of these studies shed light on the nature of shared flow experience, neither of the methods analysed the changing dynamic of flow experience in the group collaboration over time, or tracked an individual versus group level of experience.

In this study, we used a video-stimulated recall method *Flow*, which was designed to share a video recording with multiple users simultaneously on handheld tablets and collect the users' ratings of flow immediately after the activity (Figure 1). *Flow* asks participants to watch individually a recording of their group activity on a tablet device and record spoken recollections of thoughts and awareness during the task, through the reporting aloud procedure. Compared to other methods, such as reflective diaries, retrospective reports, or classic interviews, reporting aloud leads to better recall, and does not require elaborate writing skills or high commitment from participants, and is time-economic (Rowe, 2009). Investigating solo dance improvisation, Douse (2014) showed that flow experience might be accurately recognised by dancers, as well as a trained observer, through post improvisation reflective methods including video-recall stimulated interviews.

Additionally, to the usual protocol of a video-stimulated recall, *Flow* allows identifying and annotating those moments when they remembered experiencing flow (or, in other words, 'being in the zone') on the timeline of the recording. *Flow* has the advantage of supporting the analysis of dynamics of individual or group flow experience over time. It allows to track the frequency and stability of the experience, and patterns of shared flow in the group. Accordingly, group flow is defined as those moments in a group activity when participants experience flow simultaneously in a collaborative task.

Flow in dance practice

Research on flow in dance is still fragmented, and mostly focused on individual achievements: Hendin and Csikszentmihalyi (1975), studying a social form of rock dancing showed that dancers in flow performed better in improvisational problem solving, mostly due to their higher skills and therefore a closer balance between their

skills and challenges of dance. Similarly, in professional performance setting, dancers' flow is also supported by skills-challenges balance, moreover by absorption with a task that are facilitated by self-confidence, familiarity with movement materials, routines, and pre-performance rituals (Hefferon and Ollis, 2006). Dancers' flow experience on the stage might be enhanced by a positive imagery, that supports self-confidence in dance routine (Jeong, 2012).

Focusing on creative practice, Paskevskā (2001) suggested that flow allows dancers to express freely their embodied ideas, giving access to their creative abilities beyond the intellectual process of dance making. Qualitative investigation into flow in dance improvisation also reported the common belief that flow is a highly creative state for dancers, when they could surprise themselves with unusual, yet 'natural' movement solutions (Łuczniak et al., 2020).

Building upon these findings, we developed a quantitative approach to investigate the importance of flow for creative outcomes. We decided to focus on dance improvisation as a fundamentally creative practice that provides primary conditions for experiencing flow (Csikszentmihalyi, 1996). Dance improvisation is an open-ended practice focused as much on the processes of creating or choosing movements as doing them (De Spain 2014, 5). Although there is no set choreography, engaging in improvisation requires rigorous focus as dancers are constrained by an improvisational score (Middelow, 2019). It is a practice of noticing multiple creative choices and making a choice while doing (Doughty, 2019). In improvisation, the creative process is visible and not separate from the creative product; therefore, it might be seen as a laboratory for studying creativity (Łuczniak, 2015, (Sawyer, 2000).

An improvisational score, a task for dancers to engage with through their movement exploration, may provide dancers with a necessary focus and level of challenge for flow to appear (Łuczniak et al., 2020). Frequently, improvisational scores are based on imagery that is used to guide dancers' quality of movement or engagement with space and time (Millard, 2015; Tufnell & Crickmay, 2004). As Douse (2013) showed, dancers experience flow while engaging with such scores.

Yet, as Sawyer (2007) noted, group flow requires a group to engage in 'deep listening' to each other: to do not plan ahead, rather react and respond moment to moment. Therefore, improvisational scores that would bring dancers' attention into group listening and emergent collaboration could be more likely to stimulate flow within the group improvisation.

In this current study, the dancers' focus was manipulated using two types of improvisation tasks. The internal focus tasks engage the dancers' attention onto an internal, imagery-based tasks, while the external focus tasks asked a dancer to pay close attention to their surrounding and the others in the group. We hypothesised that directing attention to others in the external focus tasks would enhance group flow, while directing attention inwards in the internal focus tasks would limit group flow.

Additionally, the link between individual and group flow with dancers' empathy and creative outcomes of the improvisational tasks was measured.

Method

Participants

Sixteen contemporary dancers with at least a year's experience of dance improvisation (including group improvisations) were recruited from a BA dance program of Plymouth University. Participants worked in four groups of four dancers

(four student groups). Each participant received £12 for taking part in each 1.5 hour testing session.

Materials

Flow: *Flowⁱ*, a video-stimulated recall method was used to capture individual and shared flow experience in improvisational tasks. Between two to five minutes after completing a dance task, participants individually used tablets to review the recording, wearing noise-cancelling headphones to prevent distractions or influence from the others. Participants were asked to report aloud their recollection of the thought pattern during a task, according to the instruction: “As you are watching your improvisation, try to narrate your conscious thinking, considering a question like, ‘Where my awareness was at that moment?’ We are looking for a narration similar to a director’s commentary on a DVD” (Norgaard, 2011). Four categories for reflection were suggested: (1) my thoughts/images; (2) my senses; (3) my actions; (4) relation to others. However, they were not exclusive. Participants were able to pause or rewind the video at any moment, and this navigation was recorded to retain synchronisation between the recording of their voice and the video. Following this, participants watched the recording again, and this time were asked to tap a *flow* button every time they recognised a flow moment and tap it again when it finished (Figure 1). The following definition of flow was given: “They are those moments in which you were totally absorbed in what you were doing, and which were highly enjoyable” (Hefferon & Ollis, 2006; Martin & Cutler, 2002).

Shared creativity in dance improvisation



Figure 1. Dynamic evaluation of flow experience application – tablet view. The flow periods are marked blue at the timeline below the video.

Fluency, Importance, and Absorption: *Flow Short Scale* (FSS; Rheinberg, Vollmeyer, & Engeser, 2003; cf. Engeser & Rheinberg, 2008). This 13-item questionnaire measures flow as a state using a 7-point scale. Participants were asked how much they experienced flow-related phenomena (e.g. do not notice time passing) in the just-finished task. The FSS contains three sub-scales: *fluency with performance* (6 items), *absorption by activity* (4 items) and *perceived importance of activity* (3 items).

Empathy: *The Toronto Empathy Questionnaire* (TEQ; Spreng, McKinnon, Mar, & Levine, 2009) consists of 16 questions; each rated on a five-point scale from 'never' to 'often'. It conceptualises empathy as a primarily emotional process. The instrument has been shown to be positively correlated with measures of social decoding, other empathy measures, and to be negatively correlated with measures of

autism symptomatology. In this study, the scale was used to measure empathy as a covariate of group flow experience.

Creativity: The *Consensual Assessment Technique* (CAT; Amabile, 1982) was used to assess creative outcomes of experimental tasks. This allows for subjective viewpoints and preferences to be taken into account, recognising different views of what is considered creative. In the following study, the creativity of group improvisation was assessed by participants, individually, at the end of the session. They were given the following instruction: 'Using your own definition of creativity, rate the degree to which each dance was creative', and were asked to compare all performed tasks on the nine-item scale from '*not at all*' to '*very much*'.

Procedure

Ethical approval for this study was granted by the University of Plymouth, Faculty of Health and Social Studies. All participants gave written, informed consent following a briefing session, in which they were given written and verbal information about the experiment.

The testing session was designed to be as similar to a regular improvisation workshop as possible. Each group warmed up with a set of walking and focus exercises, sense and group awareness building, and a game that asks a group to co-ordinate movement.

After this warm-up, the dancers were asked to complete four improvisational tasks together. Two different types of improvisation tasks commonly used in dance practice were introduced. Two *internal focus* tasks were based upon multimodal imagery, while two *external focus* tasks were based upon sense-awareness and asked dancers to use 'here and now' cues from the surroundings (Appendix 1).

These two different types of tasks were chosen to examine whether an internal focus upon imagery and an external focus upon sensation differentially facilitated a flow state or affected the shared character of the group improvisation. To balance task order effect, two groups performed internal focus tasks first, while the two others started with external focus tasks.

Each task lasted 4-5 minutes. Immediately after completing each improvisational task, participants were asked to fill out the FSS and to complete the two phases of the video-stimulated recall (recollection of improvisational awareness and assessment of flow), taking around 15-20 minutes in total.

After four rounds of improvisational task and reporting, the group formed a circle to share feedback, and were debriefed.

Results

Dancers reported medium to high ratings of absorption with activity and fluency, but importance of activity was rather low (Table 1)ⁱⁱ. This indicates dancers' high engagement with tasks and a lack of pressure on achieving 'right' results. The *Flow* measure indicates that dancers spent on average 52% of tasks time in flow states. However, there were large individual, inter-tasks differences.

	Individual measure (n=16)			
	<i>Mean</i>	<i>SD</i>	<i>Min.</i>	<i>Max.</i>
Flow	52.2	17.71	11	97
Absorption (FSS)	21.0	3.79	7	28
Fluency (FSS)	29.1	6.42	12	39
Importance (FSS)	7.0	2.52	3	15

Empathy (TEQ)	43.5	5.10	35	55
Creativity (CAT)	5.3	1.43	2	7
Group measure (n=4)				
Group flow (GF)	31.4	15.24	9.3	68.3

Table 1. Descriptive statistics of measures.

To create a group measure of flow, the group flow factor (GF) was computed from the individual *Flow* reports by counting the proportion of pairs within the group simultaneously reporting flow experience. With groups of four, there were six possible pairs, so at any moment the group could score zero if no, or one, person reported a flow state; $1/6$ or 17% if any single pair of individuals reported flow, $3/6$ or 50% if three individuals reported flow, and 1 (100%) if all four participants reported flow (Figure 2). These values were computed for every 5 seconds, and the overall GF score for each task was the mean value over the entire task duration. Shared flow experience, measured by GF, was rather rare. Dancers evaluated their improvisation as moderate to highly creative.

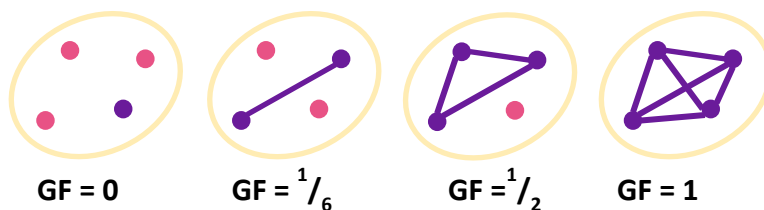


Figure 2. Group flow measure GF, as the proportion of pairs within the group simultaneously reporting a flow state.

Due to group activity and the repeated measures design of this study, the data had a highly structured, hierarchically nested character. Such a structure suggested the use of Multi-Level Modelling (MLM) for hypothesis testing to differentiate between the individual, group and task-related effects (Quené & van den Bergh, 2004). The data set was structured into a three-level model: the level 1 units were measurements occasions (tasks), further clustered within individuals (dancers), who represented the level 2 units. In this study, also the group measures were taken into consideration; therefore groups were the level 3 units of the model (Figure 3). All analyses below were performed using R version 3.4.4 (R Core Team, 2018) with R2MLWin package (Zhang et al., 2016).

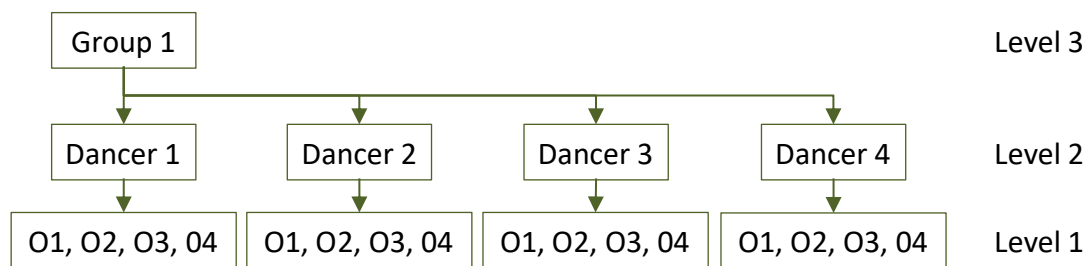


Figure 3. A diagram of three level structure of data set of flow experience.

As each of the sixteen dancers completed four tasks, there were 64 observations for analysis. There are no accepted methods for computing power analyses in hierarchically nested multi-level modelling (Judd et al., 2012), but by analogy with repeated measures ANOVA, for an estimated effect size $f = 0.33$, with alpha of .05, a design with four measurements from 16 participants and no group factors would achieve a power of .86.

Prediction of Flow from FSS dimensions and Empathy

A multilevel modelling analysis of the relationship between *Flow* and FSS subscales and empathy was performed with fixed effects of absorption, fluency, importance and empathy (without interaction terms). As random effects, intercepts for groups, subjects and occasions were added, reflecting the fact that observations tend to be more similar if they are (a) taken on the same occasion (experience effect), (b) taken from the same person, (c) taken within the same group. To aid interpretation, and reduce multicollinearity, variables were centred on their respective grand means.

Model F1: $\text{Flow} \sim (1 \mid \text{Group}) + (1 \mid \text{Dancer}) + (1 \mid \text{Occasion})$

Model F2: $\text{Flow} \sim \text{Absorption} + \text{Fluency} + \text{Importance} +$

$+ (1 \mid \text{Group}) + (1 \mid \text{Dancer}) + (1 \mid \text{Occasion})$

The Null Model, F1, sums variability in the dependent measure *Flow* related to individual and group random effects, with none of the fixed effects of interest (Table 2). Due to centering all variables, the intercept in the null model equals 0 and corresponds to the mean value of *Flow* ($M=49.1$). In tested models, *Estimate* describes a change in *Flow* for one standard deviation of change in the predictor.

Parameter	Model F1		Model F2		Model F3	
	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>
Fixed:						
Intercept	0	.23	0	.156	0	.142
Absorption (FSS)			.01	.145	0.04	.154
Fluency (FSS)			.38**	.142	.37*	.149
Importance (FSS)			.11	.126	.13	.134
Empathy (TEQ)					-.09	.152
Random:						
Group (Intercept)	.15	.155	.03	.074	.03	.058
Dancer (Intercept)	.10	.122	.10	.112	.12	.088
Occasion (Intercept)	.74	.151	.67	.136	.53	.096
Deviance	173.7		164.4		164.2	

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

Table 2. Multi-level modelling analysis of the relationship between *Flow*, FSS subscales and empathy (TEQ).

In Model F2, the fluency, absorption and importance subscales of FSS were added as fixed effects that predict changes in *Flow*. Fluency was the only significant predictor of *Flow*, $B = .38$, $z = 2.66$, $p = .006$: the rise of 1 Z-score on fluency scale (6.4 points), predicted an increase of 17.7 points on *Flow* scale. The other fixed effects were not statistically significant. The FSS factors explained 80% of *Flow* variance at the Group level but only 8% of the variance at the Occasion level. Including FSS factors significantly improved model fit over the null model, (change in log likelihood: $\chi^2(3) = 9.31$, $p = .015$).

Model F3 additionally included Empathy as a fixed effect.

Model F3: $\text{Flow} \sim \text{Absorption} + \text{Fluency} + \text{Importance} + \text{Empathy} +$
 $+ (1 \mid \text{Group}) + (1 \mid \text{Dancer}) + (1 \mid \text{Occasion})$

The pattern of FSS factors was similar, but empathy showed no significant effect on predicting *Flow* and did not improve model fit. Further exploration, such as adding random slopes for empathy in each group, did not improve the model either.

In conclusion, the *Flow* measure obtained from the video-stimulated recall method was mostly related to the fluency of performance dimension of flow, which described the ease of keeping the right level of concentration and moving between different aspects of an activity. Empathy was not a significant predictor of flow.

Creativity and individual flow

Flow experience was commonly reported as a highly creative state (Csikszentmihalyi, 1996; Sawyer, 2003). All participants, after completing the testing session were asked to evaluate the four tasks in terms of their group's creative outcome, based on their subjective viewpoints and preferences, using the consensual assessment technique (Amabile, 1982). The relationship between these subjectively perceived creative outcomes and flow experience were explored using MLM approach. This time, in addition to the flow subscales of FSS (absorption, fluency and importance) and empathy, the DF measure of *Flow* was used as a fixed effect.

Two families of models were created: in one flow was predicted based on FSS subscales and second based on *Flow* (we could not include *Flow* and Fluency in the same models, as they were too highly correlated, leading to collinearity). The data were organised in the same structure as in previous analysis, therefore as random effects intercepts for groups, subjects and occasions were added. The full models, Model C2 and C3 (Table 3) included fixed effects of flow and empathy on creativity ratings, but differed in the variables used to measure Flow:

Model C2, C3: Creativity ~ *Flow* + Empathy +

(1 | Group) + (1 | Dancer) + (1 | Occasion)

Model C2 explored the relation between flow measured by FSS factors, Empathy and Creativity. Fluency was a significant predictor of creative outcomes ($B=.54$, $z=4.08$, $p<.001$). Additionally, empathy had a significant linkage to creativity ($B=.29$, $z=2.51$, $p=.012$). The inclusion of FSS dimensions and empathy explained

38% of the variance and significantly improved model fit over the null model C1, change in log likelihood $\chi^2(4)=28.48$, $p < .001$.

Model C3 included flow experience measured by *Flow*, the video-stimulated recall method. In this model both fixed effects were significant: *Flow* ($B=.31$, $z=2.63$, $p=.009$) and empathy ($B=.23$, $z=2.00$, $p=0.05$) were predicting positively creativity ratings. The model was significantly better than the null model C1, with change in log likelihood of $\chi^2(2)=9.18$, $p=.01$; however, the fit of *Flow* and empathy explained only 13% of variance and the relationship between *Flow* and creativity was weaker than between fluency and creativity. It is worth remembering that fluency is a momentary experience sampling measure taken at the end of the task, while *Flow* retrospectively explores flow experience over the entire duration of task. The *Flow* measure is taking account also of 'warming-up time' before getting into flow or creative process fully, whereas fluency is assessed only afterwards, capturing the peak of flow (and creative process), so a weaker relationship between *Flow* and creative outcome is not surprising.

Parameter	Model C1		Model C2		Model C3	
	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>
Fixed:						
Intercept	0	.124	0	.099	0	0
Absorption (FSS)			.05	.132		
Fluency (FSS)			.54***	.131		
Importance (FSS)			0	.107		
Flow					.31**	.117
Empathy (TEQ)			.29*	.114	.23*	.117
Random:						
Group (Intercept)	0	0	0	0	0	0
Dancer (Intercept)	0	0	0	0	0	0
Occasion (Intercept)	.98	.174	.63	.111	.85	.151
Deviance	180.6		152.1		171.4	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3. Multi-level modelling analysis of the relationship between Creativity, *Flow*, FSS factors and empathy (TEQ).

In conclusion, there was a significant relationship between individual flow experience and group creativity: higher fluency (FSS) in a task and overall flow measured by DF were correlated, and positively influenced ratings of creative outcomes. Interestingly, the individual's level of empathy was also positively correlated with the group's creative outcomes. Therefore, empathy might be seen as another group process that facilitates group creativity.

Group Flow

The aim of the following section is to explore whether empathy is a positive predictor of group flow experience.

As with the individual flow analysis, a series of multilevel models were constructed. This time, empathy (TEQ) was added in model E3 as a fixed effect. Intercepts for groups, subjects and occasions, and, in the final model, by-group random slopes for the effect of empathy level within the group, were added as random effect:

Final model E3: Group flow ~ Empathy +
+ (1 + Empathy | Group) + (1 + Empathy | Dancer) + (1 | Occasion)

Table 4.5 presents exploration of the model. Neither Model E2 nor E3 significantly improved fit compared to the Null Model E1 (change in log likelihood for E2: $\chi^2(1)=.07$, $p=.79$, and for E3: $\chi^2(3)=.07$, $p=.99$); the fixed effect of empathy and moderated by group effect of empathy were not statistically significant predictors of

GF. Thus, there is no evidence in this study to support the hypothesis of a relationship between empathy level of participants and experiencing group flow.

Parameter	Model E1		Model E2		Model E3	
	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>
Fixed:						
Intercept	0	.304	0	.299	0	0
Empathy (TEQ)			-.04	.133	-.04	.133
Random:						
Group (Intercept)	.33	.261	.32	.253	.32	.253
Empathy					0	0
Intercept*Empathy					0	0
Dancer (Intercept)	0	0	0	0	0	0
Occasion (Intercept)	.65	.120	.66	.120	.66	.120
Deviance	163.4		163.3		163.3	

Table 0. Multi-level modelling analysis of the relationship between group flow (GF) and empathy (TEQ).

Flow and dancers' focus

Subsequently, the relationship between *Flow* and dancers' focus (internal imagery or external environment) was tested, for both individual and group flow. This time focus was added as a fixed effect to the model. Additionally, to check if shared flow develops over time, a fixed factor of experience (the order number of the task) was added as another fixed effect to the model. For individual flow, intercepts for occasions, dancers and groups, as well as by-occasion, by-dancer, by-group random slopes for shared experience were added as random effects; for group flow the dancers terms were omitted. Models IF5 and GF5 included Focus and Experience only as main effects, while models IF6 and GF6 added their interaction:

Model IF5: Flow ~ Focus + Experience +

+ (1 | Group) + (1 | Dancer) + (1 | Occasion)

Model IF6: Flow ~ Focus * Experience

+ (1 | Group) + (1 | Dancer) + (1 | Occasion)

The null model remained the same as in the previous analysis and just accounted for differences between dancers, groups, and changes over time. Table 5 summarises the exploration of the model.

Model F6 significantly improved model fit in comparison to F5 (change in log likelihood: $\chi^2(1)=7.46$, $p=.006$) and explained variance at the Group level. The interaction of focus and experience was significant ($B=.73$, $z=3.65$, $p<.001$), as well as the focus of task ($B=-1.65$, $z=-3.08$, $p=.002$). Figure 4 illustrates the different relationship between flow and group experience for internal and external focused tasks. While the level of flow in internal focus tasks remained at a similar level regardless of the order number of the task in the session (adjusted $B=-.02$), an external focus was beneficial for flow experience in the latter tasks of the session (adjusted $B=.62$).

Parameter	Model F1		Model F5		Model F6	
	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>
Fixed:						
Intercept	0	.23	-.96**	.32	-.04	.357
Focus			.19	.182	-1.65**	.535
Experience			.35***	.082	-.02	.130
Focus*Experience					.73***	.201
Random:						
Group (Intercept)	.14	.156	.14	.155	0	0
Dancer (Intercept)	.10	.122	.15	.119	.10	.087
Occasion (Intercept)	.74	.151	.53	.108	.53	.109
Deviance	173.7		157.8		150.3	

Note. ** $p<.01$, *** $p<.001$.

Table 5. Multi-level modelling analysis of the relationship between *Flow* and dancers' focus.

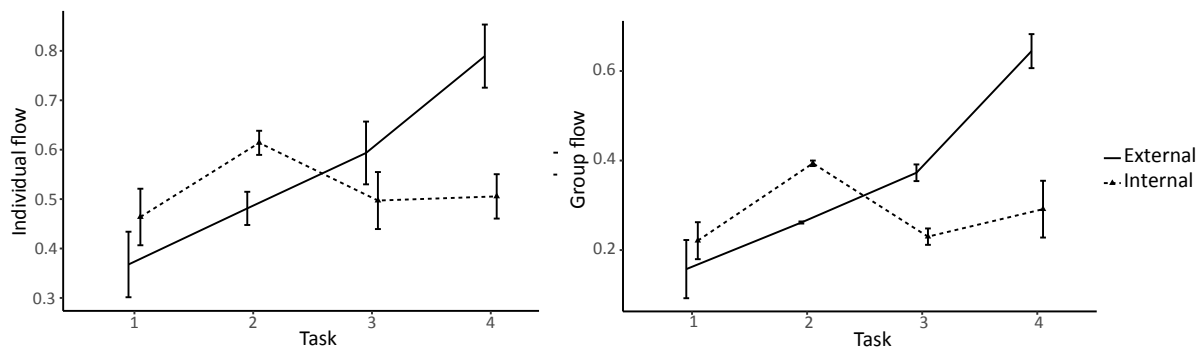


Figure 0. Impact of shared experience and type of task on individual flow (left) and group flow (right).

To summarise, an externally focussed task did positively influence individual flow experience, but only if the external focus task was performed later in the session, after the internally focussed task (effect of shared experience). The difference in the level of flow between the internal and external focus in the last task of the session proved to be significant ($t = 3.64$, $p = .002$).

Table 6 summarises the modelling results for group flow. In Model GF3 an interaction effect between the focus of the task and experience was introduced and it significantly improved the model fit; compared with Model GF2, with change of likelihood of $\chi^2(1) = 9.70$, $p = .002$. Similarly, as for individual flow, the interaction effect was significant ($B = 1.03$, $z = 4.89$, $p < .001$), as well as the fixed effect of task's focus ($B = -2.10$, $z = -3.64$, $p < .001$).

Parameter	Model GF1		Model GF2		Model GF3	
	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>	<i>Estimate</i>	<i>SE</i>
Fixed:						
Intercept	0	.29	-1.51**	.44	-0.23	.409
Focus_External			.47'	.260	-2.10***	.578
Experience			.51***	.116	-.01	.149
Focus*Experience					1.03***	.211

Random:						
Group (Intercept)	.15	.262	.28	.251	.	.
Occasion (Intercept)	.77	.318	.270	.110	.22	.079
Deviance	43.8		31.1		21.4	

Note. $^{\ast}p < .1$, $^{\ast\ast}p < .01$, $^{\ast\ast\ast}p < .001$.

Table 6. Multi-level modelling analysis of the relationship between group flow (GF) and dancers' focus.

While the level of group flow in internally focused tasks remained at a similar level regardless of the session's progression (adjusted $B = -.01$), an external focus was beneficial for group flow experience in the latter tasks of the session (adjusted $B = .80$). Again, the difference in the level of group flow between an internal and external focus in the last task of the session was significant ($t = 4.77$, $p = .03$). The interaction of experience and focus helped to explain variation on the group level, as well as 77% of variation on the occasion level.

In summary, there was no difference in the level of group flow between the tasks at the beginning of the session; but in the latter tasks, the external focus facilitated group flow experience.

Qualitative components of being in the group flow

To identify differences in collaboration between high and low-flow groups, video-recall reports of the creative process from the highest and matching low flow scoring tasks were compared. The two highest group flow cases of GF (scoring 68% and 61%) were associated with an external focus task when completed fourth. These were compared with two low-flow cases from different groups, both scoring 26%, from the external focus task completed second (these were not the lowest GF scores

but were chosen to match in terms of focus). To compare the reports, qualitative content analysis (QCA) was employed (Gläser & Laudel, 2013).

The conceptual framework for analysis initially replicated the initial set of categories of reflection, which had been suggested to dancers during the data collection: (1) thoughts and imagery, (2) use of senses; (3) actions; (4) relation to others. This structure evolved during the analysis into the following final set of five categories: (1) use of senses; (2) use of imagery; (3) embodied creativity; (4) relation to others, with subcategories of (4a) mutual connection and (4b) mimicry and manipulation; and (5) emotional responses, with subcategory of (5a) being stuck.

1. Use of senses

The presence of sensory awareness was expected in external focus tasks, which asked dancers to use 'here and now' cues from their surroundings. Dancers from high flow groups referred to the wider variety of sensory experiences more often, and commented that they were creating movement in response to such sensory stimuli:

Dancer 1 C (high flow group)

'Hearing those steps and my hand gestures, listening to the noises here, picking up sounds of L and A. And then I made my own squeak with my own feet. Feeling the air around me and still following the sound with my movement.'

Dancers from low-flow groups also referred to senses, but they did not find sensory stimulation so inspiring. Often they reported that sensory awareness was overwhelming and resulted in the feeling of being stuck (5a).

Dancer 2D (low flow group)

'I was feeling the air. I was trying to see what the air felt like on my arm. It

was quite soft, quite warm. S and N, and the touch again. I was really conscious of my senses, which I found quite hard.'

There was a clear difference in the attitude towards the use of stimuli offered by the space and others. Dancers from high-flow groups found them as inspiring for their creative choices and supportive to their creative process. They acted in response to sounds or other stimuli (like touch or moving air), co-creating the sensory experience for the group, for example by playing with different sounds. In low-flow groups, such collaboration was not present. Dancers were highly focused on their own sensory experience, to the point of feeling uncomfortable. It was more of an individual experience; the interactions and responses to others' actions were limited.

2. Imagery

As only external focus tasks were taken into account in this analysis, the use of imagery was not commonly present in dancer's reports. However, even in a non-imagery task, one dancer shared a vivid image as a starting point for improvisation that she maintained through most of the task.

Dancer 2C (low flow group)

'This time, before I entered the space, I do not know why, I imaged water; so I thought, my actions were based on that theme. I imaged that I was walking on a quite high water.'

Throughout the improvisation, she repeatedly commented that she interpreted actions of others through the lenses of her imagery, she was 'placing them inside' her imagined world. She also reflected that it limited her interactions with others as she was interested in maintaining the created imagery space.

3. Embodied Creativity

In high-flow tasks, dancers described their improvisation process as an immediate reaction, through the movement response, to the sensory stimulation from their surroundings. In other words, various stimuli from the group and space: images, sounds, sensations, were easily, and without hesitation, translated into movement ideas:

Dancer 1C (high flow group)

'M rattled weights in the bottom of the curtain. I'm letting that structure my elbows movement.'

Dancer 1D (high flow group)

'Taking the movement from D and then hearing the curtain rattle on the floor. Interpreting that through my fingers.'

Although all dancers discussed their creative process through embodied actions, in the high flow activity the transformation of available cues was richer, many times including multiple sensory experiences (sound, image, movement). While descriptions of low-flow groups more often referred to copying others, manipulating body parts or exploring a single movement idea.

4. Relation to others

The quality and type of interactions differed between high and low-flow groups. The high-flow groups reported a deep feeling of connection with each other, a sense of togetherness that provided them with space for sharing the movement and interacting with each other. They presented multiple *supportive connections* within the group:

Dancer 1C (high flow group)

'Feeling like I needed to join the group for this swirled position school of fish. Coming in, swirling with L.; needing to join with the sound from the back. Translating that to both hands and stopping, to flow into the next. Sharing.'

Such characteristics of group flow as mutual connection and shared goal were commonly present. Dancers often referred to offering and noticing the physical support from other dancers in the group:

Dancer 3B (high flow group)

'I come to K, she sits there, and she is giving me support. Each time, when my back was falling, K was offering support. I used it as a way to get down to the floor.'

In summary, the collaboration in high flow tasks was complex and based on exchange: dancers sourced the inspiration from each other and supported others' choices. They were closely listening but had no hesitation in expressing themselves freely.

The interactions in the low-flow groups were qualitatively different, based mostly on *mimicry and manipulation* of others' body parts. Instead of complex interaction, dancers often referred to copying others' movements or transforming them through their body:

Dancer 2B (low flow group)

'I did not have any specific thoughts. (...) I used other people's movement a lot in this score. I've just mimicked what I could see and took them into my own body.'

Such an approach to dance creation, based on movement mimicry might be perceived as more basic, as the element of creative transformation is not present. In those groups, dancers commented on being manipulated or disturbed by others' bodies more often than in high flow activity groups.

Dancer 2D low flow group)

'I was very still at this moment, watching the lift. Felt D pushed me, so responded. Lots of arms movements.'

Comparing both ways of interacting, high-flow groups were included more complex interactions, where movement responses emphasised, complemented and transformed others' actions; and dancers offered each other necessary support for ideas to appear in the space. In low-flow groups the interactions were more straightforward, based mostly on coping, mimicry of movement and physical manipulation of others' bodies. The feeling of deep connection was not present.

5. Emotional response

All dancers in the study described a joy, comfort and amusement associated with improvising tasks and dancing with others.

Dancer 5A (low flow group)

'I felt very free and like there was nothing to stop me, but I was going to the 150 % mark. I just felt free. (...) Kind of, I lost control, and the movement felt great.'

These comments emphasise that dance is a naturally autotelic activity. However, dancers from low-flow groups also reported some negative feelings and difficulties with connecting to the task, or other dancers.

Dancer 5B (low flow group)

'I found this one a lot more difficult to enter. I was looking for something, some sort of inspiration or window to enter the space. In the end, I mimicked something that someone else had done.'

Sometimes, they felt overwhelmed with sensory stimulation or unhappy with their own creative choices, which could result in being stuck with the creative process. Moreover, in low-flow groups dancers reported a feeling of being lost or stuck with the creative process. They found difficulties in finding their point of interest that sometimes resulted in stillness or repetition of movement.

Dancer 2C (low flow group)

'Some stages I felt a bit lost. Do not really know how to approach it. Felt this place was a little bit dense sometimes.'

Summary

Video-recall reports of the improvisational process revealed some essential differences between low and high flow group collaborations, primarily in the way of collaborating. A feeling of deeply supportive, mutual connection was typical for high-flow collaboration. Dancers in those groups were engaged with each other in a complex way, sharing ideas, and supporting each other's actions. They described the creative process as being largely embodied, where any stimuli from the environment were naturally interpreted through the movement. These descriptions of creative process highly resemble previous studies on group flow in jazz jams (Hart & Di Blasi, 2013; Sawyer, 2007), with the additional emphasis on the embodiment of the dance practice. In contrast, groups in a low-flow state worked more with mimicry and bodily manipulation as ways to relate to each other; they were less likely to be engaged with

sensory stimuli and were more likely to directly copy others' ideas, generally presenting a less creative approach to the improvisational process.

All groups reported positive feelings of joy and amusement associated with performing improvisational tasks and dancing together. However, in low-flow groups, negative emotions and difficulties were reported too, alongside moments of being creatively stuck. Those comments are consistent with Csikszentmihalyi's (1975) skill/challenge balance model of flow, where the extent of challenges over personal skill would result in anxiety and discomfort.

These qualitative differences between low and high-flow collaborations highlight the importance of group processes for creativity. The positive climate of collaboration described in high-flow reports allowed dancers' creativity to bloom, engaging them in complex group actions.

Discussion

Despite the growing interest in group creativity research and group flow experience, there is a narrow choice of tools to assess group flow. So far, most of the researchers limited their exploration to the qualitative methods of observing collaborative groups (Hart & Di Blasi, 2013; Sawyer, 2003) or use of aggregated individual flow ratings from group members (MacDonald et al., 2006). These issues were partially addressed by Salanova et al., 2003, as they created the combined flow scale that would ask participants to evaluate the group process as a whole. Still, such an approach raises the questions about how fairly group members might assess the mental state of others. Addressing these limitations, in this study flow was evaluated from an individual perspective, using the video-recall method; and the group flow

measure was calculated in the second step of exploration as a shared, simultaneous flow experience.

Flow, a video-stimulated recall method revealed that flow was experienced in dance as bursts of total involvement rather than over an entire creative task. It might be interrupted by some strong shift in the group dynamic, like the sudden movement of the other dancers, but also by critical self-reflection. The stable and long-lasting flow experience was rather rare. Also, flow was experienced more often in the latter part of the task, and the session. This finding showed up some limitations of the conventional sampling method of measuring flow, which is usually used just after finishing the task. Sampling methods ask a participant to report their mental state 'now' or refer to the just finished task (Moneta, 2012). Because flow is more likely to be experienced in the latter part of the activity, when the task is already familiar and strategies for acting developed, sampling measures might overestimate the intensity of flow experience during the entire activity. Such a trend was visible in the current exploration too: the flow experience assessed by FSS scale was usually moderate to high, while the variance of *Flow* and GF measures was much bigger (from very short periods of flow experience, to almost entire task in the flow).

The validity of the video-recall method of assessing flow (*Flow*) was determined through comparison with Flow Short Scale (Engeser & Rheinberg, 2008). *Flow* was mostly influenced by the fluency of performance aspect of flow experience: there was no relationship with absorption by activity nor with the importance subscale of FSS. The fluency of performance items address characteristics such as the merging of action and awareness, the sense of control and the presence in the moment of activity. The absorption by activity, describes these aspects of flow connected with the right amount of challenge, losing time awareness, total absorption with the

activity, the feeling of being lost in thoughts. The lack of relationship of flow with this dimension of FFS scale might be due to specific characteristics of dance practice and, in particular, group improvisation. The social aspect of creation facilitates the interactive process between dancers, rather than 'getting lost in thoughts' (Hart & Di Blasi, 2013; Sawyer, 2007). Additionally, improvisation is not usually perceived as a goal-directed practice but rather as an approach of working, noticing and selecting possibilities (De Spain, 2014, p. 5; Doughty, 2019), so it is hard to define clear challenges. For the same reason, a relationship between *Flow* and importance of activity was not expected.

The effect of focus on flow experience

Two different types of tasks were chosen to examine whether an internal focus upon imagery and an external focus upon sensation differentially facilitated a flow state or affected the shared character of the group improvisation. The MLM analysis did not confirm the main effect of the task's focus on individual or shared flow experience; however, there was a significant interaction between focus (internal versus external) and experience of the order of tasks within the session, with no difference in frequency of flow experience between internal and external focus tasks at the beginning of the session, but at the end, flow is more likely in the external focus tasks. The influence of shared experience on flow is not surprising. Sawyer (2007, p. 55) emphasised that many of the successful musical groups required a preliminary warm-up period to move into group flow. For this reason, our testing session was preceded by a warm-up and freezing game. Still, dancers had had no experience with the 'testing situation' before, so the procedures of recording and video-recall of improvisations were very new to them. In consequence, the effect of tasks was visible only in the latter part of the session. As the qualitative analysis of

dancers' video-reports revealed, focusing upon external stimuli, and highlighting sensory awareness in dance improvisation might facilitate the close interaction between dancers and build mutual connections within their practice; in consequence, building conditions for the development of group flow (Sawyer, 2007, p. 43).

The effect of individual flow on creative outcomes

As expected, there was a significant relationship between flow experience and creativity. Dancers placed a higher value on the creative outcome from tasks when they were experiencing more flow. This connection was confirmed by two different ways of evaluating flow. The FSS fluency scale showed a positive link with creativity; but absorption and importance did not. As pointed out above, absorption refers to a highly individualist state of mind, 'being lost in thought', that is not preferable in social settings of dance improvisation. The video-recall method of assessing flow also showed a positive relationship with creativity; however, the linkage was not so strong. These findings support the positive influence of flow on creativity found both in dance (Łuczniak et al., 2020) and within other domains (Cseh et al., 2016; MacDonald et al., 2006). Creativity in this study was a subjective measure, as participants retrospectively evaluated the session they had just finished, so their judgments could have been influenced by the flow ratings they had just given.

Empathy, creativity and flow

Interestingly, there was a positive relationship between empathy level and creativity. Previously, empathy was considered as a significant factor of group or shared flow (Hart & Di Blasi, 2013; Waddington, 2013). Further, Sawyer (2003) suggested that many group flow characteristics, such as mutual connection, listening and communication skills, and the phenomenon of blending egos, are closely related

to the empathic traits of group members. Consequently, empathy was claimed to be an important factor of social creativity (Cross et al., 2012). The results of this study support these conclusions from the complementary perspective, showing that empathy not only supports a positive climate in the group but is also a positive predictor of group creative outcomes.

Surprisingly, there was no significant relationship between empathy and individual nor group flow experience. Careful analysis of multilevel models did not reveal any significant main or interactive effects. Moreover, estimators in the model were always close to zero. This result is inconsistent with the previous, qualitative studies on the development of group flow (Hart & Di Blasi, 2013; Sawyer, 2003).

Limitations

While the present study has provided a number of findings on the nature of the flow experience and its shared character, there are several limitations of the current work. First, due to time limitation and specificity of the research interest, the sample size was very small, so all findings should be considered as preliminary results that need future research based on more groups. This recommendation is not easy to address; as the exploration in this study exposed, the sample has to be selected carefully according to the specific requirements of the task. Recruiting other dancers, for example, a professional ensemble engaged in improvisational practice, would be highly beneficial for this exploration. Nevertheless, the a priori power analysis indicated that reasonable power could be achieved, and statistically significant findings were observed, so this does not seem to have adversely affected the analyses.

The second major limitation of the study is that, while improvisation is commonly practised in contemporary dance and used as a creative device for performance practice on its own (Blom & Chaplin, 1988), the way that dancers engage in improvisation is highly dependent on their training and personal preference. This study was conducted with students of Plymouth University, and their improvisation training is highly influenced by Adam Benjamin's inclusive, open score improvisation practice (Benjamin, 2002). Such a context might influence dancers' preference of external focus over internal focus tasks and therefore facilitate the flow experience in the former. However, dancers never referred to such a preference, either in video-recall reports or closing discussions of the session, so this is thought to be unlikely.

Conclusions

This study developed a novel method of assessing flow (*Flow*) that allowed the investigation of the dynamics of flow experience over time and the derivation of a measure of group flow experience (GF) through video-stimulated recall. The validity of this method was confirmed with the well-established FSS scale (Engeser & Rheinberg, 2008) and a qualitative comparison of the creative processes of high and low group flow tasks. The analysis of the influence of dancers' focus upon group flow experience, revealed an interactive effect of shared experience and dancers' focus: an external focus (upon senses awareness, surrounding and others), facilitated flow experience in the latter tasks in the session. Finally, it was shown that flow was a predictor of groups' creative outcomes.

Our approach – the video-stimulated recall reports of group activity and subjective experience – might find wide use in future studies, not only in research of

group creativity in dance, but applied to any collaborative processes. It allows the experience and internal states of the group members to be captured in a relatively straightforward, time-efficient way. In particular, it would be interesting to apply this method to study group creativity in domains such as music and music improvisation, improvised theatre or even problem-solving groups. Any practice where the creative process is entangled with momentary group dynamics, would benefit from such multi-layer analysis.

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ⁱ The technical setup for using *Flow* approach is described in details in Łucznik, K., & Loesche, F. (2017). Dance Improvisational Cognition. *AVANT. The Journal of the Philosophical-Interdisciplinary Vanguard*, VIII(Special), 227–239.

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ⁱⁱ The data that support the findings of this study are openly available in Zenodo repositoty at <https://doi.org/10.5281/zenodo.4027471>

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Appendix 1.

Two *internal focus* tasks were based upon multimodal imagery as a starting point for improvisation:

'It is dark. You are in an ancient woodland. Sense what is around you... in every direction... There is a variety of lush tangles of old trees, ferns, mosses and lichens. What is close by? What is far away? See how they might move and what you might hear. Sense the movements... of weather... land... sky... light... What calls to you... in this landscape? How might you respond to these surroundings?'

'A crowd of people are milling around you. Sense what is around you... in every direction... behind... above... below... Imagine what people are saying. Locate the sounds that are furthest away. Those that are closer and those that are closest to you. Sense the movement. What smells are reaching you? What calls to you... in this landscape? How does it make you feel? Respond to the crowd.'

Two *external focus* tasks were based upon sense-awareness and asked dancers to use 'here and now' cues from the surroundings:

'Let your ears listen to the sounds – of your body, of others, of space. Let your feet sense the floor. What can you see? What can you hear? What can you feel? Let all your senses open and lead you for the next few minutes of the dance.'

'It is a journey. Find the starting point. Let all your senses open. Let your eyes look around; sense your weight. How does your skin perceive the surrounding? The others? The space? Find your way through the space till

*the ending. Let all your senses, what you see, feel, listen, scent, to lead you
through the space.'*