Journal of Dance Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ujod20

Feldenkrais to Improve Interoceptive Processes and Psychological Well-being in Female Adolescent Ballet Dancers: A Feasibility Study

Amie Wallman-Jones, Claudia Mölders, Mirko Schmidt & Andrea Schärli

To cite this article: Amie Wallman-Jones, Claudia Mölders, Mirko Schmidt & Andrea Schärli (2022): Feldenkrais to Improve Interoceptive Processes and Psychological Well-being in Female Adolescent Ballet Dancers: A Feasibility Study, Journal of Dance Education, DOI: 10.1080/15290824.2021.2009121

To link to this article: https://doi.org/10.1080/15290824.2021.2009121

Published online: 09 Feb 2022.

JOURNAL OF DANCE EDUCATION
https://doi.org/10.1080/15290824.2021.2009121

Routledge
Taylor & Francis Group

FEATURE ARTICLE

Feldenkrais to Improve Interoceptive Processes and Psychological Well-being in Female Adolescent Ballet Dancers: A Feasibility Study

Amie Wallman-Jones, MSc*, Claudia Mölders, MFA*, Mirko Schmidt, PhD, and Andrea Schärli, PhD

Institute of Sport Science, University of Bern, Bern

ABSTRACT

The Feldenkrais Method® (FM) is a form of somatic education aiming to increase brain-body communication, reportedly via interoceptive mechanisms. Although empirically proven to improve perceived interoceptive ability and psychological well-being in adults, feasibility in adolescents remains unclear. We therefore used a combined randomized control-group pretest-posttest design with qualitative interviews to explore the feasibility of an eight-week FM intervention to enhance interoceptive processes and psychological well-being in a population of adolescent female recreational ballet dancers. Participants' (N = 12, M_{age} = 14.25 ± 1.29) interoceptive accuracy, perceived interoceptive ability, and psychological well-being were measured pre- and post-intervention, followed by individual interviews. Interview responses demonstrated high enjoyment, increased perceived embodied criticality, and reduced social comparison, supported by a significant increase in self-reported attention regulation (p = .042) in the intervention group. These preliminary findings support the feasibility of FM in this population and thus warrant further research using well-powered randomized controlled trials.

KEYWORDS

Body-awareness; dance science; physical activity; mental health; intervention

Adolescence is a critical period of development open to great adversity, where mounting social-environmental pressures can increase ones' vulnerability to impaired psychological well-being (Reinboth, Duda, and Ntoumanis 2004; Niwa et al. 2016). Among other concerns, issues of low self-esteem and negative body self-perception are particularly prevalent in females in this age group (Bibiloni et al. 2013), with ballet dancers representing a subgroup of this population who are most vulnerable (Nerini 2015). The increased susceptibility of this subgroup is thought to originate from ballet being regarded as an art form where emphasis is on aesthetic effect and expression (Schärli 2016). In this way, practices incorporate cultural pressures toward an "ideal of leanness" (Ravaldi et al. 2006) with an increased focus on body-image and weight concerns (Davison, Earnest, and Birch 2002). A lack of objective indicators of ability promotes socially driven evaluation and subjective judgments of performance (Quested and Duda 2010). This approach encourages social comparison and unhealthy competition which is thought to lead to impaired psychological well-being, reflected by an increased prevalence of eating disorders (Abraham 1996; Smolak, Murnen, and Ruble 2000; Byrne and McLean 2001) and lower levels of self-esteem in this population (Bettle et al. 2001). As a result, researchers from the field of pediatric psychiatry are calling for a shift away from the purely technical and aesthetic focus of ballet to adopt an increased regard for the dancers' psychological well-being (Bettle et al. 2001).

Self-determination theory (SDT) (Deci and Ryan 1985, 2000), which is a theory explaining how motivation influences human behavior and well-being, has become a popular framework within which to examine the social-environmental factors associated with both psychological well-being and ill-being in dance (Quested and Duda 2010; Quested et al. 2013). The Basic Psychological Need Theory (BPNT), a central subtheory of SDT, proposes that the fulfillment of the three basic psychological needs are essential for human flourishing and well-being (Vansteenkiste, Ryan, and Soenens 2020). These are: autonomy (the feeling one has choice), competence (the feeling of mastery and feeling effective in ones' activity), and relatedness (the need to feel connected to and belongingness with others). Investigating which social-environmental factors have the strongest influence on these indicators therefore posits an important avenue to better understand how the basic needs can be best fulfilled. In doing so, previous studies have found factors such as perceived autonomy support from the teacher to be the most important predictor of basic need satisfaction in dance

CONTACT Amie Wallman-Jones amie.wallman-jones@unibe.ch University of Bern, Bremgartenstrasse 145, Bern 3012, Switzerland

*These authors contributed equally to this work.

students (Quested and Duda 2010; Quested et al. 2013), whilst physical self-concept has been found to represent an important factor in childhood and adolescence (Garn et al. 2012; Schmidt et al. 2013; Fraguela-Vale et al. 2020). Taken together, this supports the need for autonomy promoting practices with an increased focus on the bodily self in adolescent dance. One method appearing to fit this criterion is the Feldenkrais Method® (FM), with a strong focus on strengthening the participants' own resources through increasing body awareness (Öhman, Åström, and Malmgren-Olsson 2011). Whilst FM has been used for somatic practice with children and adolescents, it has seldom been empirically examined as a viable method of somatic education in this population. Its feasibility therefore remains unclear, warranting further research into potential benefits in children and adolescents.

The Feldenkrais Method® represents a mind-body approach to somatic education, where it is believed that changes in the physical state can lead to changes in the emotional or cognitive state, and vice versa (Feldenkrais 1987). What makes FM unique is its focus on independent learning, aiming to engage the learner to recognize such changes in states. Through increasing the metacognitive awareness of the connection between the mind and body in this way, it is thought that FM improves aspects such as growth, learning, and mastery to encourage autonomous decision making (Lazarus and Folkman 1984), which thus may have a positive impact on psychological well-being. Previous researchers described the method as a conscious exploration of one's own movements to achieve a differentiated self-awareness (Klinkenberg 2006), where reflection in action is encouraged to promote embodied criticality (Kampe 2015). Movement in this context is therefore not understood strictly in relation to dance, but rather in how increased self-awareness can improve self-regulation (Ives 2003).

The core principles of FM concerning sensing, feeling, and action emulate those of interoception, defined as the sense of the physiological condition of the body (Craig 2003). Whilst serving as a homeostatic regulator at the basic physiological level, the psychological significance of interoceptive processing can be seen in its implications to emotion, cognition, and behavior (Tsakiris and Critchley 2016). More specifically, the successful exchange of signals along the brain-body axis is key to self-regulation and well-being, where an inaccurate representation of the body has been associated with numerous somatic-based mental health conditions e.g., anxiety (Garfinkel et al. 2016b) and panic disorders (Ehlers 1993), somatic symptom disorders e.g., chronic pain (Di Lernia, Serino, and Riva 2016), and body-image disorders e.g., anorexia (Badoud and Tsakiris 2017; Zamariola et al. 2017) and body dysmorphia (Kunstman et al. 2016). As such, the ability to accurately track and monitor physiological signals—interoceptive accuracy (IAcc)—has been proposed to support a more finely-tuned regulation of the self. This therefore posits the question of whether we can train someone to become more accurate in perceiving their internal bodily signals, where both cognitive e.g., focus of attention (Ainley et al. 2013; Fischer, Messner, and Pollatos 2017) and physiological e.g., induced physiological arousal (Jones and Hollandsworth 1981; Montgomery, Jones, and Hollandsworth 1984; Durlik, Brown, and Tsakiris 2014) interventions have been found effective in altering interoceptive ability. The FM could be argued to present a combined mind-body intervention, with a focus on teaching embodied criticality through movement. Here the integration of afferent stimuli with later top-down processing could be optimized, in line with previous research supporting the equal importance of the cognitive and physiological adaptations of physical activity in increasing IAcc (Wallman-Jones et al. 2021).

Benefits from FM interventions in adults support its efficacy in improving IAcc, where improvements have been found in areas previously coupled to interoceptive processes, e.g., psychological well-being (Kerr, Kotynia, and Kolt 2002; Connors, Pile, and Nichols 2011; Teixeira-Machado et al. 2015), eating disorders (Fortin and Vanasse 2012), and chronic pain (Öhman, Åström, and Malmgren-Olsson 2011; Paolucci et al. 2017; Ahmadi et al. 2020). Despite the lack of overlap in previous research, it could be argued that embodied interoceptive mechanisms underpin the core values of FM in increasing metacognitive awareness of the connection between the mind and body (Craig 2014). Whilst a recent study has found improvements in *perceived* interoceptive ability (Paolucci et al. 2017; Ahmadi et al. 2020), we do not know how FM affects more *objective* measures of interoceptive ability, such as IAcc. This is important considering IAcc has been found to have more relevance to well-being due to potential bias in subjective judgments (Garfinkel et al. 2016b). Taken together this presents a gap in the research addressing the potential role of underlying interoceptive mechanisms in the ameliorative effects of FM. Additionally, the lack of empirical research across ages fails to address how FM could work as a protective measure during critical periods of development, rather than as a prospective response.

The aim of the present study, therefore, was to test the feasibility of FM to improve interoceptive processes (objective and subjective) and psychological well-being in a group of adolescent female recreational ballet dancers. In doing so, a mixed methods design was used combining a randomized control-group pretest-posttest design with qualitative interviews. In the quantitative part of the study, IAcc (objective), perceived interoceptive ability (subjective), and psychological well-being were measured before and after an eight-week FM intervention. In the qualitative part, attitudes toward the intervention were assessed using qualitative individual interviews to determine the suitability of FM in female adolescent populations. The novel age range of the participants should reveal whether adolescents are accepting of this holistic approach, where previous studies using FM have been limited to adult populations (Kerr, Kotynia, and Kolt 2002; Connors, Pile, and Nichols 2011; Öhman, Åström, and Malmgren-Olsson 2011; Fortin and Vanasse 2012; Teixeira-Machado et al. 2015; Paolucci et al. 2017; Ahmadi et al. 2020). Results from this study could provide important information to shape future FM research to adopt a more interoceptive-centered approach, as well as supporting its use across different ages.

Methods

Participants

Twelve adolescent female recreational ballet students (M_{age} = 14.25 ± 1.29, M_{BMI} = 18.11 ± 2.49) aged between 13 and 17 were recruited from a private ballet school. To be included in the study, participants had to be between 10 and 19 years, should have engaged in classical ballet training around once a week for an average of ten years, reached a higher level of "Royal Academy of Dance" education, and additionally had no experiences in somatic training methods. Further, participants did not partake in any other dance classes during the intervention. To allow for a fair comparison, participants were selected to be matched closely on their demographic characteristics (i.e., age, height, weight, BMI) before being split randomly into two groups to form an intervention (IG) (N = 6, M_{age} = 15.17 ± 1.17, M_{BMI} = 19.17 ± 2.27) and a waitlist control (CG) (N = 6, M_{age} = 13.33 ± 0.52, M_{BMI} = 17.05 ± 2.39) group. The experiment was approved by the ethics committee of the University of Bern and conducted in accordance with the Declaration of Helsinki. Due to the age of the sample, both participants and their parents or legal guardians gave written consent to participate.

Procedure

This feasibility study was designed with an eight-week FM intervention. The eight FM lessons were performed on top of the weekly classes, directly following the regular ballet training (total of one additional hour per week). The duration of eight-weeks was selected based on previous studies reporting positive effects after this length of intervention on both psychological (Burkhardt and Brennan 2012) and physiological (Vrantsidis et al. 2009; Czasche et al. 2018; Joseph et al. 2020) outcome measures. Further, this is in line with recommendations based on systematic reviews of the literature, where eight-weeks was determined as the minimum timeframe for dance interventions in young people (Schwender et al. 2018). Demographic variables were measured once at pretest, whilst all dependent variables (IAcc, perceived interoceptive ability, psychological well-being) were measured at two separate time points: pre- and post-intervention. Due to known effects of aerobic exercise on IAcc scores (Jones and Hollandsworth 1981; Montgomery, Jones, and Hollandsworth 1984), all measurements were taken at rest. Finally, individual interviews were conducted at posttest once all measures had been taken.

Intervention

The Feldenkrais Method® (FM) is a mind-body practice based on Awareness Through Movement lessons (ATM) (Feldenkrais 1987), conducted as a group exercise. FM is traditionally taught by two forms: Functional Integration (FI), which uses one-on-one hands-on lessons where the practitioner uses gentle, noninvasive touch to help the student explore new movements, and Awareness Through Movement (ATM), which involves verbally led group lessons, guiding the students through movement sequence. This study will refer to ATM alone considering the greater relevance to the focus of interoception through increased autonomous sympathetic activity. Further, group lessons were chosen considering the increased accessibility for a wider population of participants. All eight lessons were taught by a certified FM practitioner, who was both a trained dancer and dance teacher, and had been teaching ATM through FM for 20 years. In each lesson, the FM practitioner verbally guided the exploration of a movement that is related to a specific function, such as a forward bend performed as a *cambré devant* in ballet training. Participants were encouraged to use sensory awareness to modulate movement range and effort, exploring the potential for new methods of mobility. In this way, the participants should pay attention to the quality of

movement, sensing subtle differences between repetitions of movement and acknowledging the functional relationships that are created throughout the body. For example, in a forward bend of the upper body, the whole spine can be used, from the thoracic vertebrae to the lumbar vertebrae. To achieve this whole-body integration, the dancer must perform the movement with increased critical attention. Habitual patterns of movement were therefore addressed with the aim of increasing self-awareness and expanding the movement repertoire. Here, the learning process emphasizes personal exploration, self-acceptance, and non-judgment, shifting away from a goal-oriented effort toward a refined muscular effort. Lessons were selected due to their relatedness to ballet training (e.g., pelvis movement, spinal alignment, arm extension, and joint range of motion) and their suitability to adolescents (Appendix), chosen from Alexander Yanai (AY) material. The AY material was selected from the original records of Moshe Feldenkrais and taught without deviations. During the lessons, the practitioner provided the following prompts aiming to promote the ideals of Feldenkrais in reframing mind-body communication: *Is the movement easy and flowing? Can you take care of yourself while doing the movement? How many parts of the body are involved in the movement? Can you breathe freely while doing the movement? Can you find the most effective way to move?* In doing so, the practitioner aimed to use language appropriate to the adolescent age group. All participants were provided with the same type of mat, and the FM practitioner encouraged the participants to adjust as necessary to make themselves comfortable.

Measures

Interoceptive Accuracy

Interoceptive accuracy (IAcc) was assessed using the heartbeat counting task (HCT) (Schandry 1981). After a practice interval of 20 s, there were three randomized intervals (25, 35, and 45 s) separated by standard resting periods of 20 s (Schandry, Bestler, and Montoya 1993; Ainley, Brass, and Tsakiris 2014). During each interval, participants were given the following instructions: "Without manually checking, can you silently count each heartbeat you feel in your body from the time you hear 'start' to when you hear 'stop?'" Participants were seated throughout the task and were given no information as to the length of the intervals or their performance. Participants were asked to report the number of counted heartbeats straight after the "stop" signal, as well as rating their confidence in their response using a continuous visual analogue scale (VAS) with verbal descriptors of "Total guess/No heartbeat awareness" and "Complete confidence/Full perception of heartbeat." Participants' heartbeats were recorded using the mobile heart frequency monitor (Polar Electro Oy, Kempele, Finland), for which validity and reliability compared to alternative ECG measurement devices have been shown in children and adults (Radespiel-Tröger et al. 2003; Gamelin et al. 2008; Nunan, Sandercock, and Brodie 2010). For each trial, an accuracy score was derived: 1- $|(n\mathrm{HB}_{\mathrm{recorded}} - n\mathrm{Hb}_{\mathrm{counted}})/n\mathrm{HB}_{\mathrm{recorded}}|$. Resulting accuracy scores were averaged over the three trials, yielding an overall average value for each participant. To account for potential confounds of the HCT (Ring et al. 2015; Brener and Ring 2016; Desmedt, Luminet, and Corneille 2018; Zamariola et al. 2019), participants' ability to estimate the length of an elapsed interval was also calculated. During the time control task, participants were required to estimate elapsed time duration for three randomized intervals (23, 40, 56 s), following the same procedure as the HCT. This was named the "time modulus" measure as done in previous studies (Dunn et al. 2010; Ainley, Brass, and Tsakiris 2014).

Perceived Interoceptive Ability

Perceived interoceptive ability was measured using the Multidimensional Assessment of Interoceptive Awareness (MAIA) (Mehling et al. 2012). The following four subscales were chosen based on their relatedness to the FM; noticing (assessing the awareness of uncomfortable, comfortable, or neutral body sensations), non-distracting (assessing the tendency not to use distraction to cope with discomfort), attention regulation (assessing the ability to sustain and control attention to body sensations), and self-regulation (assessing the ability to regulate distress by attention to body sensations). The German version of the MAIA demonstrates acceptable internal validity for each subscale (Cronbach's $\alpha = 0.69$—noticing, 0.66—not-distracting, 0.87—attention regulation and 0.83—self-regulation), and good construct validity with measures of mindfulness (Five Facet Mindfulness questionnaire) and body perception questionnaires (Private Body Consciousness questionnaire) (Mehling et al. 2012; Reis 2017; Cramer et al. 2018).

Psychological Well-being

Psychological well-being was measured using The Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS) (Deci and Ryan 2000). The BPNSFS was chosen for this study as it is based on the three psychological needs of autonomy (the feeling one has choice), competence (the feeling of mastery and feeling effective in ones' activity), and relatedness (the need to feel connected and belongingness with others), which together

are said to be prerequisites for maintaining optimal performance and well-being. Answers are given using a 5-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree), and the role of basic need satisfaction and frustration in the context of well-being and ill-being was examined. Participants were instructed to respond to each question in terms of their feelings and thoughts concerning everyday life. Examples of questions include, "I feel capable at what I do" (basic need satisfaction) and "I feel excluded from the group I want to belong to" (basic need frustration). The German version of the twelve-item scale has been shown to have good internal validity, with Cronbach's α = .84 (Heissel et al. 2018).

Interviews

Following completion of the eight-week intervention, all participants completed qualitative individual interviews to assess their feelings toward FM, e.g., "How did you find the Feldenkrais intervention?" and "What experiences did you have in the lessons?" Interviews took place between the investigator and participant one-by-one after the final session of the intervention period, and once all posttest measurements had been taken. All interviews have been translated from German to English.

Data Analysis

All statistical analyses were conducted using SPSS 27.0 (SPSS Inc., Chicago, IL, USA). Due to the small sample size in this initial feasibility study and because of the ordinal nature of our questionnaires, non-parametric tests were used. Wilcoxon signed rank tests were used to compare pre- and post- scores for each variable within group, and Mann-Whitney U tests were used to compare the difference in IAcc change scores between the intervention and control group. Statistical significance was set a priori at $p < .05$ for all analyses. Responses from the interviews were categorized into themes that reflect the core values of FM: examples of embodied criticality, examples of critical attention, examples of transfer from the social environment.

Results

Demographic Variables

A Mann-Whitney U test revealed that there was a significant difference in age between the intervention and control group ($U = 2.00$, $p = .008$), but no significant difference in height ($U = 6.00$, $p = .053$), weight ($U = 6.00$, $p = .054$), or BMI ($U = 9.00$, $p = .146$). Detailed sample characteristics are shown in Table 1.

Table 1. Sample characteristics.

	Group	
Variable	Intervention	Control
Age	15.17 ± 1.17	13.33 ± 0.52
Height (cm)	165.83 ± 5.56	158.66 ± 4.96
Weight (kg)	53.33 ± 4.59	43.33 ± 7.96
BMI	19.17 ± 2.27	17.05 ± 2.39

BMI = body mass index

Confounding Variables

A Wilcoxon signed rank test revealed that there was no significant difference between pre- and post-time modulus scores (pre = 0.90 ± 0.06, post = 0.83 ± 0.11, $p = .060$), supporting that any differences in IAcc will not be down to training effects. Furthermore, there was no significant correlation between pretest IAcc and time modulus scores ($r = -.203$, $p = .700$).

Main Results

Wilcoxon signed ranks tests revealed a significant difference in the MAIA subscale—attention regulation ($p = .042$) between pre-post scores in the intervention group, but not in the control group (Table 2 and Figure 1). Further, a Mann-Whitney U test revealed a significant difference in MAIA—attention regulation change scores (post-pre) between the intervention and control group ($p = .020$). Wilcoxon signed ranks tests revealed no significant differences between pre-post scores for all other variables in both groups; Interoceptive accuracy (IAcc), psychological well-being [BPNSFS] (autonomy, competence, and relatedness), and perceived interoceptive ability [MAIA] (noticing, non-distracting, and self-regulation).

Table 2. Descriptive statistics (median and IQR) of the dependent variables separated by group with results of the two-tailed Wilcoxon signed-rank test.

Variable	Pre median (IQR)	Post median (IQR)	Sig. (*p*)
Intervention group			
Interoceptive accuracy	.52 (.85—.32)	.49 (.91—.74)	.345
BPNSFS autonomy	3.50 (4.00–3.00)	3.65 (3.98–3.00)	.496
BPNSFS competence	3.65 (4.30–2.32)	3.9 (4.20–2.55)	.194
BPNSFS relatedness	4.4 (4.85–4.23)	4.50 (4.58–4.45)	.785
MAIA noticing	3.8 (4.08–3.50)	3.65 (3.93–3.50)	.498
MAIA non-distracting	2.0 (2.70–1.45)	2.0 (2.08–1.45)	.285
MAIA attention regulation	2.2 (3.00–1.40)	3.6 (4.25–2.60)	.042*
MAIA self-regulation	3.05 (6.75–1.58)	3.9 (4.33–2.10)	.686
Control group			
Interoceptive accuracy	.56 (.76—.38)	0.41 (.63—.22)	.075
BPNSFS autonomy	3.3 (3.75–2.83)	3.3 (4.35–2.73)	.715
BPNSFS competence	3.30(3.58–2.56)	3.5 (4.05–3.13)	.138
BPNSFS relatedness	4.15 (4.58 –3.38)	4.5 (4.85–4.00)	.223
MAIA noticing	3.0 (3.58 –2.95)	3.4 (3.88–1.68)	.916
MAIA non-distracting	3.0 (3.48 –1.68)	1.5 (1.78–1.23)	.058
MAIA attention regulation	3.0 (3.58 –2.50)	3.35 (3.95 –2.38)	.344
MAIA self-regulation	2.5 (4.85–1.50)	3.3 (4.25–2.05)	.785

**Significance set at p <.05*
MAIA = multi-dimensional assessment of interoceptive awareness
BPNSFS = basic psychological need satisfaction and frustration scale
IQR = interquartile range

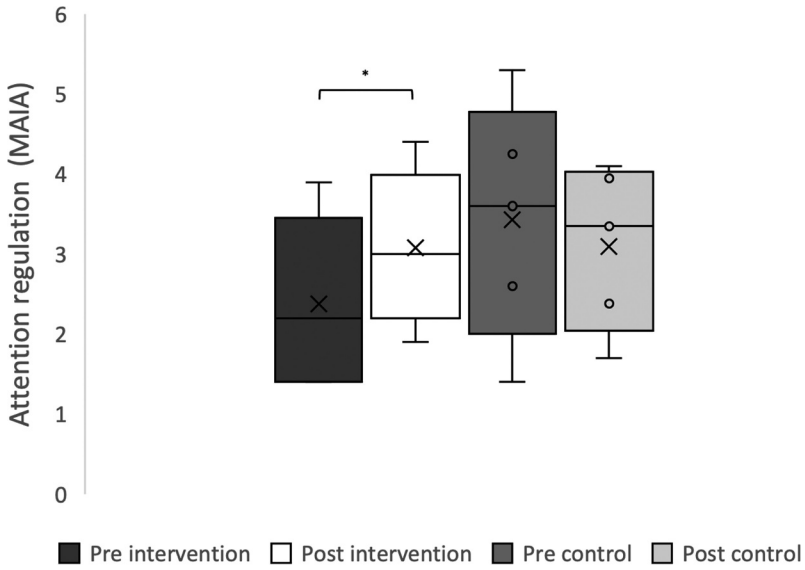

Figure 1. Boxplot depicting median, Q1 and Q3 with smallest and largest unbooked sample values shown as whiskers for IQR of attention regulation (MAIA) in both pre- and posttest in the intervention and control group respectively.

Interviews

After the intervention was finished, the participants of the intervention group gave individual feedback regarding their feelings and attitudes toward FM. Participants were asked, "How did you find the Feldenkrais intervention?" and "What experiences did you have in the lessons?"

Examples of Embodied Criticality

Some of the participants reported a differentiated ability to recognize the quality and effort of their movement, demonstrating embodied criticality through a conscious evaluation of movements during the exercises.

- "For me the head rolling at the beginning of every Feldenkrais lesson was unpleasant and at the end very easy and natural. Things that just seemed to be easy, such as lifting the legs, were surprisingly exhausting. Twists were easier than expected, and I was surprised every time what strange twists are possible without it hurting."
- "In the beginning I wasn't lying on the floor with my whole body, some parts were heavier, bigger, etc. At the end of the lesson, I lay completely on the ground. Meanwhile, after a few weeks, I already lay 'better' at the beginning."

Examples of Critical Attention

One participant could enjoy the outcome of a lesson and felt more relaxed, finding it easier to breathe, as well as showing critical attention to the body and their feelings.

- "I found all the exercises very relaxing and enjoyed everything very much. After the exercises, I felt a very nice change and could breathe more relaxed. But when I lay down, I sometimes had a little headache because I didn't have a pillow under my head."
- "The Feldenkrais lessons were a kind of 'duty' for me to recover, to take time for myself and my body as I can't otherwise do."
- "Relax from everyday life, it's interesting what you feel in your body during the exercises and also notice how far you can go."

Examples of Transfer from the Social Environment

One student referred to changes in their practice of comparison, indicating a transfer from the social environment that can be ego involved i.e., reduced comparison to others.

- "I think the Feldenkrais lessons helped me not only to pay more attention to my breathing, but also to do exercises without comparing myself with others."
- "It's always a nice change from everyday life, always come to rest here and concentrate only on me."

Discussion

FM is a form of somatic education that uses a mind-body approach to learning, where it has been suggested to improve psychological and physical well-being via interoceptive mechanisms (Paolucci et al. 2017; Ahmadi et al. 2020). Whilst the efficacy of FM has

been shown in adults (Ives 2003; Vrantsidis et al. 2009; Joseph et al. 2020), little is known about how suitable FM is for children and adolescents due to a lack of empirical research, despite being frequently used in practice. The aim of this feasibility study therefore was to assess the suitability of an eight-week FM intervention for adolescent female recreational ballet dancers, investigating its efficacy in improving interoceptive processes (objective and subjective) and psychological well-being. Results revealed a significant increase in the MAIA attention regulation subscale (subjective) in the intervention group, but not in the control group (IG pre = 2.30 ± 0.94, IG post = 3.47 ± 1.28; CG pre = 3.05 ± 0.82, CG post = 3.17 ± 0.90). Further, participants from the intervention group generally reported a positive attitude toward the eight-week FM intervention in the individual interviews, where responses reflected the core principles of FM: Embodied criticality, critical attention, and transfer from the social environment. Contrastingly, however, no significant improvements were observed in IAcc (objective) or psychological well-being (BPNSFS).

The attention regulation subscale of the MAIA assesses the subjective ability to sustain and control attention to body sensations. Improvements in this subscale were therefore unsurprising considering the interview responses, where several participants stated a better perceived ability to maintain focus on bodily sensations (e.g., " . . . helped me not only to pay attention to my breathing . . . "). Further, the attention regulation subscale emulates one of the core aims of FM in encouraging directed critical attention toward the body, increasing awareness through movement (Fortin and Vanasse 2012). This therefore supports its efficacy in achieving its specific goals. Despite such promising findings, it should be noted that there were no significant changes in IAcc, a more objective measure of attention toward and processing of bodily sensations. These results should therefore be considered with caution, bearing in mind the tendency for subjective and objective measures of interoception to lack correspondence (Garfinkel et al. 2016b). In other words, believing to have a good accuracy in perception doesn't necessarily constitute to an objectively good accuracy in perception in behavioral tasks. Despite the lack of significant findings in IAcc, however, there was a trend toward an increase in the intervention group (IG pre = 0.56 ± 0.30, IG post = .070 ± 0.23, CG pre = 0.58 ± 0.24, CG post = 0.44 ± 0.29). This could therefore indicate that effects could be observed with a larger sample size, supporting the need for further research at a larger scale. Alternative explanations for the null results could be down to the intensity of the activity. It has been suggested that interoceptive mechanisms are primarily activated in an intensity-dependent manner, where interoceptive cues dominate past the point of the anaerobic threshold (Ekkekakis 2009). Although objective measures of exercise intensity were not taken during this study, intensities were determined based on the principles of FM to use limited force (Feldenkrais 1987). This could therefore indicate that the low to moderate intensity of FM may curtail potential improvements in IAcc. If true, this would therefore put the benefits of FM down to attention toward bodily signals rather than the strength of the signals themselves. As no objective measures of exercise intensity were taken in this feasibility study, future research should measure or systematically manipulate intensity during the intervention sessions to support the above speculation.

Surprisingly, there were no significant findings for all other variables (BPNSFS; autonomy, competence, relatedness, and MAIA; noticing, non-distracting, self-regulation). As with the IAcc results, this could be explained by the small sample size. Regarding psychological well-being, however, alternative explanations could refer to the fact that the population of the present study was a healthy, non-clinical sample. More specifically, the baseline basic needs' scores would already be considered moderately satisfied in comparison to previous studies (Quested and Duda 2010). This therefore would make it unlikely that improvements would have been observed due to potential ceiling effects. Benefits could instead however come in the form of protection against violations to psychological well-being, rather than direct benefits to psychological well-being itself. Future research could therefore add additional measures related to improved self-regulation, such as resilience and coping strategies (Artuch-Garde et al. 2017), which would be more indicative of an improved ability to cope with future violations of psychological well-being. Alternatively, it could have been that the duration and frequency of the intervention was too short to elicit effects. The duration of eight weeks (eight one-hour lessons) was chosen based on guidelines as the minimum requirement for dance interventions (Schwender et al. 2018). Nevertheless, perhaps this minimum requirement was not suitable for this specific intervention. It should be noted, however, that feasibility studies are recommended in preparation for randomized control trials (Craig et al. 2008; Eldridge et al. 2016), with the aim of determining whether the research question should be pursued at a larger scale. The shorter duration was therefore chosen specifically to provide an initial insight on the efficacy of the intervention, with the intention to use more rigorous designs in follow up studies.

Considering the individual interviews, findings provide an initial positive view for the use of FM in female adolescent recreational ballet dancers, supporting the feasibility of such interventions in future research to further establish their efficacy. The reports incorporate themes of improved attention regulation toward the body, embodied criticality, and reduced social comparison. Contextualizing these findings relating to our research outcomes, one could assume that there is some level of bodily processing stimulated by FM. This could provide initial support for our predictions, in that the core principles of FM are based upon the foundations of interoceptive processing. As mentioned earlier, however, it remains unclear how deep this level of processing goes, where changes in bodily perception were only observed at the subjective level. Without demonstrating objective improvements in perception, we cannot assume that these subjective evaluations are based upon psychophysiological adaptations (Garfinkel et al. 2016a). Despite this, co-occurring reductions in social comparison provide some indication that even subjective improvements in bodily perception could provide benefits to indices of psychological well-being. This emulates previous findings where increases in perceived interoceptive ability were associated with improved positive states of mind following an integrative exercise program of aerobic exercise with mindfulness-based principles (Mehling et al. 2018).

The results from both the quantitative and the qualitative data analyses indicate the feasibility of FM interventions for adolescent populations, adding to findings from previous studies focussed on adult populations (Kerr, Kotynia, and Kolt 2002; Connors, Pile, and Nichols 2011; Öhman, Åström, and Malmgren-Olsson 2011; Fortin and Vanasse 2012; Teixeira-Machado et al. 2015; Paolucci et al. 2017; Ahmadi et al. 2020). This study provides a first step to provide empirically driven recommendations for the use of FM in adolescent populations. Being able to use such somatic-oriented education practices in younger populations presents a potential avenue to intervene and foster healthy practices to promote psychological well-being and prevent the manifestation of mental health conditions. Through integrating principles of FM into classes, dance educators could promote healthy practices through increasing metacognitive awareness of brain-body communication to promote self-awareness and self-control. This could be transferred to benefits in different dancing contexts, where dancers learn to develop more autonomous movement sequences that could mitigate the challenges and psychological demands of a dance class. It should be emphasized, however, that well-powered randomized controlled trials are needed to test these speculative hypotheses.

Limitations

This feasibility study does not come without limitations. Firstly, the small sample size limited our statistical power. Whilst this present study was only a feasibility study, a larger sample size would provide a greater powered comparison between groups. Other limitations include potential ceiling effects resulting from the non-clinical sample. As mentioned earlier, the basic needs of participants in this sample were already moderately satisfied at baseline. This makes it unlikely to observe benefits due to a reduced room for change. Future research should therefore look at differences compared to a more experienced population of ballet dancers, where through increased participation they could be more at risk to violations of psychological well-being. Due to increased exposure to competitive environments, such interventions could thus hold more relevance to professional dancers. It should be acknowledged, however, that risks to psychological well-being are relevant independent of the level of dance. This is down to more generalized issues to female adolescent populations as a whole, such as difficulties with personality development, self-esteem, and body-image (Lee 2001).

Considering background characteristics, whilst participants were matched as closely as possible, results revealed a significant difference in age between the intervention and control group. This could have confounded the results due to rapid physical, psychological, and social developmental changes in this critical period (Christie and Viner 2005). However, it should be noted that no significant differences were found in the other physical characteristics, such as height, weight, or BMI. This age difference could have further impacted the level of dance experience, where it's possible that the older group have been participating in ballet for longer. As no participants from either group had experience in FM, however, we suspect that this was unlikely to confound the results. Nonetheless, more effort should be made in future research to ensure participants are matched more closely. With this should come additional measures of sporting background and fitness to complement current background characteristics.

From a methodological perspective, future research might use alternative strategies to assess IAcc based on the current discussion concerning the reliability and validity of the HCT (Zamariola et al. 2018; Ainley et al. 2020; Corneille et al. 2020). Nonetheless, it should be mentioned that the HCT is a widely used research instrument to measure IAcc, mainly due to its feasibility of implementation. IAcc scores from the HCT have also been associated with concepts related to interoceptive processes e.g., emotional regulation (Füstös et al. 2013),

mental health conditions (Garfinkel et al. 2016b), and the regulation of exertion (Herbert, Ulbrich, and Schandry 2007), further supporting its validity. In addition, the correlation between results from the HCT and related neuropsychological indices such as heartbeat-evoked potential (Mai et al. 2018) suggest that the perception of cardiovascular signals is somewhat reflected in this task.

Considering the design of the intervention, the FM lessons were performed on top of regular dance classes for convenience, as an additional session for the intervention group. To avoid potential training effects, however, it would have been better to have an additional dance class for the control group, acting as a form of placebo. Further, this would have also accounted for potential effects of fatigue that may have been experienced in the intervention group. Future research should therefore use an active control group to minimize both training and fatigue effects in the intervention group.

Finally, although open questions were chosen in the interviews as to not influence the participant, a further follow-up question would have provided more information to explain the results in the case of no changes being observed. For example, if the participant reported a negative response to "How did you find the Feldenkrais intervention?" further probing into the reasons for this negative response would provide important information for future developments. This should therefore be considered in future research to ensure no important information is lost.

Conclusion

The findings from this current study not only provide confidence in the feasibility of FM in this sample of female adolescent recreational ballet dancers, but they also support its ability to improve important variables closely related to the goal of improving embodied criticality e.g., attention regulation (MAIA). This supports the rationale for future research where we would hypothesize to see similar benefits, as well as additional increases in IAcc based on the trends observed in this smaller sample. Whilst these preliminary findings of the presented feasibility study are promising, a well-powered randomized controlled trial is now needed to test the efficacy of FM as a mind-body intervention to improve IAcc and psychological well-being, supporting its generalizability to wider populations.

Disclosure Statement

No potential conflict of interest was reported by the authors.

ORCID

Mirko Schmidt, PhD http://orcid.org/0000-0003-4859-6547
Andrea Schärli, PhD http://orcid.org/0000-0003-3038-1513

References

Abraham, Suzanne. 1996. "Characteristics of Eating Disorders among Young Ballet Dancers." *Psychopathology* 29 (4): 223–29. doi:10.1159/000284997.

Ahmadi, Hanieh, Hanieh Adib, Maryam Selk-Ghaffari, Misagh Shafizad, Siavash Moradi, Zahra Madani, Gholamreza Partovi, and Aliakbar Mahmoodi. 2020. "Comparison of the Effects of the Feldenkrais Method versus Core Stability Exercise in the Management of Chronic Low Back Pain: A Randomised Control Trial." *Clinical Rehabilitation* 34 (12): 1449–57. doi:10.1177/0269215520947069.

Ainley, Vivien, Lara Maister, Jana Brokfeld, Harry Farmer, and Manos Tsakiris. 2013. "More of Myself: Manipulating Interoceptive Awareness by Heightened Attention to Bodily and Narrative Aspects of the Self." *Consciousness and Cognition* 22 (4): 1231–38. doi:10.1016/j.concog.2013.08.004.

Ainley, Vivien, Manos Tsakiris, Olga Pollatos, André Schulz, and Beate M. Herbert. 2020. "Comment on 'Zamariola et al. (2018), Interoceptive Accuracy Scores are Problematic: Evidence from Simple Bivariate Correlations'—The Empirical Data Base, the Conceptual Reasoning and the Analysis behind This Statement are Misconceived and Do Not Support T." *Biological Psychology* 152. doi:10.1016/j.biopsycho.2020.107870.

Ainley, Vivien, Marcel Brass, and Manos Tsakiris. 2014. "Heartfelt Imitation: High Interoceptive Awareness Is Linked to Greater Automatic Imitation." *Neuropsychologia* 60 (1): 21–28. doi:10.1016/j.neuropsychologia.2014.05.010.

Artuch-Garde, Raquel, Maria Del Carmen González-torres, Jesús de La Fuente, M. Mariano Vera, María Fernández-Cabezas, and Mireia López-García. 2017. "Relationship between Resilience and Self-Regulation: A Study of Spanish Youth at Risk of Social Exclusion." *Frontiers in Psychology* 8 (4): 612. doi:10.3389/fpsyg.2017.00612.

Badoud, Deborah, and Manos Tsakiris. 2017. "From the Body's Viscera to the Body's Image: Is There a Link between Interoception and Body Image Concerns?" *Neuroscience and Biobehavioral Reviews* 77: 237–46. doi:10.1016/j.neubiorev.2017.03.017.

Bettle, Norman, Oliver Bettle, Ursula Neumärker, and Klaus Jürgen Neumärker. 2001. "Body Image and Self-Esteem in Adolescent Ballet Dancers." *Perceptual and Motor Skills* 93 (1): 297–309. doi:10.2466/pms.2001.93.1.297.

Bibiloni, Maria Del Mar, Jordi Pich, Antoni Pons, and Josep A. Tur. 2013. "Body Image and Eating Patterns among Adolescents." *BMC Public Health* 13 (1): 1–10. doi:10.1186/1471-2458-13-1104.

Brener, Jasper, and Christopher Ring. 2016. "Towards a Psychophysics of Interoceptive Processes: The Measurement of Heartbeat Detection." *Philosophical Transactions of the Royal Society B: Biological Sciences* 371 (1708): 20160015. doi:10.1098/rstb.2016.0015.

Burkhardt, Jan, and Cathy Brennan. 2012. "The Effects of Recreational Dance Interventions on the Health and Well-Being of Children and Young People: A Systematic Review." *Arts and Health* 4 (2): 148–61. doi:10.1080/17533015.2012.665810.

Byrne, Susan, and Neil McLean. 2001. "Eating Disorders in Athletes: A Review of the Literature." *Journal of Science and Medicine in Sport* 4 (2): 145–59. doi:10.1016/S1440-2440(01)80025-6.

Christie, Deborah, and Russell Viner. 2005. "Adolescent Development." *BMJ* 330 (7486): 301. doi:10.1136/bmj.330.7486.301.

Connors, Karol Anne, Carolyn Pile, and Margo Elaine Nichols. 2011. "Does the Feldenkrais Method Make a Difference? An Investigation into the Use of Outcome Measurement Tools for Evaluating Changes in Clients." *Journal of Bodywork and Movement Therapies* 15 (4): 446–52. doi:10.1016/j.jbmt.2010.09.001.

Corneille, Olivier, Olivier Desmedt, Giorgia Zamariola, Olivier Luminet, and Pierre Maurage. 2020. "A Heartfelt Response to Zimprich et al. (2020), and Ainley et al. (2020)'s Commentaries: Acknowledging Issues with the HCT Would Benefit Interoception Research." *Biological Psychology* 152: 107869. doi:10.1016/j.biopsycho.2020.107869.

Craig, Arthur D. 2003. "Interoception: The Sense of the Physiological Condition of the Body." *Current Opinion in Neurobiology* 13 (4): 500–05. doi:10.1016/S0959-4388(03)00090-4.

Craig, Arthur D. 2014. *How Do You Feel?: An Interoceptive Moment with Your Neurobiological Self. How Do You Feel?:* 65 vols. Princeton, NJ: Princeton University Press. doi:10.3399/bjgp15x687985.

Craig, Peter, Paul Dieppe, Sally Macintyre, Susan Mitchie, Irwin Nazareth, and Mark Petticrew. 2008. "Developing and Evaluating Complex Interventions: The New Medical Research Council Guidance." *BMJ* a1655. doi:10.1136/bmj.a1655.

Cramer, Holger, Romy Lauche, Jennifer Daubenmier, Wolf Mehling, Arndt Bü Ssing, Felix J. Saha, Gustav Dobos, and Stephanie A Shields. 2018. "Being Aware of the Painful Body: Validation of the German Body Awareness Questionnaire and Body Responsiveness Questionnaire in Patients with Chronic Pain." *PLoS ONE* 13 (2): 2. doi:10.1371/journal.pone.0193000.

Czasche, Maike B., Jon E. Goodwin, Anthony M. J. Bull, and Daniel J. Cleather. 2018. "Effects of an 8-Week Strength Training Intervention on Tibiofemoral Joint Loading during Landing: A Cohort Study." *BMJ Open Sport and Exercise Medicine* 4 (1): 273. doi:10.1136/bmjsem-2017-000273.

Davison, Kirsten Krahnstoever, Mandy B. Earnest, and Leann L. Birch. 2002. "Participation in Aesthetic Sports and Girls' Weight Concerns at Ages 5 and 7 Years." *International Journal of Eating Disorders* 31 (3): 312–17. doi:10.1002/eat.10043.

Deci, Edward L., and M. Ryan. 1985. "Intrinsic Motivation and Self-determination in Human Behvaiour." *Springer Science & Business Media*. doi:10.1007/978-1-4899-2271-7.

Deci, Edward L., and Richard M. Ryan. 2000. "The 'What' and 'Why' of Goal Pursuits: Human Needs and the Self-Determination of Behavior." *Psychological Inquiry* 11 (4): 227–68. doi:10.1207/S15327965PLI1104_01.

Desmedt, Olivier, Olivier Luminet, and Olivier Corneille. 2018. "The Heartbeat Counting Task Largely Involves Non-Interoceptive Processes: Evidence from Both the Original and an Adapted Counting Task." *Biological Psychology* 138 (10): 185–88. doi:10.1016/j.biopsycho.2018.09.004.

Dunn, Barnaby D., Hannah C. Galton, Ruth Morgan, Davy Evans, Clare Oliver, Marcel Meyer, Rhodri Cusack, Andrew D. Lawrence, and Tim Dalgleish. 2010. "Listening to Your Heart: How Interoception Shapes Emotion Experience and Intuitive Decision Making." *Psychological Science* 21 (12): 1835–44. doi:10.1177/0956797610389191.

Durlik, Caroline, Gary Brown, and Manos Tsakiris. 2014. "Enhanced Interoceptive Awareness during Anticipation of Public Speaking Is Associated with Fear of Negative Evaluation." *Cognition and Emotion* 28 (3): 530–40. doi:10.1080/02699931.2013.832654.

Ehlers, Anke. 1993. "Interoception and Panic Disorder." *Advances in Behaviour Research and Therapy* 15 (1): 3–21. doi:10.1016/0146-6402(93)90001-I.

Ekkekakis, Panteleimon. 2009. "The Dual-Mode Theory of Affective Responses to Exercise in Metatheoretical Context: II. Bodiless Heads, Ethereal Cognitive Schemata, and Other Improbable Dualistic Creatures, Exercising." *International Review of Sport and Exercise Psychology* 2 (2): 139–60. doi:10.1080/17509840902829323.

Eldridge, Sandra M., Gillian A. Lancaster, Michael J. Campbell, Lehana Thabane, Sally Hopewell, Claire L. Coleman, and Christine M. Bond. 2016. "Defining Feasibility and Pilot Studies in Preparation for Randomised Controlled Trials: Development of a Conceptual Framework." *PLoS ONE* 11 (3): e0150205. doi:10.1371/journal.pone.0150205.

Feldenkrais, Moshe. 1987. *Awareness through Movement*. 1st ed. New York: Harper and Row.

Fischer, Dana, Matthias Messner, and Olga Pollatos. 2017. "Improvement of Interoceptive Processes after an 8-Week Body Scan Intervention." *Frontiers in Human Neuroscience* 11: 452. doi:10.3389/fnhum.2017.00452.

Fortin, Sylvie, and Chantal Vanasse. 2012. "The Feldenkrais Method and Women with Eating Disorders." *Journal of Dance & Somatic Practices* 3 (1): 127–43. doi:10.1386/jdsp.3.1-2.127_1.

Fraguela-Vale, Raúl, Lara Varela-Garrote, Miriam Carretero-García, and Eva María Peralbo-Rubio. 2020. "Basic Psychological Needs, Physical Self-Concept, and Physical Activity among Adolescents: Autonomy in Focus." *Frontiers in Psychology* 11 (3): 491. doi:10.3389/fpsyg.2020.00491.

Füstös, Jürgen, Klaus Gramann, Beate M. Herbert, and Olga Pollatos. 2013. "On the Embodiment of Emotion Regulation: Interoceptive Awareness Facilitates Reappraisal." *Social Cognitive and Affective Neuroscience* 8 (8): 911–17. doi:10.1093/scan/nss089.

Gamelin, François Xavier, Georges Baquet, Serge Berthoin, and Laurent Bosquet. 2008. "Validity of the Polar S810 to Measure R-R Intervals in Children." *International Journal of Sports Medicine* 29 (2): 134–38. doi:10.1055/s-2007-964995.

Garfinkel, Sarah N., Claire Tiley, Stephanie O'Keeffe, Neil A. Harrison, Anil K. Seth, and Hugo D. Critchley. 2016b. "Discrepancies between Dimensions of Interoception in Autism: Implications for Emotion and Anxiety." *Biological Psychology* 114: 117–26. doi:10.1016/j.biopsycho.2015.12.003.

Garfinkel, Sarah N., Miranda F. Manassei, Giles Hamilton-Fletcher, Yvo In Den Bosch, Hugo D. Critchley, and Miriam Engels. 2016a. "Interoceptive Dimensions across Cardiac and Respiratory Axes." *Philosophical Transactions of the Royal Society B: Biological Sciences* 371 (1708): 20160014. doi:10.1098/rstb.2016.0014.

Garn, Alex C., Nathan McCaughtry, Jeffrey Martin, B. Shen, and Mariane Fahlman. 2012. "A Basic Needs Theory Investigation of Adolescents' Physical Self-Concept and Global Self-Esteem." *International Journal of Sport and Exercise Psychology* 10 (4): 314–28. doi:10.1080/1612197X.2012.705521.

Heissel, Andreas, Anou Pietrek, Barbara Flunger, Thomas Fydrich, Michael A. Rapp, Stephan Heinzel, and Maarten Vansteenkiste. 2018. "The Validation of the German Basic Psychological Need Satisfaction and Frustration Scale in the Context of Mental Health." *European Journal of Health Psychology* 25 (4): 119–32. doi:10.1027/2512-8442/a000017.

Herbert, Beate M., Pamela Ulbrich, and Rainer Schandry. 2007. "Interoceptive Sensitivity and Physical Effort: Implications for the Self-Control of Physical Load in Everyday Life." *Psychophysiology* 44 (2): 194–202. doi:10.1111/j.1469-8986.2007.00493.x.

Ives, Jeffrey C. 2003. "Comments on 'The Feldenkrais Method®: A Dynamic Approach to Changing Motor Behavior.'" *Research Quarterly for Exercise and Sport* 74 (2): 116–23. doi:10.1080/02701367.2003.10609072.

Jones, Gary E., and James G. Hollandsworth. 1981. "Heart Rate Discrimination before and after Exercise-Induced Augmented Cardiac Activity." *Psychophysiology* 18 (3): 252–57. doi:10.1111/j.1469-8986.1981.tb03029.x.

Joseph, Leonard Henry, Aatit Paungmali, Patraporn Sitilertpisan, and Vikram Mohan. 2020. "Improved Respiratory Characteristics in Nonspecific Low Back Pain: Comparison of Feldenkrais Method versus Routine Physiotherapy". *Physiotherapy Practice and Research*, June. doi:10.3233/PPR-190382.

Kampe, Thomas. 2015. "Eros and Inquiry: The Feldenkrais Method® as a Complex Resource." *Theatre, Dance and Performance Training* 6 (2): 200–18. doi:10.1080/19443927.2015.1027451.

Kerr, Gretchen A., Filip Kotynia, and Gregory S. Kolt. 2002. "Feldenkrais® Awareness through Movement and State Anxiety." *Journal of Bodywork and Movement Therapies* 6 (2): 102–07. doi:10.1054/jbmt.2001.0274.

Klinkenberg, Norbert. 2006. "Die Feldenkrais-Methode in Der Körperverhaltenstherapeutischen Arbeit." *PiD - Psychotherapie Im Dialog* 7 (2): 175–79. doi:10.1055/s-2006-932620.

Kunstman, Jonathan W., Elise M. Clerkin, Kateyln Palmer, M. Taylar Peters, Dorian R. Dodd, and April R. Smith. 2016. "The Power Within: The Experimental Manipulation of Power Interacts with Trait BDD Symptoms to Predict Interoceptive Accuracy." *Journal of Behavior Therapy and Experimental Psychiatry* 50 (3): 178–86. doi:10.1016/j.jbtep.2015.08.003.

Lazarus, R., and S. Folkman. 1984. *Stress, Appraisal, and Coping*. vol. 1. 1st ed. New York: Springer Publishing.

Lee, Susan A. 2001. "Adolescent Issues in a Psychological Approach to Dancers." *Journal of Dance Medicine & Science* 5 (4): 121–26.

Lernia, Daniele Di, Silvia Serino, and Giuseppe Riva. 2016. "Pain in the Body. Altered Interoception in Chronic Pain Conditions: A Systematic Review." *Neuroscience and Biobehavioral Reviews*. doi:10.1016/j.neubiorev.2016.09.015.

Mai, Sandra, Chung Ki Wong, Eleana Georgiou, and Olga Pollatos. 2018. "Interoception Is Associated with Heartbeat-Evoked Brain Potentials (Heps) in Adolescents." *Biological Psychology* 137 (9): 24–33. doi:10.1016/j.biopsycho.2018.06.007.

Mehling, Wolf E., Cynthia Price, Jennifer J. Daubenmier, Mike Acree, Elizabeth Bartmess, and Anita Stewart. 2012. "The Multidimensional Assessment of Interoceptive Awareness (MAIA)." *PLoS ONE* 7 (11): 11. doi:10.1371/journal.pone.0048230.

Mehling, Wolf E., Margaret A. Chesney, Thomas J. Metzler, Lizabeth A. Goldstein, Shira Maguen, Chris Geronimo, Gary Agcaoili, Deborah E. Barnes, Jennifer A. Hlavin, and Thomas C. Neylan. 2018. "A 12-Week Integrative Exercise Program Improves Self-Reported Mindfulness and Interoceptive Awareness in War Veterans with Posttraumatic Stress Symptoms." *Journal of Clinical Psychology* 74 (4): 554–65. doi:10.1002/jclp.22549.

Montgomery, William A., Gary E. Jones, and James G. Hollandsworth. 1984. "The Effects of Physical Fitness and Exercise on Cardiac Awareness." *Biological Psychology* 18 (1): 11–22. doi:10.1016/0301-0511(84)90022-X.

Nerini, Amanda. 2015. "Media Influence and Body Dissatisfaction in Preadolescent Ballet Dancers and Non-Physically Active Girls." *Psychology of Sport and Exercise* 20 (9): 76–83. doi:10.1016/j.psychsport.2015.04.011.

Niwa, Minae, Richard S. Lee, Teppei Tanaka, Kinya Okada, Shin Ichi Kano, and Akira Sawa. 2016. "A Critical Period of Vulnerability to Adolescent Stress: Epigenetic Mediators in Mesocortical Dopaminergic Neurons." *Human Molecular Genetics* 25 (7): 1370–81. doi:10.1093/hmg/ddw019.

Nunan, David, Gavin R.H. Sandercock, and David A. Brodie. 2010. "A Quantitative Systematic Review of Normal Values for Short-Term Heart Rate Variability in Healthy Adults." *PACE - Pacing and Clinical Electrophysiology* 33 (11): 1407–17. doi:10.1111/j.1540-8159.2010.02841.x.

Öhman, Ann, Lena Åström, and Eva Britt Malmgren-Olsson. 2011. "Feldenkrais® Therapy as Group Treatment for Chronic Pain - A Qualitative Evaluation." *Journal of Bodywork and Movement Therapies* 15 (2): 153–61. doi:10.1016/j.jbmt.2010.03.003.

Paolucci, Teresa, Federico Zangrando, Marco Iosa, Simona De Angelis, Caterina Marzoli, Giulia Piccinini, and Vincenzo Maria Saraceni. 2017. "Improved Interoceptive Awareness in Chronic Low Back Pain: A Comparison of Back School versus Feldenkrais Method." *Disability and Rehabilitation* 39 (10): 994–1001. doi:10.1080/09638288.2016.1175035.

Quested, Eleanor, and Joan L. Duda. 2010. "Exploring the Social-Environmental Determinants of Well- and Ill-Being in Dancers: A Test of Basic Needs Theory." *Journal of Sport and Exercise Psychology* 32 (1): 39–60. doi:10.1123/jsep.32.1.39.

Quested, Eleanor, Joan L. Duda, Nikos Ntoumanis, and Jonathan P. Maxwell. 2013. "Daily Fluctuations in the Affective States of Dancers: A Cross-Situational Test of Basic Needs Theory." *Psychology of Sport and Exercise* 14 (4): 586–95. doi:10.1016/j.psychsport.2013.02.006.

Radespiel-Tröger, Martin, Robert Rauh, Christine Mahlke, Tim Gottschalk, and Michael Mück-Weymann. 2003. "Agreement of Two Different Methods for Measurement of Heart Rate Variability." *Clinical Autonomic Research* 13 (2): 99–102. doi:10.1007/s10286-003-0085-7.

Ravaldi, Claudia, Alfredo Vannacci, Enrica Bolognesi, Stefania Mancini, Carlo Faravelli, and Valdo Ricca. 2006. "Gender Role, Eating Disorder Symptoms, and Body Image Concern in Ballet Dancers." *Journal of Psychosomatic Research* 61 (4): 529–35. doi:10.1016/j.jpsychores.2006.04.016.

Reinboth, Michael, Joan L. Duda, and Nikos Ntoumanis. 2004. "Dimensions of Coaching Behavior, Need Satisfaction, and the Psychological and Physical Welfare of Young Athletes." *Motivation and Emotion* 28 (3): 297–313. doi:10.1023/B:MOEM.0000040156.81924.b8.

Reis, Dorota. 2017. "Further Insights into the German Version of the Multidimensional Assessment of Interoceptive Awareness (MAIA)." *European Journal of Psychological Assessment*, May 1–9. doi:10.1027/1015-5759/a000404.

Ring, Christopher, Jasper Brener, Kelley Knapp, and Jennifer Mailloux. 2015. "Effects of Heartbeat Feedback on Beliefs about Heart Rate and Heartbeat Counting: A Cautionary Tale about Interoceptive Awareness." *Biological Psychology* 104 (1): 193–98. doi:10.1016/j.biopsycho.2014.12.010.

Schandry, Rainer. 1981. "Heart Beat Perception and Emotional Experience." *Psychophysiology* 18 (4): 483–88. doi:10.1111/j.1469-8986.1981.tb02486.x.

Schandry, Rainer, Micheal Bester, and Pedro Montoya. 1993. "On the Relations Between Cardiodynamics and Heartbeat Perception." *Psychophysiology* 30 (5): 467–474. doi:10.1111/j.1469-8986.1993.tb02070.x.

Schärli, Andrea. 2016. "Functional Movement Analysis in Dance." In *Handbook of Human Motion*, 1–15. Cham: Springer International Publishing. doi:10.1007/978-3-319-30808-1_112-1.

Schmidt, Mirko, Stefan Valkanover, Claudia Roebers, and Achim Conzelmann. 2013. "Promoting a Functional Physical Self-Concept in Physical Education: Evaluation of a 10-Week Intervention." *European Physical Education Review* 19 (2): 232–55. doi:10.1177/1356336X13486057.

Schwender, Tina M., Sarah Spengler, Christina Oedl, and Filip Mess. 2018. "Effects of Dance Interventions on Aspects of the Participants' Self: A Systematic Review." *Frontiers in Psychology* 9 (7). doi:10.3389/fpsyg.2018.01130.

Smolak, Linda, Sarah K. Murnen, and Anne E. Ruble. 2000. "Female Athletes and Eating Problems: A Meta-Analysis." *International Journal of Eating Disorders* 27 (4): 371–80. doi:10.1002/(SICI)1098-108X(200005)27:4<371::AID-EAT1>3.0.CO;2-Y.

Teixeira-Machado, Lavinia, Fernanda M. Araújo, Fabiane A. Cunha, Mayara Menezes, Thainá Menezes, and Josimari Melo DeSantana. 2015. "Feldenkrais Method-Based Exercise Improves Quality of Life in Individuals with Parkinson's Disease: A Controlled, Randomized Clinical Trial." *Alternative Therapies in Health and Medicine* 21 (1): 8-14. doi:10.1016/j.jpain.2015.01.471.

Tsakiris, Manos, and Hugo Critchley. 2016. "Interoception beyond Homeostasis: Affect, Cognition and Mental Health." *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* 371 (1708). doi:10.1098/rstb.2016.0002.

Vansteenkiste, Maarten, Richard M. Ryan, and Bart Soenens. 2020. "Basic Psychological Need Theory: Advancements, Critical Themes, and Future Directions." *Motivation and Emotion*. doi:10.1007/s11031-019-09818-1.

Vrantsidis, Freda, Keith D. Hill, Kirsten Moore, Robert Webb, Susan Hunt, and Leslie Dowson. 2009. "Getting Grounded Gracefully©: Effectiveness and Acceptability of Feldenkrais in Improving Balance." *Journal of Aging and Physical Activity* 17 (1): 17. doi:10.1123/japa.17.1.57.

Wallman-Jones, Amie, Pandelis Perakakis, Manos Tsakiris, and Mirko Schmidt. 2021. "Physical Activity and Interoceptive Processing: Theoretical Considerations for Future Research." *International Journal of Psychophysiology* 166 (8): 38–49. doi:10.1016/j.ijpsycho.2021.05.002.

Zamariola, Giorgia, Flavia Cardini, Emanuel Mian, Andrea Serino, and Manos Tsakiris. 2017. "Can You Feel the Body that You See? On the Relationship between Interoceptive Accuracy and Body Image." *Body Image* 20 (3): 130–36. doi:10.1016/j.bodyim.2017.01.005.

Zamariola, Giorgia, Olivier Luminet, Adrien Mierop, and Olivier Corneille. 2019. "Does It Help to Feel Your Body? Evidence Is Inconclusive that Interoceptive Accuracy and Sensibility Help Cope with Negative Experiences." *Cognition and Emotion* 33 (8): 1627–38. doi:10.1080/02699931.2019.1591345.

Zamariola, Giorgia, Pierre Maurage, Olivier Luminet, and Olivier Corneille. 2018. "Interoceptive Accuracy Scores from the Heartbeat Counting Task are Problematic: Evidence from Simple Bivariate Correlations." *Biological Psychology* 137: 12–17. doi:10.1016/j.biopsycho.2018.06.006.

Appendix

Lesson	Description	Focus, key
1. AY 19: Preparation for a clock	Exploration of pelvis movements performed in a circle in different positions	Pelvis flexibility
2. AY 43: Lifting the pelvis to the raised feet	Lying on the back, feet standing slow pelvis movement lifted from the floor with spine articulation	Spine flexibility
3. AY 40: Lifting the pelvis with the swing of the legs	Exploration of dynamic, controlled pelvis sways exerted by the legs	Mobility + strength of the back in relation to the legs
4. AY 32: Lengthening and straightening of the left leg	Hands stroking the left leg while increasing back and torso mobility	Flexibility of hamstrings
5. AY 61: Arms in a circle above the head, soles of feet together	Exploration of arm movement combined with turned out leg movement	Arm flexibility, hip turn out position
		
6. AY 44: Lengthening the arms in the shoulder blades	Examination of the extent of arm movement under observation of shoulder movement	Arm and shoulder flexibility
7. AY 75: Turning the shoulder in relation to the pelvis	Shoulder lying on the floor, legs move independent to shoulders	Rotation in spine
		
8. AY 34: Foot on the head	Lifting the legs above the head in sitting position by increasing back mobility	Spine flexibility

**Significance set at p <.05*
MAIA = multi-dimensional assessment of interoceptive awareness