COMPREHENSIVE PSYCHOLOGY

2012, Volume 1, Article 7
ISSN 2165-2228

DOI 10.2466/02.06.20.CP.1.7

Received February 18, 2012
Accepted April 23, 2012
Published July 23, 2012

CITATION
Cooper, K., & Mohr, C. (2012) Former eating disorder impairs 3rd person but not 1st person perspective taking: does dance training help? *Comprehensive Psychology*, 1, 7.

Former eating disorder impairs 3rd person but not 1st person perspective taking: does dance training help?[1]

Kate Cooper
University of Bristol

Christine Mohr
University of Lausanne

Abstract

The mental ability to take the perspective of another person may depend on one's own bodily awareness and experience. In the present study, bodily awareness was defined as having a history of an eating disorder, and experience was defined as formal experience with dance. The study used a design in which reaction times in two mental perspective-taking tasks were compared between female dancers and non-dancers with and without a former eating disorder. Participants were asked to imagine two perspectives: (i) the position of front-facing and back-facing figures (3rd person perspective-taking task) and (ii) that these same figures are a self reflection in a mirror (1st person perspective-taking task). In both tasks, a particular hand was indicated in the presented figures, and the participants had to decide whether the hand represented their own left or right hand. Overall, responses were slower for front-facing than back-facing figures in the 3rd person perspective-taking task, and for back-facing than front-facing figures in the 1st person perspective-taking task. Importantly, having a former history of an eating disorder related to a decreased performance in the 3rd person perspective-taking task, but only in participants without dance experience. Results from an additional control group (a history of exercise but no dance experience) indicated that dance is particularly beneficial for mental bodily perspective taking. Dance experience, more so than exercise in general, can benefit 3rd person or extrapersonal perspective taking, supporting the favourable effect this exercise has on own-body processing.

Perspective taking is the ability to compare one's own position (1st person perspective, 1PP) with that of another person, or point of view (3rd person perspective, 3PP). One perspective-taking task that has received extensive interest in recent years concerns the ability to imagine the self in the visuospatial perspective of another human figure (Ratcliff, 1979; Zacks, Rypma, Gabrieli, Tversky, & Glover, 1999; Mohr, Blanke, & Brugger, 2006; Thakkar, Brugger, & Park, 2009; Gronholm, Flynn, Edmonds, & Gardner, 2012). The task requires participants to decide whether the marked hand of a front- or back-facing figure (see Fig. 1A for some examples) would be their right or left hand if they were in the position of the figure. Overall performance in this 3rd person perspective-taking task is highly reliable, i.e., participants are faster and more accurate when making decisions about back-facing than front-facing figures, because their own body position matches that of the back-facing figure. For front-facing figures, participants have to imagine their body in a position that is different from their current body position, enhancing error rates and response latencies. Originally introduced as a mental rotation task for neuropsychological assessment (Ratcliff, 1979), subsequent studies used the task to separate different forms of mental rotation abilities (Zacks, *et al.*, 1999), to assess the cognitive correlates of out-of-body experiences (Blanke, Mohr, Michel, Pascual-Leone, Brugger, *et al.*, 2005; Easton, Blanke, & Mohr, 2009; Braithwaite, Samson, Apperly, Broglia, & Hulleman, 2011) and schizotypy (Mohr, *et al.*, 2006; Easton, *et al.*, 2009), to evaluate learning (Bailey, Papadopoulos, Lingford-Hughes, & Nutt, 2007), to test for social perspective taking (Thakkar, *et al.*, 2009; Mohr, Rowe, & Blanke, 2010; Gronholm, *et al.*,

[1]Special thanks goes to our friend Sophie Scott, who drew us the female and male figures (she named them "Samantha" and "Steve"). We would also like to acknowledge the support of the Wellcome Trust who supported us with three Wellcome Trust Vacation Scholarships (Kate Cooper in 2009, Izumi Kurokawa in 2009, and Joachim Hansen in 2010) all investigating the merit of the 3PP task as a social task.

Address correspondence to Christine Mohr, Faculté des sciences sociales et politiques, Institut de Psychologie, Bâtiment Anthropole, Quartier Dorigny, CH-1015 Lausanne, Switzerland or e-mail (Christine.Mohr@unil.ch).

Ammons Scientific
www.AmmonsScientific.com

2012; Mohr, Rowe, Kurodawa, Denby, & Theodoridou, in press), embodiment (Gardner & Potts, 2010; Marzoli, Mitaritonna, Moretto, Carluccio, & Tommasi, 2011), and spatial compatibility effects (Gardner & Potts, 2011).

One aspect that remained neglected so far, but which is likely to influence the way an individual can mentally take the perspective of another person, is own body experience and awareness. Mentally manipulating bodies and body parts activates body- and motor-related brain areas (Bonda, Petrides, Frey, & Evans, 1995; Kosslyn, Digirolamo, Thompson, & Alpert, 1998; Blanke, *et al.*, 2005). Access to these body-related brain areas may be impeded in those with a negative history of own body experience (e.g., former eating disorder) and be facilitated in those with a positive history of own body experience (e.g., artistic bodily expression such as in dance). Indeed, people with current and former eating disorder reported heightened distortions of body image when compared with controls (Bardone-Cone, Harney, Maldonado, Lawson, Robinson, Smith, *et al.*, 2010). Exercise (Furnham, Titman, & Sleeman, 1994), including creative dance, has been found to improve adults' body image and esteem (Lewis & Scannell, 1995; Langdon & Petracca, 2010). However this relationship is not necessarily observed for elite exercisers, including dancers (Hulley & Hill, 2001; Heiland, Murray, & Edley, 2008; Pollatou, Bakali, Theodorakis, & Goudas, 2010), or those who begin dance traning, particularly ballet, early in life (Bettle, Bettle, Neumarker, & Neumarker, 2001). Despite some of these inconsistencies, it appears that dance can enhance one's sense of embodiment (Block & Kissell, 2001), and has been recommended for its benefits to body image in dance and movement therapy contexts (Pylvanainen, 2003).

Because own body experience might influence mental bodily perspective taking, we investigated whether individuals with a history of a former eating disorder would perform worse in the 3PP task than individuals without such a history. Moreover, because dance experience might positively affect one's own body experience, the negative impact of a former eating disorder might be counteracted through dance. We tested these predictions by questioning women with and without a former eating disorder history with half in each group having dance experience. We assessed an additional group of control exercisers with no eating disorder history and no dance experience to account for specificity of dance, because regular exercise can also have positive (Campbell & Hausenblas, 2009) and negative (de Bruin, Woertman, Bakker, & Oudejans, 2009) effects on body processing.

To summarize expected findings; individuals with an eating disorder history yield relatively impaired performance (slower reaction times) in mental bodily perspective taking when compared to individuals without an eating disorder history. This relative disadvantage should be counteracted by dance experience. These predictions concern the widely used 3PP task, because performance in this task targets self-other or self-space processing (e.g., Lorey, Bischoff, Pilgramm, Stark, Munzert, & Zentgraf, *et al.*, 2009). As an additional (control) task, we performed a 1st person perspective-taking task (1PP task) in which we showed the same stimuli, but asked the participant to treat the figures as if the respective picture was the reflection of one's self in a mirror (Mohr, *et al.*, 2010). Performance in these two tasks has been dissociated electrophysiologically as well as behaviourally (Arzy, Thut, Mohr, Michel, & Blanke, 2006; Mohr, *et al.*, 2010). Thus, we could expect that findings observed for the 3PP task are not observed for the 1PP task. On the other hand, given the possibility that both eating disorder (body checking; Delinsky & Wilson, 2006; Vocks, Wachter, Wucherer, & Kosfelder, 2008) and dance (training in front of mirrors) might associate with an elevated exposure to mirrors, both factors might be important to performance in the 1PP task, for instance through relatively faster reaction times.

Method

Participants

Through local advertisements (e.g., flyers, e-mails, local internet portals) we invited women who had (i) recovered from an eating disorder (henceforth Eating Disorder-positive, ED-pos) or never had an eating disorder (Eating Disorder-negative, ED-neg), (ii) danced (dancer) or did not dance regularly (non-dancer), and (iii) exercised (exerciser) or did not exercise regularly (non-exerciser). We were able to recruit 23 individuals into the ED-pos group (10 dancers, 13 non-dancers) and 61 individuals into the ED-neg group (21 dancers, 20 non-exercisers, 20 exercisers). Participants' mean age was 20 years (range 18–46 years). The study was approved by the local ethics committee. All women provided written, informed consent prior study inclusion.

The dancers had at least 2 years of regular formal dance training, with no other regular, formal exercise. Twenty-nine practiced a range of dance styles, but four focused on one dance style (one dancer performed only ballet, one dancer Irish dance, and two dancers contemporary dance). The length of dance experience ranged from 2 to 26 years (average 12 years). Weekly regular dance training ranged from 1-40 hours (average 3 hours). The exercisers had at least 2 years of regular exercise training (but no dance training). Seventeen of the 20 exercisers practiced a variety of exercise types. Three exercisers practiced only one type (one rower, one swimmer, one attending the gym). Length of exercise experience ranged from 2 to 20 years (average 12 years). Weekly regular exercise training ranged from 2 to 12 hours (average 4 hours). The controls (non-exercisers) consisted of individuals who did not exercise, did not regularly dance or engage in any other formal physical exercise.

Assuming that participants can remember a former illness they have been diagnosed with and recovered from (see also Walsh, McDowall, & Grimshaw, 2010), we asked individuals in the ED-pos group about the time since subjectively having recovered from the eating disorder (in months) and the kind of disorder they had been diagnosed with before recovery was assessed. Sixteen of the 23 women had suffered from anorexia, five from bulimia and one from an eating disorder not otherwise specified. The length of disorder ranged from 0.5 to 10 years (average 3.7 years), 12 had been clinically treated for their eating disorder, six had received counselling, two received psychoactive drugs, and six received hospital care. Length of subjective recovery from the eating disorder ranged from 1 to 12 years (average 4.2 years).

Self-report questionnaires

The 44-item Body Attitudes Questionnaire (BAQ; Ben-Tovim & Walker, 1991) assesses body image. For each item, participants indicated their agreement on a 5-point Likert-type scale (1 = Strongly agree to 5 = Strongly disagree). Scores range between 44 and 220 with higher scores indicating more negative body attitudes. Example questions included "I get so worried about my shape I feel I should go on a diet" and "I couldn't join in games and sports because of my shape." The scale has good test-retest reliability and internal consistency (Ben-Tovim & Walker, 1991; Liggett, Burwitz, & Grogan, 2002) with normative values being available (Ben-Tovim & Walker, 1991).

The 33-item Dutch Eating Behaviour Questionnaire (DEB–Q; van Strien, Frijters, Bergers, & Defares, 1986; van Strien, 2002) assesses eating behaviour. For each item, participants indicated their agreement on a 5-point Likert-type scale ranging from 1 = Never to 5 = Very often with an option for "not relevant." The DEB-Q consists of three separate scales, (i) emotional eating (13 items; e.g., "Do you have a desire to eat when you are irritated"?), (ii) restrained eating (10 items; e.g., "Do you try to eat less at mealtimes than you would like to eat?"), and (iii) external eating (10 items; e.g., "If food smells and looks good, do you eat more than usual?"). Thus, scores range between 0 and 65 for the emotional eating scale, between 0 and 50 for the restrained eating scale, and between 0 and 50 for the external eating scale, with higher scores indicating more "problematic" eating behaviour. The scales display good internal consistency and factorial validity (van Strien, *et al.*, 1986; van Strien, Herman, Engels, Larsen, & van Leeuwe, 2007) with normative values being available (Wardle, 1987).

Handedness (Oldfield, 1971).—This widely used 10-item scale asks about preferred hand use (left, right, either). We gave each right-hand preference a score of 1, each either-hand preference a score of 0.5, and each left-hand preference a score of 0. We calculated the mean of the sum of these scores, and defined as right-handed those participants who scored greater than or equal to 7.5 and those as non right-handed who scored less than 7.5 (see also Kita, de Condappa, & Mohr, 2007).

Perspective-taking task

Stimuli.—The four female and four male figures faced either toward or away from the participant, and

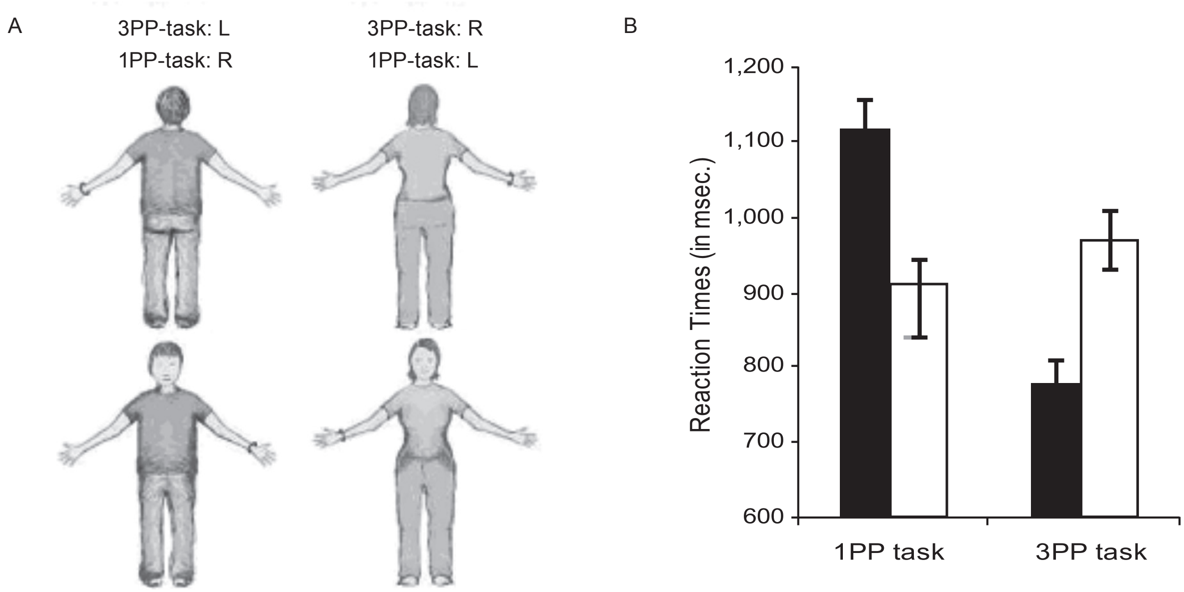

Fig. 1. A) Example of four (out of eight possible) figures used in the mental bodily perspective-taking tasks. One hand is indicated by a black bracelet around the wrist. The correct answers are indicated with letters (R = right; L = left) for the 3PP task and 1PP task. B) Mean reaction times for back-facing (■) and front-facing (□) figures in the 1PP task and 3PP task (vertical bars denote ± 1SE).

have been used for related studies (Mohr, *et al.*, 2010; Mohr, *et al.*, in press). Front- and back-facing figures had the same outline, and differed only in the rendering of the clothing of the figure, its shape (female, male) and the presence of a face (front-facing) or the back of a head (back-facing, Fig. 1A). One of the figures' hands was marked with a bracelet around the wrist on either the right or left hand (Fig. 1A).

Procedure.—The participants judged whether the bracelet was on their right or their left hand when imagining themselves in the figure's position (3PP task) or when imagining the figure to be their reflection in a mirror (1PP task; Arzy, *et al.*, 2006; Easton, *et al.*, 2009; Mohr, *et al.*, 2010). Participants made these right-left judgements about the figures (Fig. 1A) which were presented sequentially in the centre of a computer screen (5.0° × 6.1° of visual angle) until a response was provided. Right-left responses were indicated by a button press on a keyboard. Left judgments (L, Fig. 1) were indicated by a button press of the left index finger on the left SHIFT key, and right judgments (R, Fig. 1) by a button press of the right index finger on the right SHIFT key. The inter-trial interval was 1,000 msec. Participants were instructed to respond as quickly and precisely as possible, whilst continuing to respond accurately. Half of the participants in each group started with the 3PP task, and the remaining half with the 1PP task. In the 3PP task and the 1PP task, each stimulus was presented 10 times in a randomised order, so each experimental block consisted of a total of 80 trials. For both task conditions, we calculated the percentage of correct responses as well as mean reaction times for correct responses separately for the task conditions that required no additional spatial transformation (front-facing figures in the 1PP task and back-facing figures in the 3PP task) and those that required an additional spatial transformation (back-facing figures in the 1PP task and front-facing figures in the 3PP task). Response latencies faster than 200 msec. and slower than 5,000 msec. were not included in the analysis (Harris, Harris, & Caine, 2002). After verbal and written instructions, the participants first performed 10 practice trials for each task condition before commencing the experiment. Each testing session lasted approximately 30–45 minutes.

Statistical analyses

One individual in the ED-pos group (non-dancer) was unable to complete the 1PP task. The data for the 1PP task of three additional participants were excluded because of low performance: one individual in the ED-pos group (non-dancer) appeared to continue with the task strategy required to perform the 3PP task (only 19 correct trials of a maximum of 80 trials). Two additional individuals (ED-neg: one dancer, one non-exerciser) showed a performance that was close to chance (40 trials) level (42 and 58 correct trials, respectively). Of the remaining participants, the mean number of correct responses was close to ceiling with 76.6 ($SD = 2.79$, range 67–80) for the 1PP task and 77.64 ($SD = 2.60$, range 68–80) for the 3PP task.

We performed two repeated measures ANOVAs on mean reaction times for correct responses with task (3PP task, 1PP task), figure sex (men, women), and body position (front-facing, back-facing) as repeated measures and (1) ED group (ED-pos, ED-neg) and Dance group (dancer, non-dancer) as between-subjects factors, and (2) physical activity group (all individuals in the ED-neg group: dancer, exerciser, non-exerciser) as between-subjects factors. This second analysis of variance (ANOVA) tested for the role of general body activity on task performance. Effect sizes (partial eta squared, η^2_p) of significant main effects and interactions are reported. *Post hoc* comparisons were performed using Neumann-Keuls tests. All p values are two-tailed, and the significance level was set to alpha = .05.

Results

Participants

The ANOVA with ED group (ED-pos, ED-neg) and Dance group (dancer, non-dancer) as between-subjects measures on age (in years) showed a significant main effect of ED group ($F_{1,63} = 6.03$, $p = .02$; $\eta^2_p = 0.09$) with the ED-pos group being older on average than the ED-neg group (Table 1). The main effect of Dance group ($F_{1,63} = 2.39$, $p = .13$; $\eta^2_p = 0.04$), and the interaction ($F_{1,63} = 1.32$, $p = .26$; $\eta^2_p = 0.02$) were not significant. The ANOVA on the ED-neg group with physical activity group (dancer, non-exerciser, exerciser) as between-subjects factors on age showed a significant main effect of physical activity group ($F_{2,58} = 5.36$, $p = .007$; $\eta^2_p = 0.16$). *Post hoc* comparisons showed that exercisers were older than dancers ($p = .01$) and non-exercisers ($p = .01$) with the dancers and non-exercisers being of comparable age ($p = .76$, Table 1). We do not assume these age differences to importantly influence the results, because body image and body dissatisfaction are reported to remain stable across adulthood (Ben-Tovim & Walker, 1991; McLaren & Kuh, 2004). Moreover, Spearman correlations between age and RTs in the 1PP task and 3PP task (age was not normally distributed) were not significant (all $r_s < .20$, all $p > .30$).

Of the 84 participants, 68 were right-handed (19 individuals in the ED-pos group and 16 were non right-handed (4 individuals in the ED-pos group; $\chi^2_1 = .06$, $p = .81$). When taking the exercise group into account, 28 of the dancers were right-handed (out of 31), 27 of the non-dancers were right-handers (out of 33), and 13 of the exercisers were right-handed (out of 20; $\chi^2_2 = 5.08$, $p = .08$).

TABLE 1

Self-report questionnaire scores overall, for the Eating Disorder groups and Dance groups separately and in interaction

Dance	Group	*n*	Age		BAQ		RE		EE		ExE	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Yes	ED-pos	10	22.6	6.0	145.5	15.8	3.7	0.7	3.1	0.7	3.3	0.5
	ED-neg	21	21.0	2.3	112.4	19.2	2.5	1.0	2.4	0.7	3.6	0.5
	All	31	21.5	3.9	123.1	23.9	2.9	1.1	2.6	0.7	3.5	0.5
No	ED-pos	13	26.0	8.3	140.7	21.4	3.3	0.9	3.1	0.9	3.3	0.8
	ED-neg	20	21.5	2.6	118.5	21.0	2.8	0.8	2.6	0.9	3.4	0.5
	All	33	23.2	5.9	127.2	23.6	3.0	0.9	2.8	0.9	3.3	0.6
All	ED-pos	23	24.5	7.5	142.8	18.9	3.5	0.8	3.1	0.8	3.3	0.7
	ED-neg	41	21.2	2.4	115.3	20.1	2.6	0.9	2.5	0.8	3.5	0.5
	All	64	22.4	5.1	125.2	23.6	2.9	1.0	2.7	0.8	3.4	0.6
Exercisers		20	25.8	8.3	127.2	14.9	3.0	0.8	3.3	2.5	3.4	0.6

Note Information on the separate group of exercisers (all individuals ED-neg) is also presented. ED-neg: Eating Disorder-negative, BAQ: Body Attitude Questionnaire scores, RE: Restrained Eating scores, EE: Emotional Eating scores, ExE: External Eating scores.

Participants and Self-report Questionnaires

The ANOVAs with ED group (ED-pos, ED-neg) and Dance group (dancer, non-dancer) as between-subject measure on BAQ scores showed a significant main effect for ED group ($F_{1,63}=28.51$, $p<.0001$; $\eta^2_p=0.32$), with the ED-pos group having higher BAQ scores than the ED-neg group (main effect Dance group, $F_{1,63}=.02$, $p=.90$; $\eta^2_p=0.00$; interaction of ED group and Dance group, $F_{1,63}=1.10$, $p=.30$; $\eta^2_p=0.02$, Table 1). The comparable ANOVA on restrained eating scores showed a significant main effect for ED group ($F_{1,63}=15.54$, $p<.0001$; $\eta^2_p=0.21$), with the ED-pos group reporting higher restrained eating scores than the ED-neg group (main effect Dance group ($F_{1,63}=.16$, $p=.69$; $\eta^2_p=0.00$), interaction ED group × Dance group, $F_{1,63}=2.31$, $p=.13$; $\eta^2_p=0.04$, Table 1). The comparable ANOVA on emotional eating scores showed only a significant main effect for ED group ($F_{1,63}=7.12$, $p=.01$; $\eta^2_p=0.11$), with the ED-pos group reporting higher emotional eating than the ED-neg group (main effect Dance group, $F_{1,63}=.35$, $p=.56$; $\eta^2_p=0.01$, interaction ED group × Dance group, $F_{1,63}=.30$, $p=.59$; $\eta^2_p=0.01$, Table 1). Finally, the comparable ANOVA on external eating scores showed no significant main effects (ED group, $F_{1,63}=2.04$; $p=.16$, $\eta^2_p=0.03$, Dance group, $F_{1,63}=1.17$, $p=.28$; $\eta^2_p=0.02$), or interaction (ED group × Dance group, $F_{1,63}=.57$, $p=.45$; $\eta^2_p=0.01$; Table 1).

The ANOVA with physical activity group (dancer, non-exerciser, exerciser) as between-subject measure on BAQ scores in ED-neg participants was significant ($F_{2,58}=3.29$, $p=.04$; $\eta^2_p=0.10$). *Post hoc* comparisons showed that the exercisers had higher BAQ scores than the dancers ($p=.04$; comparison with non-exercisers $p=.14$). The non-exercisers and dancers did not significantly differ in BAQ scores ($p=.30$, Table 2). The comparable ANOVAs on restrained eating ($F_{2,58}=1.60$, $p=.21$; $\eta^2_p=0.05$), emotional eating ($F_{2,58}=2.12$, $p=.13$; $\eta^2_p=0.07$), and external eating ($F_{2,58}=1.50$, $p=.23$; $\eta^2_p=0.05$) were not significant (Table 2).

Performance, ED History, and Dance Experience

The ANOVA on reaction times with Task, Figures' Sex, and Body Position as within-subject measures and ED group (ED-pos, ED-neg) and Dance group (dancer, non-dancer) as between-subjects factors showed the following significant findings. Firstly, the main effect for Task ($F_{1,56}=28.43$, $p<.0001$, $\eta^2_p=0.34$) showed that reaction times were faster for the 3PP task ($M=874.9$, $SD=264.2$) than 1PP task ($M=1{,}009.9$, $SD=266.9$). Secondly, the main effect for Dance group ($F_{1,56}=7.10$, $p=.01$, $\eta^2_p=0.11$) showed that dancers performed the tasks faster ($M=864.6$, $SD=168.1$) than non-dancers ($M=1{,}020.2$, $SD=290.3$). Thirdly, the interactions Task × Body Position ($F_{1,56}=139.50$, $p<.0001$; $\eta^2_p=0.71$,)

TABLE 2

Self-report questionnaire scores for the three study groups separately

Group	*n*	BAQ		RE		EE		ExE	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Dancers	21	112.4	19.2	2.5	1.0	2.4	0.7	3.7	0.5
Non-exercisers	20	118.5	21.0	2.8	0.8	2.6	0.9	3.4	0.5
Exercisers	20	127.2	14.9	3.0	0.8	3.3	2.5	3.4	0.6
All	61	119.2	19.3	2.7	0.8	2.8	1.6	3.5	0.5

Note All participants are ED-neg. BAQ: Body Attitude Questionnaire scores, RE: Restrained Eating scores, EE: Emotional Eating scores, ExE: External Eating scores.

and Task × ED group × Dance group ($F_{1,56}=6.89$, $p=.01$, $\eta^2_p=0.11$), were significant. The remaining comparisons were not significant with F values < 2.7 and all p values > .11. *Post hoc* comparisons on the significant two-way interaction were all significant showing that front-facing positions took longer than back-facing figures in the 3PP task ($p=.0001$) and back-facing positions took longer than front-facing figures in the 1PP task ($p=.0001$). Moreover, front-facing positions took longer in the 3PP task than in the 1PP task ($p=.01$), and back-facing positions took longer in the 1PP task than 3PP task ($p=.0002$; Fig. 1B).

In order to explore the significant three-way interaction, we performed separate ANOVAs with task as a repeated measure and ED group as a between-subjects factor for dancers and non-dancers separately. The ANOVA for dancers showed the significant main effect for task ($F_{1,28}=16.75$, $p=.0003$; $\eta^2_p=0.37$) that is explained above (see also Fig. 2). The remaining comparisons were not significant, all F values < 2.0. The ANOVA for non-dancers again showed the significant main effect for task ($F_{1,28}=11.30$, $p=.002$; $\eta^2_p=0.29$) together with a significant interaction between task and ED group ($F_{1,28}=7.31$, $p=.01$; $\eta^2_p=0.21$). *Post hoc* comparisons indicated that ED-neg individuals showed the 3PP task over 1PP task advantage ($p=.0003$), while Individuals in the ED-pos group were comparably slow in both tasks ($p=.65$; Fig. 2). All other comparisons were not significant (all ps > .10).

The ANOVA with physical activity group (dancers,

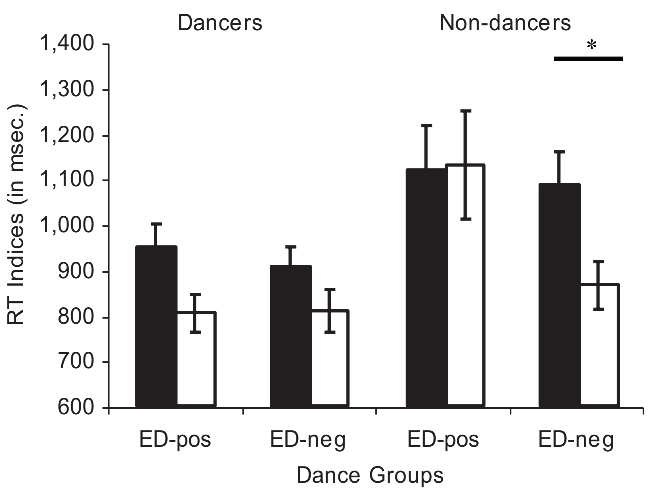

Fig. 2. Mean reaction times for dancers and non-dancers in the 1PP task (■) and 3PP task (□) for individuals Eating Disorder-positive (ED) and -negative (ED-neg). Horizontal bars with a star denote significant differences between sub-groups, and vertical bars denote ±1 *SE*. Although significant, we did not depict the main effects for TASK (reaction times being faster for the 3PP task as compared to the 1PP task) which were significant for the group of dancers as well as for the group of non-dancers.

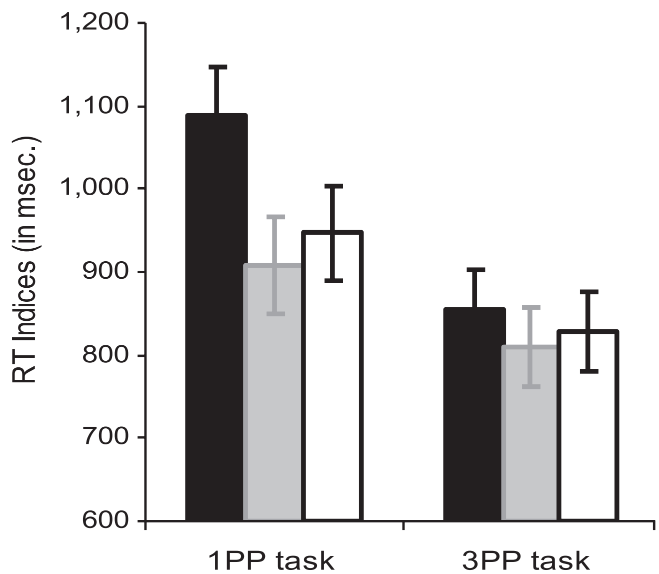

Fig. 3. Mean reaction times in the 1PP task and 3PP task for dancers (■), exercisers (□), and non-exercisers (■) (all participants are ED-neg). Vertical bars denote ±1.

non-exercisers, exercisers) as between-subject measure on reaction time in the 1PP task and 3PP task (all individuals in the ED-neg group) again showed the significant main effect of task ($F_{2,56}=36.49$, $p<.001$; $\eta^2_p=0.40$; where reaction time was slower in 1PP than 3PP task, see details above, but no significant main effect for physical activity group ($F_{2,56}=1.41$, $p=.25$; $\eta^2_p=05$). The interaction was not significant but the effect size potentially suggests a relationship that should be investigated by further studies ($F_{2,56}=2.83$, $p=.07$; $\eta^2_p=0.09$). As shown by post-hoc comparisons, reaction times were slower in the 1PP than 3PP in non-exercisers ($p=.0002$) and exercisers ($p=.04$), but not in dancers ($p=.11$). The three groups did not differ from each other in their performance in the 3PP task (all ps > .70), but in the 1PP task, the non-exercisers performed slower than the dancers ($p=.05$) and tended to perform slower than the exercisers ($p=.07$) with comparable performance between the dancers and exercisers ($p=.61$). These results should be considered for future research explicitly testing these relationships with greater statistical power.

Discussion

Mental bodily perspective taking has been studied in various contexts such as mental rotation in neuropsychological (Ratcliff, 1979) and healthy (Zacks, *et al.*, 1999) populations, to assess the cognitive correlates of out-of-body experiences (Blanke, *et al.*, 2005; Easton, *et al.*, 2009; Braithwaite, *et al.*, 2011) and schizotypy (Mohr, *et al.*, 2006; Easton, *et al.*, 2009), to evaluate learning (Bailey, *et al.*, 2007), to test for social perspective taking (Thakkar, *et al.*, 2009; Mohr, *et al.*, 2010; Gronholm, *et al.*, 2012; Mohr, *et al.*, in press), embodiment (Gardner & Potts, 2010; Marzoli, *et al.*, 2011) and spatial compatibility effects (Gardner & Potts, 2011). In the present study, we suggested that own-body experience is another major variable that can influence our ability for mental bodily perspective taking. In particular, we argued that a history of eating disorder should negatively affect performance in the 3PP task because a current eating disorder (Bardone-Cone, *et al.*, 2010) or former eating disorder (Bardone-Cone, *et al.*, 2010) are associated with impaired body processing. Dance experience, on the other hand, should have a beneficial effect (Block & Kissell, 2001; Langdon & Petracca, 2010; Pylvanainen, 2003), at least in non-elite performers (Heiland, *et al.*, 2008; Hulley & Hill, 2001; Pollatou, *et al.*, 2010), potentially counteracting the negative effect a former eating disorder has on mental bodily perspective taking.

Irrespective of dance and history of eating disorder, we replicated previous studies showing that participants responded faster for figures matching their own body position. Participants performed better when figures required no additional mental bodily transformation (front-facing figures in the 1PP task and back-facing figures in the 3PP task) as compared to those requiring an additional mental bodily transformation (back-facing figures in the 1PP task and front-facing figures in the 3PP task) (Blanke, *et al.*, 2005; Easton, *et al.*, 2009; Mohr, *et al.*, 2006; Mohr, *et al.*, 2010; Zacks, *et al.*, 1999). These overall findings are in agreement with previous reports regarding the mental rotation of objects (Shepard & Metzler, 1971; Wohlschläger & Wohlschläger, 1998), body parts (Bonda, *et al.*, 1995; Kosslyn, *et al.*, 1998), and perspective-taking tasks (Kaiser, Walther, Nenning, Kronmuller, Mundt, Weisbrod, *et al.*, 2008; Rilea, 2008): reaction times are longer when the position of a stimulus (or own-body position) does not match that of the target stimulus.

Most importantly, we found that dancers made correct responses faster than non-dancers, but that this difference was modulated by the task performed and individuals' eating disorder history. When considering task performance for dancers and non-dancers separately, we found that dancers performed the 3PP task faster than the 1PP task, irrespective of their eating disorder history. When non-dancers were considered, we again found that these individuals performed the 3PP task faster than the 1PP task, but that this was only the case for the ED-neg group. In fact, the ED-pos group performed both tasks equally slowly, i.e. they did not show a 3PP task over 1PP task advantage. These findings suggest that the ED-pos dancers performed similarly to ED-neg dancers and ED-neg non-dancers, at least in the 3PP task. ED-pos non-dancers, on the other hand, performed slowly in the 3PP task, so their performance was comparable to that of the 1PP task. In sum, these findings support the hypothesis that task performance in the mental bodily perspective-taking task is modulated by own-body experience (dance and eating disorder), and that this modulation is more pertinent for the 3PP task than the 1PP task.

This conclusion leads us to the comparisons using the exerciser group. This group was added to delineate whether there was a specific benefit from dance to mental bodily perspective taking versus other forms of exercise. When performance in the 1PP task and 3PP task was analysed in the ED-neg group, we replicated the findings that dancers performed equally fast in the 1PP task and 3PP task, but non-exercisers and exercisers performed worse (had longer reaction times) in the 1PP task than 3PP task. Moreover, these exercisers had higher BAQ scores than dancers. Results indicated that performance in the 1PP task was slowest for non-exercisers followed by exercisers, and finally dancers. It must be noted, however, that only the effect size between dancers and non-exercisers was fairly large ($\eta^2_p = 0.11$), while the effect sizes between dancers and exercisers ($\eta^2_p = 0.008$) and exercisers and non-exercisers ($\eta^2_p = 0.06$) were minor (non-significant in both cases).

The most important aspect of the present findings that needs to be explained is the difference in the modulation of former eating disorder history and dance on 3PP task, but not 1PP task performance. We formulated specific predictions regarding the 3PP task which were largely supported in the present study. We were less clear with regard to the 1PP task, but considered that the different cognitive strategies required to solve the task might be informative. While the self is compared to another figure in the 3PP task, the self is compared with the depiction of the self in the 1PP task. Evidence for different processing networks (and by inference different cognitions) in the two tasks has been found in a recent evoked-potential study in which the location and timing of brain activation showed that self-location and embodiment (1PP task) engages the extrastriate body area (also known as EBA), while spatial perspective taking and disembodiment engages the temporo-parietal junction (also known as TPJ; Arzy, *et al.*, 2006; see also Lorey, *et al.*, 2009). Moreover, social aspects of perspective taking (self-reported empathy) related to performance in the 3PP task, but not to performance in the 1PP task, at least in women (Mohr, *et al.*, 2010; Thakkar & Park, 2010; Gronholm, *et al.*, 2012). It is therefore suggested that the neuronal network and associated cognitions that are important to performance in the 3PP task are modulated by experience with dance and eating disorder histories, while this is less pronounced for performance in the 1PP task. We suggest that self-other distinction in the 3PP task and motor and proprioceptive information in the 1PP task (Lorey, *et al.*, 2009) are crucial to explain this dissociation (see also Marzoli, *et al.*, 2011).

As indicated above, the 3PP task has been linked to social aspects of perspective taking. If one is willing to accept a link between different forms of perspective taking (Blair, 2005) including the present 3PP task as a measure of social perspective taking (Mohr, *et al.*, 2010; Thakkar & Park, 2010; Gronholm, *et al.*, 2012; Mohr, *et al.*, in press), one could infer that an eating disorder history is associated with inferior social-perspective taking, while dance should enhance these abilities. While there are few published reports, problems with social interactions ("empathy-disorders"; Nilsson, Gillberg, Gillberg, & Rastam, 1999), recognition of emotional social cues (faces, voices; Kucharska-Pietura, Nikolaou, Masiak, & Treasure, 2004), inward directed self-focus (Ball & Lee, 2002), and unfavourable attachment experiences and activities (being dismissive; Ward, Ramsay, Turnbull, Steel, Steele, & Treasure, 2001) have been shown to be higher in eating disorder sufferers than in controls. Because similar deficits in individuals with an eating disorder were absent for the cognitive aspect of perspective taking (theory of mind; Tchanturia, Happe, Godley, Treasure, Bara-Carril, & Schmidt, 2004), we suggest that the interpersonal aspects of our 3PP task were crucial to our finding that ED-pos non-dancers showed no significant performance benefit in the 3PP task. Because ED-pos dancers performed comparably to controls, we consider that our findings support independent reports that social-perspective taking (empathy) might be facilitated through dance and vice versa (Bachner-Melman, Dina, Zohar, Constantini, Lerer, Hoch, *et al.*, 2005; Berrol, 2006). Possibly, this facilitation is mediated through the affective and communicative aspects of dance (Camurri, Lagerlöf, & Volpe, 2003) in space (Brown, Martinez, & Parsons, 2006), potentially mediated by the TPJ (Arzy, *et al.*, 2006; Decety & Lamm, 2007).

Explanations for findings on the 1PP task are less evident. Whether individuals had an eating disorder or not was not related to task performance. This indicates that the neuronal networks and related cognitions of the 1PP task are not affected by an eating disorder history. From a phenomenological point of view, one could consider this to be surprising. Individuals with high as compared to low body shape concerns check their body more frequently, including observing themselves in mirrors (Farrell, Shafran, & Fairburn, 2004; see Reas, Whisenhunt, Netemeyer, & Williamson, 2002, for eating disorder individuals), although avoidant behaviour has been noted as well (Farrell, *et al.*, 2004). Critical and high amounts of body checking in front of mirrors can transiently induce feelings of fatness and an increase in the strength of body-related self-critical thinking in individuals from the general population (Shafran, Lee, Payne, & Fairburn, 2007). Moreover, body image therapies put people with eating disorders in front of mirrors in order for them to acquire a more realistic and positive body image (Delinsky & Wilson, 2006; Vocks, *et al.*, 2008), an improvement that might be partially mediated by an increase in EBA activity pre- to post-treatment (Vocks, Busch, Schulte, Gronermeyer, Herpertz, & Suchan, 2010). This association of EBA activity when matching self reflections is in line with the role of the EBA in the 1PP task (Arzy, *et al.*, 2006). Whether individuals in the ED-pos group might differ in their 1PP task performance after a body image therapy is a question for future studies. This study found no particular advantage or disadvantage in the 1PP task for ED-pos participants compared with the other study groups, despite higher BAQ, restrained, and emotional eating scores. A reduced self-focus might improve these scores (Ball & Lee, 2002), and by inference improved 1PP task performance, potentially mediated by EBA activity (Vocks, *et al.*, 2010).

In conclusion, we found that body training and experience is significantly related to performance in the 3PP task but not in the 1PP task. ED-pos dancers did not perform differently in the 3PP task as compared to the ED-neg group (dancers as well as non-dancers). It was ED non-dancers who showed poorest performance (slow reaction times) in the 3PP task. These findings support the notion that negative body experience impairs bodily perspective taking, while positive body experience might counteract these negative effects. These findings can only be inferred for the 3PP task, presumably due to its interpersonal, creative, and spatially engaging nature. This latter proposition is further supported by the observation that dancers seemed to perform particularly well in these perspective-taking tasks (including the 1PP task) when compared to exercisers and non-exercisers. The artistic aspects of dance might facilitate own-body processing as well as own processing in space and interaction with others (Calvo-Merino, Glaser, Grezes, Passingham, & Haggard, 2005; Knoblich & Sebanz, 2006). We argued that these 3PP task deficits and benefits related with ED and dance, respectively, might be mediated by the TPJ, while the lack of differences in the 1PP task might be mediated via the EBA. If this is the case, future studies might find that body image therapy will also yield group differences for the 1PP task.

This latter suggestion in mind, the current study suffers from some obvious limitations such as small sample sizes (in particular in the ED-pos groups) and a lack of details on the medical records of the individuals in the ED-pos group. Future studies would also benefit from the testing of more homogenous dance (e.g., modern dance versus ballet) (Langdon & Petracca, 2010; Lewis & Scannell, 1995) and exercising (e.g., interactive sports like tennis versus running) groups as well as groups of individuals in the ED-pos group who do not dance but perform other forms of exercise. Finally, we do not know of the amount of time dancers train in front of mirrors and whether any benefit of dance may be mediated via visual and/or motor processes. Despite these shortcomings, we nevertheless argue that the present study provides relevant results regarding body and self processing, and the current paradigm can yield provocative information in body image and eating disorder research. Obviously, clinicians would have the more sophisticated opportunity to also account for different eating disorder diagnosis (e.g., contrasting anorexia, bulimia, eating disorder not otherwise specified, and others). Such studies would help to further our understanding of body experience on self-other differentiation or mere self perspectives.

References

Arzy, S., Thut, G., Mohr, C., Michel, C. M., & Blanke, O. (2006) Neural basis of embodiment: distinct contributions of temporoparietal junction and extrastriate body area. *Journal of Neuroscience*, 26(31), 8074-8081.

Bachner-Melman, R., Dina, C., Zohar, A. H., Constantini, N., Lerer, E., Hoch, S., Sella, S., Nemanov, L., Gritsenko, I., Lichtenberg, P., Granot, R., & Ebstein, R. P. (2005) AVPR1a and SLC6A4 gene polymorphisms are associated with creative dance performance. *PLoS Genetics*, 1(3), e42.

Bailey, J. E., Papadopoulos, A., Lingford-Hughes, A., & Nutt, D. J. (2007) D-cycloserine and performance under different states of anxiety in healthy volunteers. *Psychopharmacology*, 193(4), 579-585.

Ball, K., & Lee, C. (2002) Psychological stress, coping, and symptoms of disordered eating in a community sample of young Australian women. *International Journal of Eating Disorders*, 31(1), 71-81.

Bardone-Cone, A. M., Harney, M. B., Maldonado, C. R., Lawson, M. A., Robinson, D. P., Smith, R., & Tosh, A. (2010) Defining recovery from an eating disorder: conceptualization, validation, and examination of psychosocial functioning and psychiatric comorbidity. *Behaviour Research and Therapy*, 48(3), 194-202.

Ben-Tovim, D. I., & Walker, M. K. (1991) The development of the Ben-Tovim Walker Body Attitudes Questionnaire (BAQ): a new measure of women's attitudes towards their own bodies. *Psychological Medicine*, 21(3), 775-784.

Berrol, C. F. (2006) Neuroscience meets dance/movement therapy: mirror neurons, the therapeutic process and empathy. *Arts in Psychotherapy*, 33(4), 302-315.

Bettle, N., Bettle, O., Neumarker, U., & Neumarker, K. J. (2001) Body image and self-esteem in adolescent ballet dancers. *Perceptual and Motor Skills*, 93(1), 297-309.

Blair, R. J. (2005) Responding to the emotions of others: dissociating forms of empathy through the study of typical and psychiatric populations. *Consciousness and Cognition*, 14(4), 698-718.

Blanke, O., Mohr, C., Michel, C. M., Pascual-Leone, A., Brugger, P., Seeck, M., Landis, T., & Thut, G. (2005) Linking out-of-body experience and self processing to mental own-body imagery at the temporoparietal junction. *Journal of Neuroscience*, *25*(3), 550-557.

Block, B., & Kissell, J. L. (2001) The dance: essence of embodiment. *Theoretical Medicine and Bioethics*, 22(1), 5-15.

Bonda, E., Petrides, M., Frey, S., & Evans, A. (1995) Neural correlates of mental transformations of the body-in-space. *Proceedings of the National Academy of Sciences USA*, 92(24), 11,180-11,184.

Braithwaite, J. J., Samson, D., Apperly, I., Broglia, E., & Hulleman, J. (2011) Cognitive correlates of the spontaneous out-of-body experience (OBE) in the psychologically normal population: evidence for an increased role of temporal-lobe instability, body-distortion processing, and impairments in own-body transformations. *Cortex*, 47(7), 839-853.

Brown, S., Martinez, M. J., & Parsons, L. M. (2006) The neural basis of human dance. *Cerebral Cortex*, 16(8), 1157-1167.

Calvo-Merino, B., Glaser, D. E., Grezes, J., Passingham, R. E., & Haggard, P. (2005) Action observation and acquired motor skills: an fMRI study with expert dancers. *Cerebral Cortex*, 15(8), 1243-1249.

Campbell, A., & Hausenblas, H. A. (2009) Effects of exercise interventions on body image: a meta-analysis. *Journal of Health Psychology*, 14(6), 780-793.

Camurri, A., Lagerlöf, I., & Volpe, G. (2003) Recognizing emotion from dance movement: comparison of spectator recognition and automated techniques. *International Journal of Human-Computer Studies*, 59(1-2), 213-225.

de Bruin, A. P., Woertman, L., Bakker, F. C., & Oudejans, R. R. D. (2009) Weight-related sport motives and girls' body image, weight control behaviors, and self-esteem. *Sex Roles*, 60(9-10), 628-641.

Decety, J., & Lamm, C. (2007) The role of the right temporoparietal junction in social interaction: how low-level computational processes contribute to meta-cognition. *Neuroscientist*, 13(6), 580-593.

Delinsky, S. S., & Wilson, G. T. (2006) Mirror exposure for the treatment of body image disturbance. *International Journal of Eating Disorders*, 39(2), 108-116.

Easton, S., Blanke, O., & Mohr, C. (2009) A putative implication for fronto-parietal connectivity in out-of-body experiences. *Cortex*, 45, 216-227.

Farrell, C., Shafran, R., & Fairburn, C. G. (2004) Mirror cognitions and behaviours in people concerned about their body shape. *Behavioural and Cognitive Psychotherapy*, 32(2), 225-229.

Furnham, A., Titman, P., & Sleeman, E. (1994) Perception of female body shapes as a function of exercise. *Journal of Social Behavior and Personality*, 9(2), 335-352.

Gardner, M. R., & Potts, R. (2010) Hand dominance influences the processing of observed bodies. *Brain and Cognition*, 73(1), 35-40.

Gardner, M. R., & Potts, R. (2011) Domain general mechanisms account for imagined transformations of whole body perspective. *Acta Psychologica*, 137(3), 371-381.

Gronholm, P. C., Flynn, M., Edmonds, C. J., & Gardner, M. R. (2012) Empathic and non-empathic routes to visuospatial perspective-taking. *Consciousness and Cognition*, 21(1), 494-500.

Harris, I. M., Harris, J. A., & Caine, D. (2002) Mental-rotation deficits following damage to the right basal ganglia. *Neuropsychology*, 16, 524-537.

Heiland, T. L., Murray, D. S., & Edley, P. P. (2008) Body image of dancers in Los Angeles: the cult of slenderness and media influence among dance students. *Research in Dance Education*, 9(3), 257-275.

Hulley, A. J., & Hill, A. J. (2001) Eating disorders and health in elite women distance runners. *International Journal of Eating Disorders*, 30(3), 312-317.

Kaiser, S., Walther, S., Nennig, E., Kronmuller, K., Mundt, C., Weisbrod, M., Stippich, C., & Vogeley, K. (2008) Gender-specific strategy use and neural correlates in a spatial perspective-taking task. *Neuropsychologia*, 46(10), 2524-2531.

Kita, S., de Condappa, O., & Mohr, C. (2007) Metaphor explanation attenuates the right-hand preference for depictive co-speech gestures that imitate actions. *Brain and Language,* 101(3), 185-197.

Knoblich, G. N., & Sebanz, N. (2006) The social nature of perception and action. *Current Directions in Psychological Science,* 15(3), 99-104. DOI: 10.1111/j.0963-7214.2006.00415.x.

Kosslyn, S. M., Digirolamo, G. J., Thompson, W. L., & Alpert, N. M. (1998) Mental rotation of objects versus hands: neural mechanisms revealed by positron emission tomography. *Psychophysiology*, 35(2), 151-161.

Kucharska-Pietura, K., Nikolaou, V., Masiak, M., & Treasure, J. (2004) The recognition of emotion in the faces and voice of anorexia nervosa. *International Journal of Eating Disorders*, 35(1), 42-47.

Langdon, S. W., & Petracca, G. (2010) Tiny dancer: body image and dancer identity in female modern dancers. *Body Image,* 7(4), 360-363.

Lewis, R. N., & Scannell, E. D. (1995) Relationship of body image and creative dance movement. *Perceptual and Motor Skills,* 81, 155-160.

Liggett, G. R., Burwitz, L., & Grogan, S. (2002) Assessment of the body attitudes questionnaire. *Journal of Sports Sciences*, 20(1), 68.

Lorey, B., Bischoff, M., Pilgramm, S., Stark, R., Munzert, J., & Zentgraf, K. (2009) The embodied nature of motor imagery: the influence of posture and perspective. *Experimental Brain Research,* 194(2), 233-243.

Marzoli, D., Mitaritonna, A., Moretto, F., Carluccio, P., & Tommasi, L. (2011) The handedness of imagined bodies in action and the role of perspective taking. *Brain and Cognition*, 75(1), 51-59.

Mohr, C., Blanke, O., & Brugger, P. (2006) Perceptual aberrations impair mental own-body transformations. *Behavioral Neuroscience,* 120(3), 528-534.

Mohr, C., Rowe, A. C., & Blanke, O. (2010) The influence of sex and empathy on putting oneself in the shoes of others. *British Journal of Psychology,* 101(Pt. 2), 277-291.

Mohr, C., Rowe, A. C., Kurodawa, I., Denby, L., & Theodoridou, A. (in press) Bodily perspective taking goes social: The role of personal, interpersonal and intercultural factors. *Journal of Applied Social Psychology*.

Nilsson, E. W., Gillberg, C., Gillberg, I. C., & Rastam, M. (1999) Ten-year follow-up of adolescent-onset anorexia nervosa: personality disorders. *Journal of the American Academy of Child and Adolescent Psychiatry,* 38(11), 1389-1395.

Oldfield, R. C. (1971) The assessment and analysis of handedness: the Edinburgh inventory. *Neuropsychologia,* 9(1), 97-113.

Pollatou, E., Bakali, N., Theodorakis, Y., & Goudas, M. (2010) Body image in female professional and amateur dancers. *Research in Dance Education*, 11(2), 131-137.

Pylvanainen, P. (2003) Body image: a tripartite model for use in dance/movement therapy. *American Journal of Dance Therapy, 25*(1), 39-55.

Ratcliff, G. (1979) Spatial thought, mental rotation and the right cerebral hemisphere. *Neuropsychologia, 17*(1), 49-54.

Reas, D. L., Whisenhunt, B. L., Netemeyer, R., & Williamson, D. A. (2002) Development of the body checking questionnaire: a self-report measure of body checking behaviors. *International Journal of Eating Disorders*, 31(3), 324-333.

Rilea, S. L. (2008) A lateralization of function approach to sex differences in spatial ability: a reexamination. *Brain and Cognition,* 67(2), 168-182.

Shafran, R., Lee, M., Payne, E., & Fairburn, C. G. (2007) An experimental analysis of body checking. *Behaviour Research and Therapy,* 45(1), 113-121.

Shepard, R. N., & Metzler, J. (1971) Mental rotation of three-dimensional objects. *Science,* 171(972), 701-703.

Tchanturia, K., Happe, F., Godley, J., Treasure, J., Bara-Carril, N., & Schmidt, U. (2004) 'Theory of mind' in anorexia nervosa. *European Eating Disorders Review,* 12(6), 361-366.

Thakkar, K. N., Brugger, P., & Park, S. (2009) Exploring empathic space: correlates of perspective transformation ability and biases in spatial attention. *PLoS One,* 4(6), e5864.

Thakkar, K. N., & Park, S. (2010) Empathy, schizotypy, and visuospatial transformations. *Cognitive Neuropsychiatry,* 15(5), 477-500.

van Strien, T. (2002) *Dutch eating behaviour questionnaire*. London: Pearson.

van Strien, T., Frijters, J. E. R., Bergers, G. P. A., & Defares, P. B. (1986) The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders,* 5(2), 295-315.

van Strien, T., Herman, C. P., Engels, R. C. M. E., Larsen, J. K., & van Leeuwe, J. F. J. (2007) Construct validation of the Restraint Scale in normal-weight and overweight females. *Appetite,* 49(1), 109-121.

Vocks, S., Busch, M., Schulte, D., Gronermeyer, D., Herpertz, S., & Suchan, B. (2010) Effects of body image therapy on the activation of the extrastriate body area in anorexia nervosa: an fMRI study. *Psychiatry Research-Neuroimaging,* 183(2), 114-118.

Vocks, S., Wachter, A., Wucherer, M., & Kosfelder, J. (2008) Look at yourself: can body image therapy affect the cognitive and emotional response to seeing oneself in the mirror in eating disorders? *European Eating Disorders Review,* 16(2), 147-154.

Walsh, A., McDowall, J., & Grimshaw, G. M. (2010) Hemispheric specialization for emotional word processing is a function of SSRI responsiveness. *Brain and Cognition*, 74(3), 332-340.

Ward, A., Ramsay, R., Turnbull, S., Steele, M., Steele, H., & Treasure, J. (2001) Attachment in anorexia nervosa: a transgenerational perspective. *British Journal of Medical Psychology*, 74, 497-505.

Wardle, J. (1987) Eating style: a validation study of the Dutch eating behaviour questionnaire in normal subjects and women with eating disorders. *Journal of Psychosomatic Research*, 31(2), 161-169.

Wohlschläger, A., & Wohlschläger, A. (1998) Mental and manual rotation. *Journal of Experimental Psychology: Human Perception and Performance*, 24, 397-412.

Zacks, J. M., Rypma, B., Gabrieli, J. D., Tversky, B., & Glover, G. H. (1999) Imagined transformations of bodies: an fMRI investigation. *Neuropsychologia,* 37(9), 1029-1040.