



Dancing

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Akandere, M., & Demir, B. (2011). The effect of dance over depression. *Collegium Antropologicum*, 35(3), 651-656.

Dance and movement therapy are consisted of music, easy exercises and sensorial stimulus and provide drugless treatment for the depression on low rates. In this study, it has been aimed to examine the effect of dance over the depression. A total of 120 healthy male and female conservatory students ranged from 20 and 24 ages volunteered to participate in this study. They were divided randomly into 1 of 2 groups: dance training group (DTG; N = 60) and control group (CG; N = 60). A dance training program was applied to the subjects three days a week (Tuesday, Thursday, and Saturday) during 12 weeks. The subjects in the control group did not participate in the training and participated only in the pre and post test measurements. Beck Depression Scale was used for the pre and post test measurements of subjects. 12 weeks of dance training has been found to be effective on the depression levels of the subjects participating in the research as the training group ($p < 0.05$). The depression level of males and females before training has meaningfully decreased after 12 weeks of dance training ($p < 0.05$). When the depression levels of the subjects participated in research as the control group were separately evaluated for males and females, no meaningful change has been found in the depression levels during 12 weeks ($p > 0.05$). In conclusion, it has been seen that dance affects the depression levels of university students positively and decreases their depression levels.

Bernardi, N. F., Bellemare-Pepin, A., & Pertez, I. (2017). Enhancement of Pleasure during Spontaneous Dance. *Frontiers in Human Neuroscience*, 11, 572.

Dancing emphasizes the motor expression of emotional experiences. The bodily expression of emotions can modulate the subjective experience of emotions, as when adopting emotion-specific postures and faces. Thus, dancing potentially offers a ground for emotional coping through emotional enhancement and regulation. Here we investigated the emotional responses to music in individuals without any prior dance training while they either freely danced or refrained from movement. Participants were also tested while imitating their own dance movements but in the absence of music as a control condition. Emotional ratings and cardio-respiratory measures were collected following each condition. Dance movements were recorded using motion capture. We found that emotional valence was increased specifically during spontaneous dance of groovy excerpts, compared to both still listening and motor imitation. Furthermore, parasympathetic-related heart rate variability (HRV) increased during dance compared to motor imitation. Nevertheless, subjective and physiological arousal increased during movement production, regardless of whether participants were dancing or imitating. Significant correlations were found between inter-individual differences in the emotions experienced during dance and whole-body acceleration profiles. The combination of movement and music during dance results in a distinct state characterized by acutely heightened pleasure, which is of potential interest for the use of dance in therapeutic settings.

Berrol, C. F. (1992). The neurophysiologic basis of the mind-body connection in dance/movement therapy. *American Journal of Dance Therapy*, 14(1), 19-29.

As a healing art, dance/movement therapy is founded on the premise of the mind and body as a gestalt in which change in one of these domains produces corollary change in the other. This paper attempts to validate the efficacy of dance/movement therapy within the context of the mind-body paradigm. It focuses on neurophysiological factors, employing theoretical and empirical evidence. Various neurophysiologic principles are reviewed, such as brain function with respect to neural hook-ups and interactive associations, and neurotransmitters in relation to movement and affect. Examples are provided to illustrate the collaborative configuration of the brain in terms of human performance and behavior. Rhythm and movement are scrutinized with respect to neurophysiologic responses and in terms of their hypothesized capacity to: organize the individual and groups; promote healing; and, alter affect. Finally, intentional movement, a phenomenon upon which much of dance/movement therapy is predicated, is discussed from a neurophysiologic perspective.

Brauninger, I. (2016, February 10). "It can help substance abuse, PTSD, shyness, and more." Retrieved from <https://www.anxiety.org/what-is-dance-movement-therapy>

Brown, E. D., Garnett, M. L., Anderson, K. E., Laurenceau, J. (2016). Can the Arts Get Under the Skin? Arts and Cortisol for Economically Disadvantaged Children. *Child Development, 88*(4), 1368-1381.

This within-subjects experimental study investigated the influence of the arts on cortisol for economically disadvantaged children. Participants were 310 children, ages 3–5 years, who attended a Head Start preschool and were randomly assigned to participate in different schedules of arts and homeroom classes on different days of the week. Cortisol was sampled at morning baseline and after arts and homeroom classes on two different days at start, middle, and end of the year. For music, dance, and visual arts, grouped and separately, results of piecewise hierarchical linear modeling with time-varying predictors suggested cortisol was lower after an arts versus homeroom class at middle and end of the year but not start of the year. Implications concern the impact of arts on cortisol for children facing poverty risks.

Burgess, G., Grogan, S., & Burwitz, L. (2005). Effects of a 6-week aerobic dance intervention on body image and physical self-perceptions in adolescent girls. *Body Image, 3*(1), 57-66.

Research examining the impact of physical activity on body image dissatisfaction and physical self-perceptions has been both limited and equivocal. The current research investigated the effects of 6-week aerobic dance on these variables with 50 British schoolgirls aged 13-14 years. A cross-over design was used with two equivalent groups taught normal physical education and aerobic dance in a different order. The Body Attitude Questionnaire (BAQ) and Children and Youth Physical Self-Perception Profile (CY-PSPP) were administered as pre, mid and post-test to each participant in each group before the first intervention, at the change over and after 12 weeks. The results of this study revealed that participation in 6 weeks of aerobic dance significantly reduced body image dissatisfaction (Attractiveness, Feeling Fat, Salience and Strength and Fitness) and enhanced physical self-perceptions (Body Attractiveness and Physical Self-Worth), although these improvements were not sustained. The implications and future research directions are discussed.

Burkhardt, J., & Brennan, C. (2012). The effects of recreational dance interventions on the health and well-being of children and young people: A systematic review. *Arts & Health: An International Journal for Research, Policy and Practice*, 4(2), 148-161.

Aim: To explore the effects of participating in recreational dance on the physical health and psychosocial outcomes of children and adolescents. Method: A systematic review of controlled studies of recreational dance activity involving 5–21-year-olds. Results: Fourteen studies were included in the review covering a wide range of dance styles, population groups and settings. Results point to a consistency of association across a range of different populations and settings that suggest that recreational dance can improve cardiovascular fitness and bone health of children and young people and can contribute to preventing or reducing obesity. There is also more limited evidence that suggests dance participation may improve self-concept and body image and reduce anxiety. Conclusions: There is some evidence to suggest that involvement in dance may have some positive outcomes on physical and psychosocial well-being. Further high-quality research is recommended.

Cohen, E. E., Ejsmond-Frey, R., Knight, N., & Dunbar, R. I. (2010). Rowers' high: behavioural synchrony is correlated with elevated pain thresholds. *Biology Letters*, 6(1), 106-108.

Physical exercise is known to stimulate the release of endorphins, creating a mild sense of euphoria that has rewarding properties. Using pain tolerance (a conventional non-invasive assay for endorphin release), we show that synchronized training in a college rowing crew creates a heightened endorphin surge compared with a similar training regime carried out alone. This heightened effect from synchronized activity may explain the sense of euphoria experienced during other social activities (such as laughter, music-making and dancing) that are involved in social bonding in humans and possibly other vertebrates.

Devereaux, C. (2013, May 16). Why Should We Dance?, *Psychology Today*. Retrieved from <https://www.psychologytoday.com/us/blog/meaning-in-motion/201305/why-should-we-dance>

Dunbar, R. (2012). On the Evolutionary Function of Song and Dance. In Bannan, N. (Ed.), *Music, Language, and Human Evolution* (201-214). Oxford, UK: Oxford University Press.

Dunbar, R. I. (2010). The social role of touch in humans and primates: behavioural function and neurobiological mechanisms. *Neuroscience & Biobehavioral Reviews*, 34(2), 260-268.

Grooming is a widespread activity throughout the animal kingdom, but in primates (including humans) social grooming, or allo-grooming (the grooming of others), plays a particularly important role in social bonding which, in turn, has a major impact on an individual's lifetime reproductive fitness. New evidence from comparative brain analyses suggests that primates have social relationships of a qualitatively different kind to those found in other animal species, and I suggest that, in primates, social grooming has acquired a new function of supporting these. I review the evidence for a neuropeptide basis for social bonding, and draw attention to the fact that the neuroendocrine pathways involved are quite unresolved. Despite recent claims for the central importance of oxytocin, there is equally good, but invariably ignored, evidence for a role for

endorphins. I suggest that these two neuropeptide families may play different roles in the processes of social bonding in primates and non-primates, and that more experimental work will be needed to tease them apart.

Fiorella, S. (2016, December 19). *Dancing Reduces Anxiety and Depression in Students*, The Friendship Bench. Retrieved from <https://thefriendshipbench.org/dancing-reduces-anxiety-and-depression-in-students/>

Hackney, M. E. & Earhart, G. M. (2010). Social partnered dance for people with serious and persistent mental illness: a pilot study. *The Journal of Nervous and Mental Disease*, 198(1), 76-78.

Individuals with serious mental illness (SMI) often experience isolation and poor health, but normalized social opportunities aid recovery. This study aimed to determine social dance's feasibility and effects on mood, functional mobility, and balance confidence in 12 people with SMI. Participants danced once per week in 1-hour lessons for 10 weeks. Before and after lessons, participants were evaluated for gait velocity and with one-leg stance, Timed Up and Go, and 6-minute walk tests. Participants self-completed Beck Depression II and Beck Anxiety Inventories and the Activities-specific Balance Confidence Scale. Posttesting included an exit questionnaire assessing participant experiences. Participants significantly improved on the Timed Up and Go, ($p = 0.012$, effect size = 0.68), and demonstrated nonsignificant improvements in anxiety, depression, and balance confidence (effect sizes of 0.41, 0.54, and 0.64, respectively). Participants reported enjoying classes, and interest to continue. Social dance is feasible and may benefit mobility for those with SMI.

Hanna, J. L. (2014). *Dancing to Learn: The Brain's Cognition, Emotion, and Movement*. London, England: Rowman & Littlefield.

Hanna, J. L. (2006). *Dancing for Health: Conquering and Preventing Stress*. Lanham, MD: AltaMira Press.

Hannon, E. E., & Trehub, S. E. (2005). Tuning in to musical rhythms: Infants learn more readily than adults. *Proceedings of the National Academy of Science*, 102(35), 12639-12643.

Domain-general tuning processes may guide the acquisition of perceptual knowledge in infancy. Here, we demonstrate that 12-month-old infants show an adult-like, culture-specific pattern of responding to musical rhythms, in contrast to the culture-general responding that is evident at 6 months of age. Nevertheless, brief exposure to foreign music enables 12-month-olds, but not adults, to perceive rhythmic distinctions in foreign musical contexts. These findings may indicate a sensitive period early in life for acquiring rhythm in particular or socially and biologically important structures more generally.

Hartshorn, K., Olds, L., Field, T., Delage, J., Cullen, C. & Escalona, A. (2001). Creative movement therapy benefits children with autism. *Early Child Development and Care*, 166(1), 1-5.

Thirty-eight children with autism were given movement therapy in small groups led by a trained movement therapist. After two months of biweekly sessions, the movement

therapy versus the control (N = 38) children spent less time wandering, more time showing on-task behavior, less time showing negative responses to being touched, and less time resisting the teacher.

Hove, M. J. & Risen, J. L. (2009). It's All in the Timing: Interpersonal Synchrony Increases Affiliation. *Social Cognition, 27*(6), 949-960.

The tendency to mimic and synchronize with others is well established. Although mimicry has been shown to lead to affiliation between co-actors, the effect of interpersonal synchrony on affiliation remains an open question. The authors investigated the relationship by having participants match finger movements with a visual moving metronome. In Experiment 1, affiliation ratings were examined based on the extent to which participants tapped in synchrony with the experimenter. In Experiment 2, synchrony was manipulated. Affiliation ratings were compared for an experimenter who either (a) tapped to a metronome that was synchronous to the participant's metronome, (b) tapped to a metronome that was asynchronous, or (c) did not tap. As hypothesized, in both studies, the degree of synchrony predicted subsequent affiliation ratings. Experiment 3 found that the affiliative effects were unique to interpersonal synchrony. Read More: <https://guilfordjournals.com/doi/10.1521/soco.2009.27.6.949>

Hugill, N., Fink, B., & Neave, N. (2010). The role of human body movements in mate selection. *Evolutionary Psychology, 8*(1), 66-89.

It is common scientific knowledge, that most of what we say within a conversation is not only expressed by the words' meaning alone, but also through our gestures, postures, and body movements. This non-verbal mode is possibly rooted firmly in our human evolutionary heritage, and as such, some scientists argue that it serves as a fundamental assessment and expression tool for our inner qualities. Studies of nonverbal communication have established that a universal, culture-free, non-verbal sign system exists, that is available to all individuals for negotiating social encounters. Thus, it is not only the kind of gestures and expressions humans use in social communication, but also the way these movements are performed, as this seems to convey key information about an individual's quality. Dance, for example, is a special form of movement, which can be observed in human courtship displays. Recent research suggests that people are sensitive to the variation in dance movements, and that dance performance provides information about an individual's mate quality in terms of health and strength. This article reviews the role of body movement in human non-verbal communication, and highlights its significance in human mate preferences in order to promote future work in this research area within the evolutionary psychology framework.

Jeong, Y., Hong, S., Myeong S. L., Park, M., Kim, Y., & Suh, C. (2004). Dance movement therapy improves emotional responses and modulates neurohormones in adolescents with mild depression. *International Journal of Neuroscience, 115*(12), 1711-1720.

This study assessed the profiles of psychological health and changes in neurohormones of adolescents with mild depression after 12 weeks of dance movement therapy (DMT). Forty middle school seniors (mean age: 16 years old) volunteered to participate in this study and were randomly assigned into either a dance movement group (n = 20) or a control group (n = 20). All subscale scores of psychological distress and global scores

decreased significantly after the 12 weeks in the DMT group. Plasma serotonin concentration increased and dopamine concentration decreased in the DMT group. These results suggest that DMT may stabilize the sympathetic nervous system. In conclusion, DMT may be effective in beneficially modulating concentrations of serotonin and dopamine, and in improving psychological distress in adolescents with mild depression.

Koch, S. C., Mehl, L., Sobanski, E., Sieber, M., & Fuchs, T. (2014). Fixing the mirrors: A feasibility study of the effects of dance movement therapy on young adults with autism spectrum disorder. *Autism, 19*(3), 338-350.

From the 1970s on, case studies reported the effectiveness of therapeutic mirroring in movement with children with autism spectrum disorder. In this feasibility study, we tested a dance movement therapy intervention based on mirroring in movement in a population of 31 young adults with autism spectrum disorder (mainly high-functioning and Asperger's syndrome) with the aim to increase body awareness, social skills, self-other distinction, empathy, and well-being. We employed a manualized dance movement therapy intervention implemented in hourly sessions once a week for 7 weeks. The treatment group (n = 16) and the no-intervention control group (n = 15) were matched by sex, age, and symptom severity. Participants did not participate in any other therapies for the duration of the study. After the treatment, participants in the intervention group reported improved well-being, improved body awareness, improved self-other distinction, and increased social skills. The dance movement therapy-based mirroring approach seemed to address more primary developmental aspects of autism than the presently prevailing theory-of-mind approach. Results suggest that dance movement therapy can be an effective and feasible therapy approach for autism spectrum disorder, while future randomized control trials with bigger samples are needed.

Leste, A., & Rust, J. (1990). Effects of dance on anxiety. *American Journal of Dance Therapy, 12*(1), 19-25.

The study investigated the effects of modern dance on anxiety. State anxiety was assessed before and after a 3-mo. education programme, using the Spielberger State-Trait Anxiety Inventory. The target group followed a class in modern dance. Control groups were (1) a physical education group to control for the effects of exercise, (2) a music group to control for aesthetic sensitivity training, and (3) a mathematics group. Several concomitant variables were measured: age, sex, attitude towards dance, and previous experience in sport, dance, and relaxation. Dance training significantly reduced anxiety, but no control activities did so. Examination of the concomitant variables showed that the result could not be accounted for by any obvious artifacts.

Lewis, C., Annett, L.E., Davenport, S., Hall, A. and Lovatt, P. (2016). Mood changes following social dance sessions in people with Parkinson's disease. *Journal of Health Psychology, 21*(4), 483-492.

Dance interventions have physical benefits for the elderly, especially those with Parkinson's disease. This study assessed the psychological benefits of dance. A total of 37 participants, with either Parkinson's disease (n= 22) or age-matched controls (n= 15) completed mood questionnaires before and after a 10-week dance intervention. An

overall reduction in total mood disturbance and a specific reduction in anger were observed. In addition, less fatigue was found for those initially scoring higher in depression. This suggests that dance can provide psychological benefits for both people with Parkinson's disease and the elderly, with findings suggesting that this is an avenue to be explored further.

Lovatt, P. (2017). Lecture Series in Dance Psychology [PDF file]. Retrieved from <http://www.peterlovatt.com/>

The introductory lecture sets the scene by providing an overview of Dance Psychology in terms of its subject matter, breadth and methods. Dance Psychology is the study of psychology as it is applied to dance. The breadth of Dance Psychology follows the breadth of academic psychology in addressing aspects of cognitive processing, developmental and social psychology and the biological basis of behaviour. The scientific basis of Dance Psychology is established in the methods used to test hypotheses and theories and in the critical review of published findings in this field. Each lecture addresses a central question and academic research is used to provide answers to that question, to identify aspects of the question that are unresolved, and to point to areas for further study. The Introduction provides guidance on how this course can be used for academic purposes through exercises and activities.

Lovatt, P. (2013). Dance Psychology: The power of dance across behaviour and thinking. *Psychology Review*, 19(1), 18-21.

Psychologist and dance expert Peter Lovatt looks at some extraordinary facts about dance, including its health benefits, its impacts on the way we problem-solve and the link between physical symmetry, sexual attraction and dance.

Murcia, C. Q., Kreutz, G., Clift, S., & Bongard, S. (2010). Shall we dance? An exploration of the perceived benefits of dancing on well-being. *Arts & Health*, 2(2), 149-163.

Past research has suggested positive influences of musical experiences on people's health and well-being. Empirical work has focused on musical activities such as listening and singing, while neglecting the potential effects of dancing. In the present study, 475 non-professional adult dancers completed an online survey, which sought to evaluate the participants' perceived benefits of dancing. Quantitative and qualitative analysis revealed that dancing has potential positive benefits on well-being in several aspects. In particular, beneficial effects were found related to the emotional dimension, as well as physical, social and spiritual dimensions. In addition, the positive benefits were also linked to self-esteem and coping strategies. This exploratory study constitutes a starting point in understanding the impact of amateur dancing on well-being and offers arguments for including dance on the agenda of health promotion. Directions for future research are also discussed.

Mackrell, J. (1997). *Reading Dance*. London, England: Michael Joseph.

Nigmatullina, Y., Hellyer, P. J., Nachev, P., Sharp, D. J. & Seemungal, B. M. (2013). The neuroanatomical correlates of training-related perceptuo-reflex uncoupling in dancers. *Cerebral Cortex*, 25(2), 554-562.

Sensory input evokes low-order reflexes and higher-order perceptual responses. Vestibular stimulation elicits vestibular-ocular reflex (VOR) and self-motion perception (e.g., vertigo) whose response durations are normally equal. Adaptation to repeated whole-body rotations, for example, ballet training, is known to reduce vestibular responses. We investigated the neuroanatomical correlates of vestibular perceptuo-reflex adaptation in ballet dancers and controls. Dancers' vestibular-reflex and perceptual responses to whole-body yaw-plane step rotations were: (1) Briefer and (2) uncorrelated (controls' reflex and perception were correlated). Voxel-based morphometry showed a selective gray matter (GM) reduction in dancers' vestibular cerebellum correlating with ballet experience. Dancers' vestibular cerebellar GM density reduction was related to shorter perceptual responses (i.e. positively correlated) but longer VOR duration (negatively correlated). Contrastingly, controls' vestibular cerebellar GM density negatively correlated with perception and VOR. Diffusion-tensor imaging showed that cerebral cortex white matter (WM) microstructure correlated with vestibular perception but only in controls. In summary, dancers display vestibular perceptuo-reflex dissociation with the neuroanatomical correlate localized to the vestibular cerebellum. Controls' robust vestibular perception correlated with a cortical WM network conspicuously absent in dancers. Since primary vestibular afferents synapse in the vestibular cerebellum, we speculate that a cerebellar gating of perceptual signals to cortical regions mediates the training-related attenuation of vestibular perception and perceptuo-reflex uncoupling.

Reddish, P., Bulbulia, J., & Fischer, R. (2013). Does synchrony promote generalized prosociality? *Religion, Brain & Behavior*, 4(1), 3-19.

Synchrony—the matching of rhythmic behavior in time—is a common feature of many social practices. Although recent studies have demonstrated that synchrony promotes prosociality, it remains unclear whether prosociality extends to targets outside the synchronous group. Studies on the related phenomenon of mimicry (i.e., the non-conscious imitation of another's behavior) show that matching behavior in form amplifies prosociality to those outside the mimicked pair. While these studies suggest that synchrony might also evoke generalized prosociality, the minimal group paradigm predicts that any increase in prosociality will be confined to synchronous performers. Study 1 investigated the cooperative specificity of synchrony by comparing the effects of synchrony on prosociality directed to co-performers and to non-performers. We found that synchrony-induced prosociality was not restricted to fellow synchronous performers. These findings offer initial support for a generalized prosocial model of synchronous performances. Study 2 investigated whether generalized prosociality occurred when the prosocial target was conceived as another group, rather than another individual. Consistent with the first study, we found that synchronous movements were associated with greater prosociality towards a non-performance group when compared to the level of prosociality observed from the control group activity. Collectively these findings offer initial support that synchrony may amplify prosociality to non-participants, whether conceived as individuals or as groups.

Reddish, P., Fischer, R., & Bulbulia, J. (2013). Let's Dance Together: Synchrony, Shared Intentionality and Cooperation. *PLOS One*, 8(8), e71182.

Previous research has shown that the matching of rhythmic behaviour between individuals (synchrony) increases cooperation. Such synchrony is most noticeable in music, dance and collective rituals. As well as the matching of behaviour, such collective performances typically involve shared intentionality: performers actively collaborate to produce joint actions. Over three experiments we examined the importance of shared intentionality in promoting cooperation from group synchrony. Experiment 1 compared a condition in which group synchrony was produced through shared intentionality to conditions in which synchrony or asynchrony were created as a by-product of hearing the same or different rhythmic beats. We found that synchrony combined with shared intentionality produced the greatest level of cooperation. To examine the importance of synchrony when shared intentionality is present, Experiment 2 compared a condition in which participants deliberately worked together to produce synchrony with a condition in which participants deliberately worked together to produce asynchrony. We found that synchrony combined with shared intentionality produced the greatest level of cooperation. Experiment 3 manipulated both the presence of synchrony and shared intentionality and found significantly greater cooperation with synchrony and shared intentionality combined. Path analysis supported a reinforcement of cooperation model according to which perceiving synchrony when there is a shared goal to produce synchrony provides immediate feedback for successful cooperation so reinforcing the group's cooperative tendencies. The reinforcement of cooperation model helps to explain the evolutionary conservation of traditional music and dance performances, and furthermore suggests that the collectivist values of such cultures may be an essential part of the mechanisms by which synchrony galvanises cooperative behaviours.

Scharoun, S. M., Reinders, N. J., Bryden, P. J., & Fletcher, P. C. (2014). Dance/Movement Therapy as an Intervention for Children with Autism Spectrum Disorders. *American Journal of Dance Therapy*, 36(2), 209-228.

Autism Spectrum Disorder (ASD) is one of the most common forms of developmental disabilities of childhood, rooted in atypical language and social development, in conjunction with repetitive and patterned behaviors. It is also suggested that gross and fine motor impairments are a core feature of ASD, are more prevalent in comparison to the general population, and may be further exaggerated due to reduced participation in physical activity. As awareness for ASD has increased, so have the number of therapeutic approaches; however, no single intervention has proven beneficial in alleviating the cardinal symptoms of ASD. Therefore the most effective treatment or combination of treatments remains inconclusive. Creative movement and dance is a practical and feasible option for children with ASD. However, there exists a dearth of literature evaluating dance/movement therapy (DMT) for children with ASD, despite providing both physical and psychological benefits for children with ASD. This article aims to perform a narrative review of the literature.

Svoboda, E. (2007, March 1). Dance Therapy: Spin Control, *Psychology Today*. Retrieved from <https://www.psychologytoday.com/us/articles/200703/dance-therapy-spin-control>

Tarr, B., Launay, J., Cohen, E., & Dunbar, R. (2015). Synchrony and exertion during dance independently raise pain threshold and encourage social bonding. *Biology Letters*, 11(10).

Group dancing is a ubiquitous human activity that involves exertive synchronized movement to music. It is hypothesized to play a role in social bonding, potentially via the release of endorphins, which are analgesic and reward-inducing, and have been implicated in primate social bonding. We used a 2×2 experimental design to examine effects of exertion and synchrony on bonding. Both demonstrated significant independent positive effects on pain threshold (a proxy for endorphin activation) and in-group bonding. This suggests that dance which involves both exertive and synchronized movement may be an effective group bonding activity.

Tarr, B., Launay, J., Dunbar, R. (2014). Music and social bonding: "self-other" merging and neurohormonal mechanisms. *Frontiers in Psychology*, 5(1096), eCollection 2014.

It has been suggested that a key function of music during its development and spread amongst human populations was its capacity to create and strengthen social bonds amongst interacting group members. However, the mechanisms by which this occurs have not been fully discussed. In this paper we review evidence supporting two thus far independently investigated mechanisms for this social bonding effect: self-other merging as a consequence of inter-personal synchrony, and the release of endorphins during exertive rhythmic activities including musical interaction. In general, self-other merging has been experimentally investigated using dyads, which provide limited insight into large-scale musical activities. Given that music can provide an external rhythmic framework that facilitates synchrony, explanations of social bonding during group musical activities should include reference to endorphins, which are released during synchronized exertive movements. Endorphins (and the endogenous opioid system (EOS) in general) are involved in social bonding across primate species, and are associated with a number of human social behaviors (e.g., laughter, synchronized sports), as well as musical activities (e.g., singing and dancing). Furthermore, passively listening to music engages the EOS, so here we suggest that both self-other merging and the EOS are important in the social bonding effects of music. In order to investigate possible interactions between these two mechanisms, future experiments should recreate ecologically valid examples of musical activities.

Tarr, B., Launay, J., & Dunbar, R. (2016). Silent disco: dancing in synchrony leads to elevated pain thresholds and social closeness. *Evolution and Human Behavior*, 37(5), 343-349.

Moving in synchrony leads to cooperative behaviour and feelings of social closeness, and dance (involving synchronisation to others and music) may cause social bonding, possibly as a consequence of released endorphins. This study uses an experimental paradigm to determine which aspects of synchrony in dance are associated with changes in pain threshold (a proxy for endorphin release) and social bonding between strangers. Those who danced in synchrony experienced elevated pain thresholds, whereas those in the partial and asynchrony conditions experienced no analgesic effects. Similarly, those in the synchrony condition reported being more socially bonded, although they did not perform more cooperatively in an economic game. This experiment suggests that dance encourages social bonding amongst co-actors by stimulating the production of endorphins, but may not make people more altruistic. We conclude that dance may have been an important human behaviour evolved to encourage social closeness between strangers.

- TEDx Talks. (2013, June 20). *Dance As Therapy: Natalia Duong at TEDxStanford*. [Video file]. Retrieved from <https://www.youtube.com/watch?v=J9gAe9H5Rok>
- TEDx Talks. (2011, April 4). *TEDxObserver – Peter Lovatt*. [Video file]. Retrieved from <https://www.youtube.com/watch?v=nDC7Jpf8f4E>
- TEDx Talks. (2012, April 12). *TEDxObserver – Peter Lovatt – Psychologist and dancer*. [Video file]. Retrieved from <https://www.youtube.com/watch?v=ihCh5wzNjYY>
- TEDx Talks. (2011, June 22). *TEDxOslo – Peter Lovatt – Dance, thinking, hormones*. [Video file]. Retrieved from https://www.youtube.com/watch?v=-kCZZp3u_xE
- Tucker, I. (2011, July 30). Peter Lovatt: 'Dancing can change the way you think,' *The Guardian*. Retrieved from <https://www.theguardian.com/technology/2011/jul/31/peter-lovatt-dance-problem-solving>
- Valdesolo, P. & Desteno, D. (2011). Synchrony and the social tuning of compassion. *Emotion*, 11(2), 262-266.

Although evidence has suggested that synchronized movement can foster cooperation, the ability of synchrony to increase costly altruism and to operate as a function of emotional mechanisms remains unexplored. We predicted that synchrony, due to an ability to elicit low-level appraisals of similarity, would enhance a basic compassionate response toward victims of moral transgressions and thereby increase subsequent costly helping behavior on their behalf. Using a manipulation of rhythmic synchrony, we show that synchronous others are not only perceived to be more similar to oneself but also evoke more compassion and altruistic behavior than asynchronous others experiencing the same plight. These findings both support the view that a primary function of synchrony is to mark others as similar to the self and provide the first empirical demonstration that synchrony-induced affiliation modulates emotional responding and altruism.

- Verghese, J., Lipton, R. B., Katz, M. J., Hall, C. B., Derby, C. A., Kuslansky, G., ... & Buschke, H. (2003). Leisure Activities and the Risk of Dementia in the Elderly. *The New England Journal of Medicine*, 348(25), 2508-2516.

BACKGROUND: Participation in leisure activities has been associated with a lower risk of dementia. It is unclear whether increased participation in leisure activities lowers the risk of dementia or participation in leisure activities declines during the preclinical phase of dementia. **METHODS:** We examined the relation between leisure activities and the risk of dementia in a prospective cohort of 469 subjects older than 75 years of age who resided in the community and did not have dementia at base line. We examined the frequency of participation in leisure activities at enrollment and derived cognitive-activity and physical-activity scales in which the units of measure were activity-days per week. Cox proportional-hazards analysis was used to evaluate the risk of dementia according to the base-line level of participation in leisure activities, with adjustment for age, sex, educational level, presence or absence of chronic medical illnesses, and base-line cognitive status. **RESULTS:** Over a median follow-up period of 5.1 years, dementia developed in 124 subjects (Alzheimer's disease in 61 subjects, vascular dementia in 30,

mixed dementia in 25, and other types of dementia in 8). Among leisure activities, reading, playing board games, playing musical instruments, and dancing were associated with a reduced risk of dementia. A one-point increment in the cognitive-activity score was significantly associated with a reduced risk of dementia (hazard ratio, 0.93 [95 percent confidence interval, 0.90 to 0.97]), but a one-point increment in the physical-activity score was not (hazard ratio, 1.00). The association with the cognitive-activity score persisted after the exclusion of the subjects with possible preclinical dementia at base line. Results were similar for Alzheimer's disease and vascular dementia. In linear mixed models, increased participation in cognitive activities at base line was associated with reduced rates of decline in memory. CONCLUSIONS: Participation in leisure activities is associated with a reduced risk of dementia, even after adjustment for base-line cognitive status and after the exclusion of subjects with possible preclinical dementia. Controlled trials are needed to assess the protective effect of cognitive leisure activities on the risk of dementia.

West, J., Otte, C., Geher, K., Johnson, J., & Mohr, D. C. (2004). Effects of Hatha yoga and African dance on perceived stress, affect, and salivary cortisol. *Annals of Behavioral Medicine, 28*(2), 114-118.

BACKGROUND: Dance and yoga have been shown to produce improvements in psychological well-being. PURPOSE: The aim of this study was to examine some of the psychological and neuroendocrine response to these activities. METHODS: Sixty-nine healthy college students participated in one of three 90-min classes: African dance (n = 21), Hatha yoga (n= 18), or a biology lecture as a control session (n = 30). Before and after each condition participants completed the Perceived Stress Scale (PSS), completed the Positive Affect and Negative Affect Schedule, and provided a saliva sample for cortisol. RESULTS: There were significant reductions in PSS and negative affect ($p < .0001$) and Time x Treatment interactions ($p < .0001$) such that African dance and Hatha yoga showed significant declines, whereas there was no significant change in biology lecture. There was no significant main effect for positive affect ($p = .53$), however there was a significant interaction effect ($p < .001$) such that positive affect increased in African dance, decreased in biology lecture, and did not change significantly in Hatha yoga. There was a significant main effect for salivary cortisol ($p < .05$) and a significant interaction effect ($p < .0001$) such that cortisol increased in African dance, decreased in Hatha yoga, and did not change in biology. Changes in cortisol were not significantly related to changes in psychological variables across treatments. There was 1 significant interaction effect ($p = .04$) such that change in positive affect and change in cortisol were negatively correlated in Hatha yoga but positively correlated in Africa dance and biology. CONCLUSIONS: Both African dance and Hatha yoga reduced perceived stress and negative affect. Cortisol increased in African dance and decreased in Hatha yoga. Therefore, even when these interventions produce similar positive psychological effects, the effects may be very different on physiological stress processes. One factor that may have particular salience is that amount of physiological arousal produced by the intervention.

Wiltermuth, S. S. & Heath, C. (2009). Synchrony and cooperation. *Psychological Science, 20*(1), 1-5.

Armies, churches, organizations, and communities often engage in activities-for example, marching, singing, and dancing-that lead group members to act in synchrony with each other. Anthropologists and sociologists have speculated that rituals involving synchronous activity may produce positive emotions that weaken the psychological boundaries between the self and the group. This article explores whether synchronous activity may serve as a partial solution to the free-rider problem facing groups that need to motivate their members to contribute toward the collective good. Across three experiments, people acting in synchrony with others cooperated more in subsequent group economic exercises, even in situations requiring personal sacrifice. Our results also showed that positive emotions need not be generated for synchrony to foster cooperation. In total, the results suggest that acting in synchrony with others can increase cooperation by strengthening social attachment among group members.