Second Notes Assignment

PRIMARY SOURCES

1. **Coping Skills and Self-Efficacy as Predictors of Gymnastic Performance**

1.1. According to Fitzpatrick (4) the most commonly reported attributes distinguishing between high and low levels of gymnastic performance were psychological factors, in contrast with the general belief that successful performance is mainly influenced by ability (29). Thus, the psychological skills of gymnasts can influence their capability to perform successfully in a competition. These coping skills refer to the cognitive and behavioral efforts to overcome, reduce or tolerate internal and/or external demands caused by a stressful situation. Coping with stress is not directly related to the final outcome of the effort. This means that coping is defined by the efforts to control the challenge of a situation, regardless of an athlete's success (5) (p. 1).

1.2. It has been also demonstrated that, in relation to young athletes, the support offered by their coaches and fellow athletes plays a very important role in coping effectively with stress (16). In this respect the ways in which children and teenagers deal with stress are influenced by the feedback and the behavior of parents, trainers and others. When a child enters puberty the importance placed on "wins" increases substantially. This in turn amplifies the feeling of being "pressured to perform", a feeling which is carried over into puberty and adulthood (p. 2).

1.3. Bandura's theory of self-efficacy (1) examines the influence of personal belief on the actual capability to perform, with final performance being affected by two parameters: a) the strength of a person's belief in his or her ability to perform a certain task; and b) the presence of an accepting and responsive environment (14). The effect of self-efficacy [...] has been used to predict to a significant degree the actual performance in football (17), serving in tennis (25), darts (11), basketball free-throws (9), and gymnastics (13). According to Lee (13) the performance of female artistic gymnasts has been shown to vary according to self-efficacy expectations. Weiss, Wiese and Klint (30) have demonstrated that artistic gymnasts with higher expectations of final achievement before a tournament tended to be more successful than gymnasts with low expectations of success (p. 2).

1.4. Coping skills combined with self-efficacy were found to be a powerful indicator of performance. Most of the coping skills were found to predict the level of performance. More specifically, athletes with high performance scores (>75% of maximum performance) also had higher scores of Coping with adversity, Goal setting/mental preparation, Confidence/achievement motivation, Freedom from Worry, Coachability and Self-efficacy than athletes with low performance scores (< 75% of maximum performance). Best performance was achieved by athletes who believed they could control themselves in stressful situations by relaxing and competing with enthusiasm and certainty, without worrying about their performance. They set goals and prepared themselves for the competition, listened to their coaches' instructions and felt certain they could perform at their best (p. 3).

1.5. Not unexpectedly, athletes with low levels of control over a stressful situation, who didn't set goals, got angry with their coaches' instruction and did not believe they could be among the best athletes of the competition, performed poorly. These findings are consistent with previous studies, where gymnasts, in a wider range of age group and level of sport competition (2-12 years of gymnastics participation), with higher anxiety and lower ability to cope with adversity, were more likely to discontinue training (7). The findings also agree with Unestahl's (26) suggestions that gymnasts with better inner mental training show higher level of competence (p. 3).

2. **Self-belief does make a difference: A reciprocal effects model of the causal ordering of physical self-concept and gymnastics performance**

2.1. As is the case in many disciplines, in sport/exercise settings self-concept is frequently posited as a mediating variable that facilitates the attainment of other desired outcomes such as physical skills, health-related physical fitness, physical activity, and exercise adherence (Marsh, 1997, 2002). The rationale behind this research is that individuals who feel positively about themselves in a particular domain—in this study the physical domain—are more likely to pursue and achieve desirable outcomes in that domain than individuals who do not feel positively about themselves (p. 3).

2.2. In a recent meta-analysis of relevant research, Valentine (2002; Valentine, Dubois & Cooper, 2004) concluded that there was clear support for predictions based on the reciprocal effects model over those derived from self-enhancement and skill development models. Whereas the effect of prior self-concept on subsequent achievement after controlling for the effects of prior achievement was modest (mean standardized regression coefficient = .1), the effect was highly significant overall and positive in 90% of the studies in this meta-analysis. In support of the multidimensional perspective that is so important to the reciprocal effects model, the effects of prior self-beliefs were significantly stronger when the measure of self-belief was based on a domain-specific measure rather than on global measures such as self-esteem, and when self-concept and achievement measures were matched in terms of subject area (e.g. mathematics achievement and math self-concept) (p. 4-5).

2.3. More recently, [...] there has been a stronger emphasis on a multidimensional perspective of self-concept with physical self-concept measures designed specifically for physical education, sport and exercise settings (Fox & Corbin, 1989; Marsh, 1997, 2002). They show that physical self-concept is distinct from other areas of self-concept (e.g. academic). This growing body of research also provides clear support for convergent and discriminant validity of physical self-concept responses in relation to a wide variety of sport/exercise outcome measures (p. 5).

2.4. Specifically, we evaluate predictions from the reciprocal effects model of the causal ordering of gymnastics self-concept and gymnastics performance skills that are adapted from an extensive body of academic self-concept research. This model (Figure 1A) makes predictions about the effects of time 1 (T1) gymnastics self-concept and T1 gymnastics performance skills collected at the start of a gymnastics training program on time 2 (T2) gymnastics self-concept and T2 gymnastics performance skills collected at the end of the 10-week program. Not surprisingly, the reciprocal effects, self-enhancement, and skill development models all predict the effect of each T1 variable on the matching T2 variable to be substantial and positive (dashed horizontal lines in Figure 1A). The critical predictions distinguishing three theoretical models are the cross-paths relating T1 gymnastics self-concept to T2 gymnastics performance skills and T1 gymnastics performance skills to T2 gymnastics self-concept: the skill development model predicts that only path from T1 gymnastics performance skills to T2 gymnastics self-concept will be significant; the self-enhancement model posits that only the path from T1 gymnastics self-concept to T2 gymnastics performance skills will be significant; and the reciprocal effects model predicts that both paths will be significant (p. 6).

2.5. [T]he reciprocal effects model implies that self-concept and gymnastics performance are reciprocally related and mutually reinforcing. Improved physical self-concepts will lead to improved performance skills and improved performance skills will lead to better physical self-concepts. Hence, if class leaders enhance participants' physical self-concepts without improving corresponding performance skills, then the gains in self-concept are likely to be short-lived. However, if class leaders improve participants' performance skills without also fostering participants' self-beliefs in their physical capabilities, then the performance gains are also unlikely to be long lasting. If class leaders focus on either one of these constructs to the exclusion of the other, then both are likely to suffer. Hence, according to the reciprocal effects model, class leaders should strive to improve simultaneously both physical self-concept and performance skills. Importantly, the generalizability of support for these predictions in a physical setting from the well-established pattern of results-based on academic self-concept and traditional measures of academic achievement provides a much stronger basis of support for the reciprocal effects model (p. 16).

3. Are there specific conditions for which expertise in gymnastics could have an effect on postural control and performance?

3.1. In [gymnastics], and specifically in the floor exercise for male gymnasts, maintaining postures is needed and required by the international codification [1]. The ‘‘legmount’’, the scale (two postures on one leg with the other leg fully extended in a front, side or rear split position in the first one or lifted backward in line with the trunk bended forward parallel to the floor for the second one) or the handstand on the floor are such examples. Before attempting or learning these specific and difficult postures, gymnasts are first trained to maintain less specific ones, such as the unipedal; a posture that any healthy human could perform (p. 76).

3.2. Expertise represents ‘a high level of knowledge and skills gained from training and experience’ (Oxford English Dictionary). Thus, it can be argue[d] that this general effect which included gymnasts’ experience, competition level, number of hours of training, etc. can be regrouped as one notion: the effect of expertise. Then, to test such [an] effect of expertise, one could compare elite gymnasts to other athletes who are not trained to stand still (p. 77).

3.3. The visual system is a complex system but mainly it can be separated into two essential components. The first one, called foveal vision, is largely concerned with objects’ recognition and identification, textures or colours. The second one, called peripheral vision, detects movements occurring in the environment. These components, neurophysiologically distinguished, are linked by their role in the control of posture [10]. For example, in bipedal posture, any modification of the surroundings (objects position or brightness) affects postural sway [10]. This effect is more pronounced in more challenging balance tasks such as standing with the feet close together [11] or standing on one leg [9]. Closing the eyes is another and simpler way to analyse the impact of this sensory system (p. 77).

3.4. For the relative specific posture, U [unipedal condition], elite gymnasts had better performances concerning the planar amplitude of sway than other sportsmen (Scg [surface center of gravity], Fig. 1). One hypothesis to explain this difference is that it may be due to the type of training gymnasts received. Indeed, this posture must be mastered before learning any referenced unipedal configuration. Moreover, a previous study showed that training for 5 days in a unipedal posture with eyes open could enhance postural performance by approximately 50% [17]. This enhancement was still observable 40 days after the end of the training program. Thus, even if the exact amount of the gymnast’s previous training in this situation cannot be quantified, some prior practice in U will be enough to improve their overall performance. This is in agreement with previous findings analysing different kind[s] of movements [18] or different postures [2], the transfer of skills seemed to occur only during movements or postures which have been previously trained (p. 79).

3.5. Expertise in gymnastics only has an effect on postural performance when performing configurations that are consistent with those that have been trained and so correspond to gymnastics' goal. Moreover, this effect is only seen in a visual condition that matches to the one in which elite gymnasts are practicing. Their expertise at keeping still during different and difficult postures also fails to reduce the effect of removal of vision as observed in other sportsmen. Expertise in gymnastics influences body sway only if the configuration and also the visual condition are consistent with the training. So, sport-training effects might be compared by choosing precise corresponding situations relevant to the targeted sports (p. 80).

4. Exploring Visual Patterns and Judgments Predicated on Role Specificity: Case Studies of Expertise in Gymnastics

4.1. The contextual approach suggests that cognitive processes (e.g., perception) are dependent on interactions with the environment, indicating that perceptual mistakes could be influenced by memory (Jacoby et al. 2001; Ste-Marie et al. 2001). For example, the decisions of referees may be mediated by their current and previous behaviors (i.e., sequential effects) or by their visual perspective when viewing a sport sequence (i.e., a positioning effect). In contrast, the embodied approach focuses on the relationship between cognitive processes, the body and movement (Goldman and de Vignemont 2009). Errors in perception emerge when people misinterpret the actions of other individuals from their own motor representations (Jeannerod 2001) (p. 935).

4.2. Empirical evidence shows that previous motor experiences could improve the accuracy of perceptual judgments (Hecht et al. 2001; Pizzera 2012), decision-making process (Poplu et al. 2003), and the sensitivity to perceived actions (Hodges et al. 2007). For example, Aglioti et al. (2008) showed that neural activation in brains of expert basketball players increased during observation of video action sequences, suggesting that motor experience is used to predict movements of their opponents (Rizzolatti and Craighero 2004) (p. 935).

4.3. The objective of this study was to determine, using an embodied cognition approach, whether the perceptual judgments of participants with expertise in gymnastics may have been influenced by previous domain-specific visual and motor experiences. As the sample had extensive experience in the task, the method of verbal reporting was also introduced to analyze how expert participants used their previous sport-specific experiences gained during years of training and practice to make perceptual judgments (p. 939).

4.4. We expected to find that the judge’s combination of perceptual-motor experiences in (performing and judging) the task would lead [to] a greater likelihood of identifying execution errors in the gymnastic skills. However, he only achieved a slightly better level of judging performance than the coach and gymnast. This result is consistent with the findings reported previously by Bard et al. (1980) who noted that expert judges in gymnastics detected more errors than novices, but that this difference was not statistically significant. We suggest that the lack the differences between participants may have [been] due to the difficulty in controlling the combination of sensory-motor experiences (Cañal-Bruland et al. 2010; Pizzera and Raab 2012) because it is challenging to find participants with only one type of experience (i.e., participants with experiences in just one domain, e.g., as a performer only vs. as a judge only) (p. 939).

4.5. Analyses showed that there are no differences between participants in the perceptual strategies according to the type of gymnastic skill observed. However, when the analysis included the perception of all three gymnastic skills, differences in visual search patterns were found. For example, the gymnast displayed different visual search behaviors than the coach and the judge, focusing more often, and for longer, on the hips and next to the legs. This evidence is consistent with previous studies that observed differences between gymnast groups according to the performance level (e.g., in gymnasts; see Vickers 1988 or in coaches; see Moreno et al. 2002). Therefore, our findings also contributed to knowledge about the differences between expert and novice samples (Mann et al. 2007), because the gymnast spent more time perceiving information about the gymnastic skills due to the lack of experience in evaluating them (p. 939-940).

5. Gymnastic judges benefit from their own motor experience as gymnasts

5.1. Fast and complex movements characterize several gymnastic skills; therefore, judges have a highly challenging and difficult mission. Research on gymnastic judges has shown they also have to cope with imperfect positioning (Plessner & Schallies, 2005), sequential effects influenced by previously judged performances (Damisch, Mussweiler, & Plessner, 2006), and conformity bias (Boen, Van Hoye, Auweele, Feys, & Smits, 2008). The question arises concerning the information sources judges use to overcome these obstacles. Researchers have examined different factors, such as gaze behavior (Bard, Fleury, Carriere, & Halle, 1980; Ste-Marie, 2000), anticipation (Ste-Marie, 1999) , and judging experience (Plessner & Schallies, 2005; Ste-Marie & Lee, 1991) (p. 603).

5.2. Studies have shown that observers' motor and visual experiences positively influence their visual perception of other people's movements (Loula, Prasad, Harper, & Shiflrar, 2005). These authors asked participants to identify and discriminate point-light videos of themselves, friends, and strangers performing various actions. Performance was best for their own actions, indicating a positive influence of motor experience on visual perception, as people do not usually have visual experience of their own movements. Participants performed second best for friend trials, which the authors attributed to visual experience as the determining factor. In a study on action identification and discrimination, Casile and Giese (2006) showed that pure motor learning can enhance visual perception. Participants had to learn a novel coordinated upper-body movement, characterized by arm movements that matched a gait pattern with a phase difference of 270°, while blindfolded. Although visual experience during the training was absent, there was a selective improvement of the visual recognition performance for the learned movement (p. 603).

5.3. During a gymnast's routine, judges repeatedly identify, discriminate, categorize, and assess different skills. They must be capable of judging joint angles correctly. Studies have shown that people accurately estimate body part angles or geometric angles visually (Genaidy, Simmons, Guo, & Hidalgo, 1993; Kennedy, Orbach, Gordon, & Loffler, 2008). Judges must also detect movement and form errors and give credits or deductions accordingly. In high-level competitions, judges are divided into two panels (IFG, 2009). Panel D is in charge of identifying and determining the difficulty of the routine, while Panel E judges deduct for general, execution, and artistry faults. In low-level competitions, one panel performs both tasks. Judges must also be alert to intentional deceptions of gymnasts who try to cover up errors to get fewer deductions (MacMahon & Plessner, 2008) (p. 603-604).

5.4. Judges benefited from their own motor experience for this specific skill relative to judgment quality. Regression analysis showed that specific components characterized this motor experience, because general motor experience as a gymnast did not contribute to judgment performance in this task. Similar to results found by Casile and Giese (2006), in which all participants improved their perceptual judgments of those that matched a previously learned motor movement, results from the current study also showed that motor experience was evident only for the complex skill judges had learned before. Judges with SME [specific motor experience] seemed to focus on aspects that allowed them better perceptual sensitivity. In the current study, judges were most accurate in assessing angles. Although there were no significant differences between accuracy of specific components, judges with SME tended to be more sensitive to the angle legs and arms were bent and whether the legs were parallel. At this point, studies focusing on gaze strategies may provide a more in-depth view of the mechanisms underlying these advantages (p. 606).

5.5. In summary, an important factor that helps judges optimize judgment quality is their own experience as gymnasts. Using their own sensorimotor experience may equip them to more accurately assess the complex movement patterns in gymnastic skills. Retiring gymnasts could be encouraged to use this advantage to continue to contribute to their sport by getting to know it from a totally new perspective as a judge (p. 607).

6. Expressiveness of gestural communication through body actions

6.1. The human body is, through its structure and mobility, a mirror of the infinite psychics hue that animate the individual. Receptive to everything that happens inside and outside, the dancer/athlete conveys and transpose[s] his psychic and infinite fluctuations, into a multitude of possibilities and expressions to those around him or her. His body becomes a micro-universe in which the muscular tensions, his own breathing and his sensory channels instruments, the nonverbal communication individual instruments, [represent] a present reality, of which the performer is not always aware of. The gesture is, most often, a voluntarily controlled movement that carries the semantic load of the message (p. 53).

6.2. The instrument with which the dancer/athlete expresses himself is his body. He must master the expressions technique means so as to instantly respond to the imposed commands of the choreographer/coach conceptions. In order to achieve the impulse and action simultaneity, it is necessary for the performer to develop the parallel development of both thinking and self-control, as well as the body's physical qualities that will act. In order to obtain a special artistic effect, the dancer/athlete becomes conditioned by the movement plasticity and expressiveness (p. 53).

6.3. Understanding the gesture in terms of its expressiveness, represents an outside projected expression essentiality that reflects a pre-existing psychic content through the body which can be transmitted to a present audience. “The gesture can become [the] body`s expression when we want to convey the emotional nature of a situation by capitalizing the original function which consists in the artistic act [of] beauty”. Thus, the gesture can be the intermediary of two distinct planes: the mental (inner) and the physical body (outer). The viewer/spectator can be guided towards the inner message understanding through gestures with expressive value *developed in the outer space by the body`s dancer/athlete* (p. 54-55).

6.4. In dance as in gymnastics, practitioners must constantly prove the art of mixing in their exercises the technique with the movement expressiveness. Both claim a harmonious development of the body, a proper controlled outfit with great precision in execution, safety and expressiveness from the simplest gestures to the process of gymnasts, leads to education on movement expressiveness that restore harmony, dynamics and amplitude of the movement. Mixed with rhythm and emotional message they form a homogeneous unitary whole. The artistic training represents, in Adrian Dragnea`s theory, “the choreographic and musical means totality of expressiveness stimulating creativity, whose finality materializes in motor skills performed with a high degree of expressiveness able to send a message to the spectator or the referees". Thus, women's artistic gymnastics is characterized by their beauty, grace, rhythm and musicality, and development of the artistic standards perfection, guides us to the body`s expressiveness in motion. Added to this the facial expressiveness must reflect the inner feeling synchronization range with those related to movement experiencing (p. 57).

6.5. The choreography/gymnastic exercise presented in competition with a high degree of difficulty, complexity and technical by the dancer/athlete defines the compositional conditions of musical accompaniment and plastic education and can be classified within the artistic sphere of representation. Along with other factors from sports training (physical, technical, tactical, theoretical, mental training), the artistic training has a particularly important role in the preparation of athletes contributing in the achieving of high performance. The means of physical education through the artistic gymnast uses can go beyond the sphere of technicality and reach the level of expressiveness and gestural communication (p. 57-58).

7. Affordances in Interaction: The Case of Aikido

7.1. Scholarship inspired by J. J. Gibson is showing considerable interest in multiagent environments and interactive behavioral dynamics (Warren, 2006), which underlie everyday social activities (Fusaroli, R˛aczaszek-Leonardi, & Tylen, 2014; Marsh, 2015) but also decision making in domains such as soccer, basketball, boxing, social dances (Araujo, Davids, & Hristovski, 2006; Bourbousson, Seve, & McGarry, 2010a, 2010b; Esteves, de Oliveira, & Araujo, 2011; Hristovski, Davids, & Arujo, 2006; Kimmel, 2012; Kimmel & Preuschl, 2015; Passos, Davids, & Chow, 2016; Torrents, Hristovski, Coteron, & Ric, 2016; Travassos et al., 2012), and robotics (Horton, Chakraborty, & St. Amant, 2012; Ibanez-Gijon, Diaz, Lobo, & Jacobs, 2013). In behavioral dynamics, due to real-time coupling between bodies, a new decision opportunity presents itself frequently. In dance and high-paced sports this can be up to several times a second. To succeed with this, agents must source cues from other agents whom they supply with cues in return. Typically, the behavioral dynamics are not scripted (p. 195-196).

7.2. Agents shape and are shaped by smoothly adapting to each other's ongoing actions and the environment. As this embodied dialogue unfolds, a stream of transient perceptual configurations offers guidance. That is, actions are selected, modulated, switched, and terminated based on evolving interactional contingencies (McGann & De Jaegher, 2009), which are drawn from spatio-temporal information such as geometry between the bodies or relative timing (p. 196).

7.3. The associated empirical challenge is that such coregulated perception–action streams (a) are tightly interwoven and difficult to dissect, (b) involve highly task- and phase-specific sensorimotor skills, and (c) generate myriad alternative interpersonal dynamics. To address these challenges we report on selected data from a wider project tapping into first-person practitioner know-how. We applied special dialogic interviewing techniques, which allow both learners and seasoned experts to verbalize what usually remains implicit about their sensorimotor and strategic skills. (p. 196).

7.4. Aikido is about training how to best adapt to a unique encounter and its emergent configurational and temporal details, albeit exhibiting coregulation to different (modality-specific) degrees: In training, standard techniques are practiced by taking turns between attacker and defender roles, whereas advanced practitioners also train free responses to specific attacks (jiyu waza) or mutually practice freestyle (randori). In techniques called out by the teacher the functional principle of defense—a specific arm lever or throw—to be practiced is known beforehand but leaves much coregulative leeway in the specifics. The defender's precise response timing, trajectory, and technical details respond to interactional contingencies gleaned from the attacker's relative geometry, speed, power, exact timing, and so on. In freestyle practice, experts choose from a repertoire of several dozens of techniques or even create their own hybrids. Here, coregulation occurs at its fullest, by improvising both the "how" and the "what" (p. 200).

7.5. The role of skill and further individual variables comes into the picture through effectivities, the subject-sided counterpart of affordances (Turvey, 1992): a person's strength, height, weight, balance, dexterity, perceptual acuity, and momentary training state all shape what can be easily acted on. Effectivities codetermine what kinds of affordances of the Aikido system are perceivable and/or available to someone's skills. (Skills for recognizing and actualizing the action may not always be equally developed: for example, some novices possess perceptual acuity regarding the information but are too unskilled or slow to act on it.) Specifically, the degree of expertise shapes both the breadth of the general affordance landscape and the momentary affordance field a practitioner perceives, the sum total of available "doables." Despite intuitive preferences, a fourth, fifth, or sixth dan, that is, a high rank, might perceive literally dozens of different affordances where a novice perceives one or two at best. The number of competing affordances grows with time, but perhaps so does subjective clarity about which among them is best, so they can become an "intelligent reflex" (Sutton, McIlwain, Christensen, & Geeves, 2011) (p. 202).

8. Performance and Health Concepts in Artistic Gymnastics

8.1. The extreme forces placed on the gymnasts' body in combination with the repetitive movements and high training hours are more than likely a major factor behind the reportedly high incidence of injuries (Lilley, 2006). Although the types of injuries sustained in gymnastics are comparable with many other sports, gymnastics is unique in that the gymnasts receive the majority of their training during their childhood years (Sands, 2000) (p. 52).

8.2. During training, a preferred leg and hand often develops when aiming to achieve performance consistency and reliability of a skill. This can lead to a potential functional imbalance between the limbs. In non-elite competitive gymnasts (National Levels 4-6), Lilley et al. (2007) identified only two gymnasts out of 15 who had functionally symmetrical landings (less than 10% difference between limbs; Grace, 1985) with one gymnast having a staggering 73% of asymmetry (X = 18.14+20.46%). Recent unpublished results of 25 international development stream (elite) gymnasts performing drop landings from heights of 70 and 95 cm revealed a more favourable result, with 11 of the 25 gymnasts displaying functionally symmetrical landings (X = 6.85+14.59%, Max=32.74%) and much lower overall levels of asymmetry (p. 52).

8.3. Often the most important test of biomechanical research is whether it eventually improves performance and/or influences coaching (and training) practice through increased knowledge. One study that achieved success in Australia was that on target-directed running in vaulting (Bradshaw, 2004). It revealed that gymnasts who want to perform more advanced vaults need to be able to target and adjust their strides early in the approach in order to hit the beat board with high velocity (p. 53).

8.4. Whilst there is a vast array of good quality research on gymnastics (e.g. Hiley & Yeadon, 2005; Irwin et al., 2005), further fundamental research that exhibits great promise for influencing coaching (and training) practice is that of computer simulation forward modelling. This is because coaches with gymnasts seeking the epitome of competition performance are always seeking to know how to push skills further, such as the number of saltos and/or twists that can be successfully performed on floor or vault. Forward modelling such as Yeadon's (2009) simulation of the aerial skiing triple and quadruple twisting performance begins to provide information on the take-off velocity and technique required to accomplish these feats. Eventually this method of biomechanical enquiry should begin to impact upon the upper levels of elite gymnastics training (p. 54).

8.5. Biomechanics can help improve gymnastics performance and reduce injury risk to provide a positive participation and/or competition experience. Research that addresses fundamental issues in gymnastics that can influence the performance of gymnasts and/or the knowledge of the coaches (e.g. Bradshaw, 2004), or can prevent injury (e.g. Bradshaw et al., 2006) has provided these avenues. A wider perspective of the sport (e.g. general articles in the Code of Points), and by using techniques and knowledge developed by other scientific disciplines (e.g. motor control, engineering) can further enhance the influence of biomechanics on this sport in the future (p. 54).

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9. **Creating an internal environment of cognitive and psycho-emotional well-being through an external movement-based environment: An overview of Quadrato Motor Training**

9.1. In recent decades, neuroscientists have become increasingly interested in how the human brain modifies its structural and functional organization throughout the lifespan as a result of various external and internal determinants [5,6]. This phenomenon of neural adaptation and change is known as neuroplasticity [7,8]. It provides a scientific basis for developing, studying, and adopting practical interventions that promote health and well-being across the lifespan in both healthy and clinical populations. [...] The concept of the environment can be defined in various ways. Here, environment refers to both internal and external settings, as follows: the internal environment encompasses intrinsic determinants, namely, the person's neurological and physiological mechanisms, and the external environment comprises extrinsic determinants, including life events and experiences. Internal and external environments do not act independently on the individual, but rather work together to shape thoughts, feelings, and behaviors (p. 1-2).

9.2. Environment and experience also act on the brain and affect behavior. For instance, adversities and negative life events may interfere with physiological developmental processes in the brain, leading to altered neural circuits that have been associated with behavioral phenotypes such as delinquency, physical aggression, depression, and anxiety [13,14]. Meanwhile, positive life experiences and enriched environments can nurture healthy brain function and behaviors [13,14]. Human mental states and behavioral outcomes are thus a reflection of environmental and genetic factors that impact the brain's ability to adapt to changing environmental demands [9,10]. In other words, subjective well-being stems from bidirectional phenotypic adaptation to internal and external environments [14]. The flexibility of neural programming during critical periods seems to be a significant mediator of long-lasting effects on behavior [15,16]. Cognitive and emotional developments coincide with developmental changes in the brain. From birth, the brain rapidly creates connections between neurons that form our habits, thoughts, consciousness, memories, and mind [17,18]. Massive biological changes affect the gross morphology of the brain, including regressive processes (e.g., synaptic pruning), in which unused information is eliminated, and progressive processes (e.g., myelination), which increase the speed at which information travels between nerve cells [19–21]. Furthermore, in accordance with Hebbian theory [22], one of the most effective ways to create a more efficient brain and more focal recruitment of different brain areas, is to strengthen the synapses through repeated experiences and learning (for more details, see [23,24]). That is, learning results in more consolidation of neuronal activity and brain activity becomes more efficient, thus, every experience excites some neural circuits and leaves others unaffected. Increases in the efficacy of synaptic connections, including the connections between higher-order association areas in the frontal lobes, strengthen the ability to exert cognitive and emotional control [19,25], and are thought to support improvements in executive abilities such as response inhibition [26], strategic planning [27], and impulse regulation [28] (p. 2).

9.3. Overall, enhancing synaptic and neuronal activity at afferent locations throughout the brain affects the gross morphology of the brain and plays a particularly important role in the interaction between cognitive and emotional processes and their effects on behavior. Support for interrelated cognitive-emotional processes can be found in studies indicating that executed, goal-directed behavioral responses require interactions and coordination between cognitive and emotional neural circuitries [19,29]. Specifically, different forms of cognitive and emotional processes (e.g., attentional control, emotion regulation) are products of the reciprocal interactions between frontal-subcortical circuits (FSCs) and limbic structures, such as the amygdala [30]. In addition, the prefrontal cortex (PFC) is often associated with changes in behavior and cognition that fall within the broader area of EFs, which play an important role in social and emotional wellness [4]. [...] Of the interventions believed to enable neuroplasticity, PA is one of the most studied [31,32]. [...] By building an external movement-based environment, it is possible to elicit positive neural changes throughout the lifespan. Through this process, PA reduces brain-related physiological and functional decline due to aging, and could potentially be used to improve several brain-related clinical conditions, including neurodegenerative diseases (e.g., dementia), psychiatric disorders (e.g., depression [33]), and neurodevelopmental disorders (e.g., autism and dyslexia) [32,34] (p. 2-3).

9.4. Studies addressing WM [white matter] [109–111] showed that QMT [Quadrato Motor Training, a fairly new non-aerobic, coordination-demanding form of physical activity that involves the incorporation of balance, coordinative movement, a heightened awareness of the body and its position in space, and attention paid to motor responses and cognitive processing] increased FA [fractional anisotropy] and decreased RD [radial diffusivity] in the cerebellum and, more specifically, in the cerebellar peduncles, a brain structure involved in the cerebro-cerebellar interaction and in the connection of this pathway with the midbrain [113]. QMT also resulted in enhanced FA and reduced RD in the anterior thalamic radiations, which are generally related to EFs [executive functions], memory encoding, and planning of complex behaviors [114,115], gait stability, and speed [116,117]. Significant FA increases were also found in both the left and right uncinate fasciculi, which play an important role in emotion regulation, learning, and language functions [118,119]. Other significant FA increases were found in the body of the corpus callosum, suggesting an increase of inter-hemispheric communication between frontal areas [120]. Finally, QMT induced FA increments in sensorimotor tracts (e.g., corticospinal tract), and other brain tracts involved in verbal and visual memory, language, and attention, including the superior and inferior longitudinal and inferior fronto-occipital fasciculi. In fact, increased FA/decreased RD in the right anterior thalamic radiation and left superior longitudinal fasciculus were associated with training-induced improvements in originality and general self-efficacy (see Section 2.4) (p. 7).

10. Dance as therapy: Embodiment, kinesthetic empathy and the case of contact improvisation

10.1. A fundamental notion in Merleau-Ponty's philosophy is the *motor intentionality*. But to arrive at this notion, we must stop for a moment in the consideration of bodily sensations in which we find those perceptions of our own body that are conscious, explicit, and experiential, including differentiated sensations, visualizations, and other mental representations of our body and its parts. Despite the fact that these explicit perceptions include the sensations of hunger, pleasure, pain, and so on, the term ‘‘sensations’’ must be sufficiently wide to cover the perceptions of bodily states. Between these bodily states, we can distinguish those that are dominated by our external senses (such as hearing and seeing) and those more dependent on bodily senses such as proprioception or the kinesthetic sensations. I can consciously feel the position of my hands on the keyboard of my computer or of my legs as I am sitting down; I notice the general orientation of my body, and when I close my eyes I can proprioceptively feel the position of my limbs in relation with other parts of my body and with other objects in my field of experience. Such explicit proprioceptive perceptions teach us about the conditions of our body and help us perform such bodily actions that we put ourselves to do, for example, a person who dances can check her feet to notice that they are appropriately turned in order to make a specific move. But besides these external perceptions, we also have an internal knowledge about the localization and position of our limbs without having to direct the attention directly on them in every moment. This pro- proprioceptive consciousness improves significantly in every movement and gives us a more general sensation of our body, its volume, alignment, figure, and density without the need to use our external senses (p. 92).

10.2. This leads us to the notion of *habit*; Merleau-Ponty, in his explanation about this notion (and referring to it in several passages of *Phenomenology of Perception*) refers to the pre-reflexive character as the way we originally unite with the world, and to the type of ‘‘comprehension’’ that is developed by our body regarding the world. This kind of bodily balance or preparation to which Merleau-Ponty refers to in *Phenomenology of Perception* as *habit* consists of a kind of non-cognitive, pre-conceptual motor intentionality (PP, p. 153). Habit is not a function of reflexive thought, instead it manifests in the perceptual body; it "is the body that "comprehends" in the acquisition of habit" (PP, p. 145). For example, is it not the case that forming the habit of dancing is discovering, by analysis, the formula of the movement in question, and then reconstructing it on the basis of the ideal outline by the use of previously acquired movements, those of walking and running? But before the formula of the new dance can incorporate certain elements of general motility, it must first have had, as it were, the stamp of movement set upon it. As has often been said, it is the body which "catches" (kapiert) and "comprehends" movement. The acquisition of a habit is indeed the grasp- ing of a significance, but it is the motor grasping of a motor significance. (PP, pp. 143–144) (p. 93).

10.3. Now, in daily life, and in practices such as dance of any kind, we trust in our proprioceptive information, we trust our body, this pre-reflexive knowledge of our sensorimotor system. [...] in a choreography, the dancers must learn the dance steps and every move they must move in determined times in determined spaces, in this process of learning that begins at a conscious level of movement. The initial information is processed, but gradually turns into information that no longer requires reflection to take place, we trust in proprioception and in the body itself to make the dance happen. This way, the dancer first thinks every movement step by step, carries out every move carefully until reaching a mastery of every step, and then the body takes control and the reflection on every movement becomes unnecessary. This is the kind of dance that Merleau-Ponty refers to when talking about habit. On the other hand we have dance improvisation; the dancer in this kind of dance is not carrying out a determined kind of movement, but makes improvised movements in the moment of the dance itself. These movements arise from exercises directed toward affectivity more than toward the body. The dancer reacts on the perceptual spatial-temporary input and on their own affectivity and generates movements that evidence a possible dynamic relation between body-movement-affectivity. The crucial characteristics in the dance improvisation that must be taken into consideration are the high levels of alertness of the dancer, a quick reaction system, a sensory-attentional system synchronized with the environment, and a focus toward the bodily movements that actually starts in the affectivity. This considered, what we can notice in the dance improvisation is that the crucial movements are those in which the mind is not thinking and planning every move, but when the body begins to move without the explicit use of a configuration or mental reference, as what we saw earlier on motor intentionality (adding the affective factor that is not evident in Merleau-Ponty philosophy and that is part of another research) in Merleau-Ponty and as what happens in CI [contact improvisation] (p. 95).

11. Music and embodied cognition: Listening, moving, feeling, and thinking

11.1. If music cognition is embodied in a musically meaningful way, in the flesh of experience, then we ought to be able to specify just how this occurs. One way begins in imitation of musical sounds and of the physical exertions that produce them. This bodily comprehension of sounds and of sound-producing actions is one of the bases of embodied cognition of music, and it is the central basis that we will be exploring in the following chapters. The issue of musical embodiment may be relatively straightforward in the case of performers, in the sense that performing, planning, and otherwise thinking about musical performance are tied to the bodily actions of performance. But the situation is less straightforward in the case of listeners: How and why would listening to or thinking about music, apart from planning or recalling one's own performance, have anything to do with embodiment beyond the operations of the auditory system? The answer offered here is that listening to, recalling, or otherwise thinking about music involves one or more kinds of vicarious performance, or imitation (or simulation), and that the role of this imitation in music is a special case of its general role in human perception. The gist of this idea is not new, but the details of how it actually plays out in music comprehension will take some time to describe (p. 11).

11.2. I will refer to overt mimetic behavior as *mimetic motor action* (MMA), and for the relevant muscle-related brain processes that do not manifest in overt actions I will use the term *mimetic motor imagery* (MMI): *mimetic* for imitative, *motor* for muscle related, and *imagery* for "thought," "imagination," or "mental representation." I intend *imagery* to include not only voluntary and conscious forms, but especially those forms that occur automatically and with or without our awareness. The involuntary and non-conscious forms of MMI are in some respects the most significant in the construction of musical meaning. It is important to distinguish *imagination*, as the term is commonly used, from *imagery*. When I imagine playing the cello, for example, this is normally a conscious and deliberate enactment of motor imagery, and when I imagine playing the cello like Jacqueline du Pré, this is conscious and deliberate MMI and is thus a special case of MMI generally. MMI is grounded in motor-related brain processes that occasionally become conscious and occasionally are initiated deliberately.
[...]

1. Sounds are produced by physical events; sounds indicate (signify) the physicality of their source
2. Many or most musical sounds are evidence of the *human* motor actions that produce them
3. Humans understand other entities (animate or not, human or not) and events in their environment in part via mimetic behavior (MMI and MMA)
4. MMA and MMI are bodily representations of observed actions
5. Mimetic comprehension is based on visual, auditory, and/or tactile information:

- The observed behavior can be seen, but not heard (the sight of action)
- The observed behavior can be heard but not seen (the sound of action)
- The observed behavior need not be seen or heard (the feel of action)

6. Musical imagery is partly motor imagery
7. Mimetic behavior (MMI and MMA) involves the variables of volition, consciousness, and overtness:
   - Mimetic behavior can be voluntary, but often it is involuntary
   - It can be conscious, but often it is nonconscious (beyond awareness)
   - It can be overt but often it is covert (occurring only in imagery)
8. MMI and MMA are more strongly activated in observation of goal-directed actions
9. MMI and MMA occur in real time, recall, and planning
10. MMI and MMA take three forms:
    - Intramodal, or direct-matching (e.g., finger imitation of finger movements)
    - Intermodal, or cross-modal (e.g., subvocal imitation of musical sounds generally)
    - Amodal (abdominal exertions that underlie limb movements and vocalizations)

[...]

(p. 12-13)

11.3. Social interaction among humans and other animals involves individuals comprehending and responding to the gestures of others. These include limb movements, gaits, postures, facial expressions, and nonlinguistic vocalizations, all of which contribute to “body language” or nonverbal communication. Among humans and some other species, comprehension of these gestures involves both mimetic and nonmimetic processes. In this section I described how mimetic comprehension plays out and both functional and aesthetic human experiences, including comprehension of musical gestures. Because gestures signify something of the state and/or intention of the gesture, let us refer to them as gestural signs. While comprehension of a gestural sign is sometimes conscious, more often it is either unconscious or only marginally conscious. For example, the subtle gestural signs, or *microexpressions* (Ekman 2001) that signify attempted deceit may register explicitly in consciousness and provoke a corresponding response (such as a belief that the speaker is lying), or they may register only implicitly (nonconsciously) and provoke a subtler response (such as a feeling of doubt), or they may not be recognized at all and thus provoke no response (the deceit goes undetected). The issue here concerns the role of MMI in comprehending these and other gestural signs. We can begin by acknowledging that imitation is not directly relevant in comprehending all gestures. For example, imitation is not needed for the comprehension of, and appropriate response to, aggressive gestures that threaten immediate bodily harm, as in the cross-species case of walking past a parked car and being surprised by a dog suddenly barking at me: my startled response is, I want to say, entirely nonmimetic. Despite the significance of such cases, however, they are exceptional. The majority of gestural cues that we read in other people and animals are more subtle and nonthreatening, and comprehension of these cues regularly involves imitation (p. 19-20).

12. Dance as a way of knowing

12.1. Movement has the capacity to touch us physically and emotionally at our roots, provoking the deepest emotions, from love to fear to joy to abandon. One of the central aspects of dance that I integrate in my own work with students is the act of play. Dance has the capacity to be the muscle of the imagination, a magical invitation through the creative process to reimagine new worlds. This is the same imagination that is needed for every new beginning in life, whether it is a different way to lead, a personal decision, a cure for cancer, or a way to build the bones of innovation. The art of play connects each of us to material that is often dormant in our lives, whether that is a new way of moving, accessing places of emotion, or inspiration. The creativity of dance accesses the place within us that has primal imagination. Integrating play within dance making has the capacity to return us to the place where we lose inhibitions of the self-consciousness of our bodies and remember our bodies back to themselves (Snowber, 2007). Play also gives us the courage to access aspects of dance making, which include lament and sorrow, for the paradox of both beauty and loss always honors the whole person's experience in the world (p. 56).

12.2. Dance accesses many kinds of knowledge beyond kinesthetic intelligence, including visual, tactile, mental, cognitive, and emotional intelligence. And the contribution of dance, choreography, and improvisation to a broad way of understanding and perception is clear from the works of dance education scholars over the years (Fraleigh, 2004; Hanna, 1987, 2008; Shapiro, 1999; Stinson, 1995). [...] The body has constant data that speaks to us, whether it is the flurry in the stomach, the stretch of an elbow, or the abrupt contraction. Body data is the information that occurs in the present moment, the immediate present time, the ways we experience information through our bodies (Winton-Henry and Porter, 1997). The choreographer and performer have long known that the creative process is one of questioning and sifting, forming and unforming, making and remaking, and always a place of discovery (Cancienne, 2008; Cancienne and Snowber, 2003). By dancing our questions, we can uncover the questions underneath the questions and open up a deep listening to the body's knowledge. Dance awakens us to emotional and spiritual intelligence, as Anna Halprin (2000), a pioneer in integrating dance as a place of discovery, has modeled for many years. The dancer follows the movement impulse and is awakened to the nuances of the language of the heart, one that calls us back to an ancient way of knowing. The place of not knowing is fertile ground for excavating the choreographic process and opening the whole body and mind to a place of growth. Knowledge opens to the dancer in ways that are particular to the body's insight through its capacity to explore both balance and nonbalance, gravity and levity, or contraction and release. Principles of composition in dance and improvisation have correlations to how one can perceive and understand themselves and the world around them (p. 57-58).

SECONDARY SOURCES

1. **Embodied Cognition With and Without Mental Representations: The Case of Embodied Choices in Sports**

    1.1. We argue that when embodied choices in complex environments such as sports are considered, taking two recently discussed theoretical approaches into account can be useful. One of them assumes that there is mediation between a person and the environment through mental representation, and the other assumes direct contact between a person and the environment and thus no need for mental representation. Both approaches will be used to contrast interpretations of embodied cognition in sports (p. 2).

    1.2. Radical embodied cognition approaches assume that the functioning human body itself constitutes a cognitive process (Chemero, 2011; Jacob, 2016). According to Jacob (2016), there are at least two approaches. The "basal radical" approach principally denies the existence of representations and challenges computational approaches to cognition. We refer to this as taking a direct contact approach. The "constructive radical" approach describes bodily processes with regard to their functionality and as a component of cognition. In some cases, a constructive radical approach accepts that there can be a mediating role of mental representation (see Newen et al., 2018, for a range of positions). In sports, this discussion can be traced back to the motor-action controversy (Beek and Meijer, 1988), in which a rather representational approach based on motor program theory (Schmidt, 1988) and an ecological approach to movements (Reed, 1988; Warren, 1988) that excludes representations from its explanations were pitted against each other (p. 2).

    1.3. The conceptual basis of this paper is that empirical findings indicating effects of sensorimotor processes on cognitive processes cannot be ignored (Goldinger et al., 2016) or explained as an "epiphenomenon" (Topolinski, 2010). Further, following the frequently cited review "Six views of embodied cognition" (Wilson, 2002), we agree on Wilson's major assumption of cognitive processes being situated, dynamic, and functional and serving actions or being expressed by actions. The mental representation and direct contact approaches differ in whether they see a strict separation of the environment and the person (p. 2).

1.4. The enactivist approach tends to start from the individual, characterizing the individual's exploratory, self-regulating behavior. Here, we present a particular ecological framework that combines dynamical systems with Gibsonian ecological psychology: the ecological dynamics framework (Araújo et al., 2006, 2017). This approach stresses the primacy of individual-environment relations in understanding cognitive processes. The link between a performer and his or her environment is the proposed starting point for understanding how performers move about, select routes, decide with whom to cooperate, and compete with adversaries in the actual competition environment (see Correia et al., 2013, for a review of studies exemplifying how). In the representational view, the behavioral expression of those decisions is not at the heart of cognition because behavior is assumed to be an implementation of a mental representation (p. 5).

1.5. An individual's behavioral history as well as the skills and characteristics of the body channel action to a landscape of possibilities for behavior (affordances) offered by a particular environment. The field of affordances reflects the multiple possibilities for action that stand out as relevant for each individual in a particular situation because of his or her specific training, skills, and experience in related tasks (Rietveld et al., 2018). This means that the affordance landscape is constrained not only by the past (e.g., what is in memory) but also by the future, that is, by task goals, actions' path dependency toward which the current action may be directed (not necessarily expectations or beliefs about the future). Behavior is an expression of skill, and at the same time, it is an expression of how the environment draws the individuals into it and solicits actions (Gibson, 1994; Reed, 1996) (p. 5).

2. Optimizing Performative Skills in Social Interaction: Insights From Embodied Cognition, Music Education, and Sport Psychology

2.1. Expert musicians and skilled athletes often display the stunning ability to adapt to, and coherently engage with, the shifting demands of their contingent milieu. A sudden change in the tempo of a music performance or the emergence of a particular spatial configuration of players in team sports requires the immediate generation of appropriate novel actions to keep the music "alive" or the sport performance possible. Traditionally, this process is described as a largely automatic mechanism, where little or no attention is dedicated to the generation and enactment of the new actions (see Dreyfus and Dreyfus, 1986; Schmidt and Wrisberg, 2008) (p. 2).

2.2. It has been argued that the automaticity of such mechanisms develops through a progressive shift from an initial phase where skills are acquired to a final performative stage where the task (e.g., repeating and elaborating an "error" to make it sound intentional in improvised music or dribbling the opponent in ball games) can be achieved without any explicit “cognitive” involvement (c.f., Papineau, 2013). By this view, musicians and athletes do not follow pre-defined rules as they become experts; it is only at the beginning of the process, when skills are acquired and developed, that these schemas need to be examined and discussed (p. 2).

2.3. In this article, we aim to provide additional grounding for this line of research by comparing and further developing original themes concerning how performative skills are acquired and optimized by novices in the context of music and sport. In particular, we will draw on recent research in embodied cognitive science (ECS) with the aim of developing a more integrated view of how action and thought shape each other dynamically. Scholars inspired by ECS emphasize the deep continuity between perception, action, biological organization, reflection, and intersubjectivity (Di Paolo et al., 2017). By this view, talking about the physical location of the mind becomes meaningless. Instead, “mind” is here conceived as an emerging property of the interplay between a brain–body system and the contingent (social, cultural, physical) environment in which the organism is situated (Thompson, 2007) (p. 3).

2.4. ECS [embodied cognitive science] offers a non-reductive view of mental life− one that brings together insights from disciplines such as theoretical biology, linguistics, phenomenology, aesthetics, constructivism, ecological psychology, and complex systems theory, among others (see e.g., Shusterman, 2009; Stewart et al., 2010; Colombetti, 2014). In its broadest sense, the central idea of ECS is that physical resources from the entire body of a living system and its environment participate in driving cognitive processes. Therefore, our capacity to think, feel, reason, and interact with others depends directly on the ongoing patterns of interaction between a brain–body system and its niche (Johnson, 2007; Clark, 2008). Because factors external to the brain are said to co-constitute the mind, this approach offers a useful alternative to more traditional accounts of mentality, which are often based on an individualist and internalist perspective (p. 4).

2.5. More recent scholarship inspired by ECS and phenomenological philosophy offers a different view. If we are to consider the body as a constitutive tool for cognition, we cannot but examine the body in its dynamical interplay with its environment. The body, in other words, does not operate in a vacuum (Chemero, 2009). Because of this, ECS emphasizes the necessarily full involvement of body and world for the realization of mental life. This involves patterns of behavioral, emotional, and social adaptivity that are enacted within a contingent milieu, giving rise to a complex *brain-body-environment system*, where aspects inherent to each of them are mutually relevant for its maintenance and development (Varela et al., 1991). Such a view resonates with earlier insights on the notion of "functional system" discussed by Luria (1966), who defined *flexibility* as the set of constant and coherent goals implemented by the responses emerging from the environment (p. 4).

3. Introduction: when embodied cognition and sport psychology team-up

3.1. [...] excellence in sporting skills inspires embodied cognition by exhibiting tangible evidence that the details of our bodily constitution are not accidental to our mental powers, but define them in various inherent ways: not only because the informational processes that realize our intelligent functions are specifically regulated, distributed, filtered, or scaffolded by the physical and biological compound that implements them (Shapiro 2011); but also because the modes and the efficacy of our practical intelligence primarily depend on the originary unprincipled engagement with a perceptual environment that can only be discovered by and become meaningful to an embodied agent (p. 213).

3.2. [...] it is not just metaphorically that we speak of "good feet" and "quick hands" as making a difference in the way a professional football player or a Formula One pilot perceive the world and skillfully cope with it, because the athlete's conceptual understanding and decision-making capabilities build first of all on her situated expertise, i.e., on the development of a direct responsiveness to the surroundings, a readiness to anticipate and take advantage of the opportunities of action that the others cannot see. Maurice Merleau-Ponty (1945) used to characterize this practical, relational know-how as a sort of "tacit knowledge" or "knowledge in the hands", a kind of proficiency that—as opposed to the conceptual knowledge based on explicit instructions, stored heuristics, and amodal representations – relies on the concrete familiarity with practical contexts and personal or interpersonal experience situated in the contingencies of individual or collective performance (p. 213-214).

3.3. The theory of embodied cognition resonates at least in part with some of the psychological doctrines situated at the root of the sport sciences, e.g., both the cognitive-computational approach by Fitts and Posner (1967) (which stresses how bodily engagement with the environment provides specific tools for perceiving, remembering, thinking, and acting that can hardly be replaced by "intellectual" skills on their own) and the cognitive-ecological approach by Gibson (1979) (maintaining that the physical constitution of our body carries out a significant portion of the information-processing traditionally attributed to mentation). These psychological doctrines are deeply implanted in the everyday research practice of the sport sciences; that is why it is not surprising that the most influential theories of embodied cognition begin to be seriously addressed (though not universal[ly] accepted at all) by many researchers in sport psychology (p. 214).

3.4. But what is exactly an athletic skill, and how does it deploy the kind of situated intelligence studied by embodied cognition? This special issue of *Phenomenology and the Cognitive Science* tries to answer this question from a particular perspective, i.e., investigating what happens when sporting skills stop working and unreflective know-how is temporarily impaired: strikingly, it is when our routine coping skills break down that the very normative structure of intelligent action becomes most perspicuous. In this spirit, this collection of papers is meant to recapitulate, compare, and possibly expand, through the help of the phenomenologically oriented cognitive sciences, the explanatory models of the debilitative phenomenon called “choking under pressure” or the “choking effect” (Beilock 2011). This phenomenon is related to a multifaceted complex of cognitive, motivational, and emotional dynamics that are largely studied—but diversely defined—by sport psychologists (Mesagno 2013; Mesagno and Hill 2013). While the scientific definition of choking may vary significantly, and there is no universal agreement about its nature and causes, the term refers to a common paradox many practitioners have to become familiar with in their everyday life: expert athletes often produce below-standard performances (suddenly failing even routine tasks) just during competitions that overemphasize the expectation to produce excellent results (p. 215).

3.5. Embodied cognition theory deeply resonates with this idea and provides its perfect background: as importantly observed by Powers (1978), competent goal-directed action involves monitoring one’s perceptions of how the world is changing as one acts, not the actions themselves; and, interestingly, similar ideas were subsequently elaborated in various flavors by the sensorimotor theories of consciousness and enactive cognition theory (Varela, Thompson, and Rosch 1991; O’Regan and Noë 2001; Noë 2004; Thompson 2007). Powers’ perceptual control theory maintains that the skill of a performer consists in making—with her actions—the world look a certain way, as it is how the world is changing (toward or away from the desired goal state) that constitutes the information that guides action in real-time and allows adjustment to the immediate changes. The full acquisition of automaticity in these sensorimotor feedback loops, which is possible when the online updating of the body-world configurations brings about a dynamic coupling between the agent and its cognitive environment, is exactly what allows for reliable predictability and flexible adaptivity in our skillful sensorimotor performances (p. 217-218).

4. Moving Wisdom: Explaining Cognition Through Movement

4.1. Starting with the notion of activities for which performance, movement, and the pursuit of excellence are central, the two driving questions are: 1) what may be fruitful ways to modify existing research mores and theoretical assumptions in cognitive studies? In this regard, this study is an overture to expand the cognitive canon. And, 2) how do we integrate the cognitive sciences with the normative? Uniquely, the normative weight to excel is derived not only from conceptual requirements from the ethical sphere, but also from work in the mind sciences and skillful coping that is connected to standards inherent to and resulting from the active pursuits central to this examination—sports, performing and martial arts, and crafts. Animate bodies, in particular as incorporated into active pursuits, best show the connection between the normative and the cognitive, and how these correlate with bodies, their kinetic capabilities, and the context of a community (p. 59).

4.2. To effect this, I propose to expand the current research in congruent ways to Shaun Gallagher and Dan Zahavi's proposal in The Phenomenological Mind, where they write, "If real progress is to be made in the study of the mind, it requires a collaborative effort that draws on all the available resources and that integrates a variety of theoretical and empirical disciplines and methods."(2008: 221. My emphasis) My goal is to make a case for active pursuits, highly demanding in an intelligently kinetic and tactile fashion, to legitimize them as activities themselves, objects of study, and cognitive modes. In particular, I wish to go beyond vision, normality and the pathological to also incorporate much more explicitly the kinetic-tactile and the exceptional under a framework that re-conceptualizes matters (p. 60).

4.3. A more inclusive view of what counts as cognition is in order. Robert P. Crease's points out that of the two ways we have of knowing the world, one theoretical and linguistic, endorsed by science, and the other experiential, subjective and practical, we feel as if we must prioritize and favor the former. After convincingly arguing that athletes do not 'know' the laws of physics but rather know the laws of 'physics,' Crease concludes that, "Conflating the senses of knowing – and giving priority to the theoretical sense over the practical – simply reflects our adherence to the ancient myth that true knowledge is theoretical." (2012a: 19) Indeed, both are complementary and serve our varied needs and interests. As a matter of fact, most of our every day lives' interactions take place in the realm of the practical as Edmund Husserl points out (Gallagher and Zahavi, 2008:136) (p. 60-61).

4.4. Aligned with and building on a modified cognitively embodied approach I contend that active pursuits, being grounded in movement, 1) cultivate our capability to learn and excel kinetically and kinesthetically, and 2) are not merely advantageous but vital to understanding cognition, particularly as it intersects with excellence. And this as subjects of study, and as methodological tools and modes themselves. The overarching context is one of practical abilities that are displayed and rooted in corporeal kinetic cognition, i.e., intelligence originating in movement, touch, and corporeality intentionally engaged in purposive practices such as sailing or dance. Moreover, to handle the inherently practical challenges requires a creative modus operandi and the exercise of skill. As Maxine Sheets-Johnstone argues in The Roots of Thinking and elsewhere, movement has intrinsic gnostic possibilities, especially when coupled to refined methodological analysis (1990). In this way Theoria becomes kinetic praxis – wise intelligence grounded in movement. Crucial to this is the view that animate movement, a body kinetically engaging its environment, enriches our lives cognitively and existentially. Further contentions are that knowledge and excellence thrive, ceteris paribus, in rich communitarian collaborative climates (entailing socially cognitive import), and that both originate in said intersubjective context (p. 61).

4.5. The idea of the extended mind, that our cognition is partly located in the external environment, is hotly debated in contemporary philosophical circles, as Richard Menary makes patently clear (2010). One way to address the issue is to observe, analyze, and incorporate insights acquired from highly-skilled athletes, craftspeople, or performers (some may be philosophers, scientists themselves) who, working with tools or interacting with the environment, couple kinesthetically in ways that extend normal human skills and discriminatory and experiential possibilities. Climbers who can "read" mountain faces to find seemingly impossible lines, surfers and kayakers who also read water and rocks like open big-print books, sailors whose boat becomes like an extension of their persona, or woodworkers or metalworkers who handle their tools as veritable corporeal extensions can help reveal how our cognition may be outsourced and genuinely coupled to the external environment by way of refined skills such that the inner/outer distinction is one of degree and not kind—the porosity of the frontier depending on the skill level and level of reflection… all part of a process of self-cultivation. This may lead to a better understanding and perhaps more meaningfully warrant for experiences where one feels at one with tool or rock or water. In other words, since movement involves a kinesthetically aware body kinetically and tactilely engaging with and coupled to the environment in mutually responsive ways, analysis of these pursuits also implies norms and ways that implicate extended models of the mind (p. 79-80).

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5. How did we get from there to here? An evolutionary perspective on embodied cognition

5.1. Given that many of the precursors to human intelligence are present in other animals—some in virtue of related lineage, others by convergent evolution—one might ask why various unique human abilities have not arisen in other species. It is difficult to see how these kinds of abilities could not contribute to adaptive fitness. Why, then, are humans the oddballs? One possible reason is that the "engineering solutions" required to build such a cognitive system may not be easy for evolution to construct out of previous genetic resources (cf. Wilson, 2002, p. 627). If this is true, then humans are the beneficiaries of a lucky and unlikely evolutionary accident. An alternative explanation, and one that is gaining some empirical support, is that the caloric needs of brain tissue offset the survival advantages of smarter brains. According to this view, hominids broke through the brain-size barrier by learning to extract additional calories from their environment, through the discovery of roots and tubers (“underground storage organs”) as a food source during times when other food sources were unreliable (Laden & Wrangham, 2005; Yeakel et al., 2007), or the discovery of cooking, which releases additional calories (Lucas et al., 2006; Gibbons, 2007) (p. 379-380).

5.2. How do we embody abstract thought? In the early years of embodied cognition theorizing, this was a large unmet promissory note. It was assumed that progress would be made in this area, and plausible examples were proposed, but empirical data were lacking. Instead, studies tended to focus on embodying thoughts that were themselves very close to external activities, such as mental rotation (Kosslyn et al., 1998), playing video games (Kirsh & Maglio, 1994), and understanding mechanical diagrams (Hegarty, 1992). Recently, however, considerable progress has been made in identifying the embodied underpinnings of various cognitive domains. These include representation of language and of abstract concepts (Barsalou, 2005; Gallese & Lakoff, 2005; Zwaan & Taylor, 2006), spatializing of abstract quantities such as numbers and time (Stoianov et al., 2008), gesturing to support cognition (Broaders et al., 2007; Goldin-Meadow, 2006), and offloading information onto body-based resources in working memory (Wilson, 2001b; Wilson & Fox, 2007). The striking feature that these have in common is the way in which we expand the domain of what is “embodyable” by creative use of body resources, decoupled from immediate action on the environment (p. 380-381).

6. At the root of embodied cognition: Cognitive science meets neurophysiology

6.1. [T]he central point of Gibson’s theory was his explicit refusal of the dichotomy between *action* and *perception* and the underlying dualism between physical and mental capacities; ‘‘So we must perceive in order to move, but we must also move in order to perceive’’ (p. 223). Gibson’s pioneering efforts and his ecological perspective certainly represent a fundamental antecedent for the paradigm of *embodied cognition*, which is steadily making headway in the panorama of cognitive science. Lakoff and Johnson (1999) effectively described this progressive mutation of the cognitive science paradigm, by distinguishing between first generation and second generation cognitive science, defining them *disembodied mind* and *embodied mind*, respectively. The first generation of cognitive science coupled the computational metaphor of cognitive processes as software- independent of cerebral hardware- with an abstract conception of reason, which, in a Cartesian way, was considered as being independent from the body and its activity. Conversely, the central point of second generation cognitive science is represented by close interaction between mind and body, between thought and action, between rational schemas and sensorimotor schemas. Just as Varela, Thompson, and Rosch (1991) before them, Lakoff and Johnson identified the matrix of the concept of *embodied* in the phenomenology of Merleau-Ponty (1945/1962) and in the dual valence of the notion of *body* within it: bodiness is a combination of a physical structure (to the biological body) and an experiential structure, which corresponds to the living, moving, suffering, and enjoying body. From here we arrive at the dual acceptation of embodied cognition, which refers, on one hand, to the grounding of cognitive processes in the brain's neuroanatomical substratum, and on the other, to the derivation of cognitive processes from the organism's sensorimotor experiences. Therefore, second generation cognitive science differs from the first, not only in its refusal of computational functionalism, but also in the actual conception of its subject, human cognition (p. 101).

6.2. The motor system's role in categorization processes was shown earlier in canonical mirror neuron studies conducted on primates. Canonical neuron experiments demonstrated that the same neurons fire and simulate an interaction schema, not only in response to the same object, but also in response to a group of objects with the same characteristics, in terms of allowing a certain type of interaction. In other words, objects are categorized according to the type of interaction they allow. Similarly, mirror neuron experiments demonstrated that the same neurons are activated and simulate an observed action in response to different movements, e.g., movements that are executed with one effector rather than another, but which have a common purpose. The conclusion was that actions can be categorized according to their intended purpose. As with Rosch's categories, an adaptive dimension also emerges for canonical and mirror neuron simulative mechanisms. Being able to represent objects according to their motor function is certainly advantageous in the evolutionary sense, as it allows the immediate production of an interaction schema that is appropriate to the object's use. Mirror mechanisms also offer great adaptive value in understanding other people's actions. In fact, being able to represent objects in terms of their purpose can help us predict other people's behavior (Gallese, 2003; Gallese & Goldman, 1998). Furthermore, the same advantage has been observed for categorization based on simulative mechanisms found to be implicated in the emotional system: ''the evolutionarily most ancient systems linked to emotional life may also provide a further, and possibly even more basic, description of objects such as 'edible,' 'not edible,' 'dangerous,' 'sweet,' etc.'' (Gallese, 2000, p. 32) (p. 105).

7. Deeper than reason: Emotion and its role in literature, music, and art

7.1. Another striking feature of emotion consists in physiological responses of various kinds. When we see a man who is angry, we may notice that his face is getting red and his hands are trembling; that he is beginning to sweat, and his face is contorted. These are all physiological symptoms of his emotional state, but once again it doesn't seem right simply to identify emotion with physiological changes. After all, each of the marks of anger just listed may be nothing more than symptoms of strenuous exertion. [...] Currently, the most widely accepted theory of emotion is probably the 'cognitive' or 'judgement' theory of emotion. What, after all, is the big difference between the trembly feeling I get when I'm in love and the trembly feeling I get when I run up the stairs too fast? In the one situation my feeling is caused partly by a rapid heartbeat brought on by a sudden burst of strenuous exercise; in the other situation my feeling may be (partly) caused by a rapid increase in heartbeat, but in this case the increased heartbeat appears to be caused not by some physical activity I'm engaged in- such as running too fast- but by a judgment that I make, the judgment that my beloved has arrived and that he is a darling of my heart. [...] The judgement theory also explains why the same piece of behavior or tendency to behave in a certain way is sometimes the result of an emotion and sometimes not. If I care for you and cherish you out of love, then my behavior is plausibly construed as a result of my judgment that you are the darling of my heart, a wonderful person, and a joy to be with. Alternatively, if I care for and cherish you solely out of a sense of duty, then my caring for and cherishing you is caused by my sense of duty; I do not judge you to be the darling of my heart; I may be indifferent to you or even dislike you (p. 7-8).

7.2. [E]motions are essentially ways in which organisms interact with their environments. As we shall see, fish and even insects respond emotionally to their environments, and some non-human mammals have a fairly rich emotional life. Human beings, with their capacity for language, enjoy more diverse and subtly differentiated emotional states than do fish or monkeys, but their emotions too are not essentially private events but interactions with the environment, ways in which people deal with the characteristic situations in which they find themselves, situations arising from the nature of their physical limitations, as well as their physical and social environment. Emotions are ways of evaluating the environment in terms of how it affects the organism, and this is just as true whether we are thinking of crayfish, frogs, cats, chimpanzees, or human beings. So for this reason alone I think it is wise to think of emotional states not as directed toward propositions (*the fact that* Jones had offended me by stealing my car or *the thought that* I have suffered an irrevocable loss) but as provoked by the environment, whether internal (our thoughts and imaginings) or external (Jones and death and taxes), viewed under a particular *aspect*, as threatening, as amiable, as offensive, etc. Emotions are provoked when frogs, cats, or humans interact with the environment, viewed in terms of its effect upon their wants, interests, and goals (p. 18-19).

8. Embodied research: A methodology

8.1. The following methodology is based on the argument for embodied research put forward in *What a Body Can Do: Technique as Knowledge, Practice as Research* (Spatz 2015). That volume includes a range of scholarly, artistic, and practical references for the ideas discussed below. Here I attempt to offer a compact and accessible introduction to embodied research to support its implementation both inside and outside the university. The methodology is written in an accessible, second-person style. It is intended for embodied researchers at all levels and especially for hybrid practitioner-researchers and artist-scholars who come to academia with a strong background in embodied practice. I believe it offers an important complement to more discursively oriented proposals. The methodology is organized in five sections:

1. Introduction to embodied research
2. Framing your project
3. Working with people, space, and time
4. Archives and documents
5. Criteria for assessment

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8.2. In an embodied research project, at least these three kinds of resource[s]—people, space, and time—come together in practice. Surprisingly, there is no generic term for a repeatable structure of embodied practice. Dancers speak of choreographies and structured improvisations; musicians and actors of scores; coaches and healers of exercises and sequences; athletes (and others) of games; spiritual leaders of rituals and calendars—but there is no word for the general phenomenon of a repeatable pattern of practice. Some scholars use the word "performance" for all of these things, emphasizing their function as social and cultural communication, but many important patterns of practice are solitary or private affairs. For this reason I use the phrase "practice structure" to refer to any repeatable structure of practice. Thinking of choreographies, scores, structured improvisations, exercises, sequences, games, and rituals as practice structures allows us to move more easily across these disciplinary boundaries. It also allows us to develop embodied research projects without having to define the genre or category of our practice—whether dance, theatre, or music; martial, healing, or performing arts. Such distinctions are historical developments attached to technical choices that support the development of specific kinds of practice structure as opposed to others. The most innovative embodied research projects are often those that combine elements from different genres within a new and innovative practice structure. Such combinations are limited only by matters of technical compatibility, not by the boundaries of genre or style, and must be discovered and developed through embodied research. More than the body itself as a physical object, the practice structure is the focus of embodied research (p. 18-19).