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Designing parkour-style training environments for athlete development: Insights from experienced Parkour Traceurs

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Abstract

Contemporary models of motor learning implicate the value of Parkour-style training as an activity to enrich athletic performance in different sports. We explored Parkour Traceurs' experiential knowledge on the range of physical, perceptual, psychological and social skills that they perceive to be developed during Parkour practice and performance. We also investigated their recommendations on how to design Parkour practice to facilitate the development of foundational performance behaviours. Experienced male Parkour Traceurs (n=14) were interviewed using an open-ended, semi-structured approach, with a two-stage thematic analysis being conducted to identify themes. The analysis identified two dimensions: Skills Developed Through Parkour and Recommendations for Designing Parkour Training Environments. Parkour Traceurs outlined numerous physical (locomotor skills; endurance; strength; agility; balance), perceptual (multi-limb coordination; control precision; rate control; response orientation), psychological (problem solving; stress relief; self-efficacy; risk management) and social (networking; initiative; social perceptiveness; receptiveness to feedback) capacities and skills that could be augmented through Parkour training. Parkour Traceurs explained how indoor Parkour environments should promote creative and exploratory movement behaviours that enable physical conditioning, whilst enhancing decision making and action functionality. Responses suggest that these aims are often achieved by designing a modular practice landscape where Parkour Traceurs manipulate the spacing, orientation and angles of bars and wall set-ups to facilitate the development of different perceptual, cognitive and physical skills. In conclusion, this study provides insights on how affordances offered by a Parkour environment could be integrated into practice to enhance athlete self-regulation and transfer of functional behaviours to team sport performance. **Key Words:** Affordances; Athletic Development; Athletic Skills Model; Donor Sport; Free Running.

Introduction

Since the 1990s, the popularity of Parkour has undergone rapid expansion in countries across the globe (Akinson 2009; Stranding and Maulder 2015). Parkour requires performers (known as Traceurs) to negotiate obstacles with differing properties such as textures, surfaces, inclinations, sizes and angles in the most efficient and effective way possible (Greenberg and Culver 2019). In comparison to many other sports, preparation for performance in Parkour differs from traditional coaching methods, with coach-led instructions and feedback being limited. Rather, learning tends to take place primarily through exploration and self-guided experiences of discovery and exploration (Greenberg and Culver 2019).

With origins in France, early Parkour Traceurs utilised George Hébert's *Méthode Naturelle,* a training model focused around exercises relating to basic movement skills. This focus on skill development through exploration of one's environment to develop adaptive and versatile performers shares many parallels with contemporary approaches to skill acquisition and motor learning informed by concepts of ecological dynamics theory (Chow et al. 2019) and the Athletic Skills Model (Wormhoudt et al. 2018). These contemporary pedagogical approaches advocate that, to develop health, well-being and athletic potential, coaches need to design learning environments that first enrich foundational athletic skills, from which future specialised performance behaviours and self-regulation linked to a target sport can be developed (Savelsbergh and Wormhoudt 2019). However, many talent and skill development programmes continue to favour early specialisation which advocate a training focus on one specific sport (and repetition and rehearsal of its specific techniques) from an early age (for a review see: Coutinho, Mesquita, and Fonseca 2016). The early specialisation model, however, can result in some areas of sport performance being underdeveloped (Güllich 2017) and may result in physical, psychological and emotional problems for developing athletes (Coutinho, Mesquita, and Fonseca 2016). The conceptualisation of ecological dynamics

proposes that early training in athletes should comprise of rich and varied opportunities for action (termed *affordances*) in order to enhance self-regulation in performance. It is through the invitation of relevant affordances that practices are maintained and regulated (Kiverstein, van Dijk, and Rietveld 2019). Therefore, practice landscapes should be designed to invite learners to pick up and utilise affordances for perceptual, cognitive, psychological and physical behaviours in a varied range of sports and activities (Renshaw et al. 2019). These functional self-regulation behaviours can often be developed during unstructured activities and experiences, conceptualised as 'enrichment activities' which are not always coach-led.

Aligned with the ecological dynamics conceptualisation of skill acquisition and talent development, the Athletic Skills Model introduces the concept of 'donor sports' as a way to enrich practice and enhance athletic performance and avoid the documented problems with early specialisation in sport (Wormhoudt et al. 2018). Donor sports are proposed to "donate" elements of basic athletic skills that enable performers to excel in a target sport through transfer of skill learning between sports or sport elements, which support athlete performance functionality at the moment of sport specialisation (Savelsbergh and Wormhoudt 2019). Donor sports target the development of general capacities that underpin functionality of each athletes perceptual skills and intrinsic dynamics (e.g. anticipation, balance, coordination, postural stability, strength, visual search) under a new set of performance constraints (Strafford et al. 2018). Therefore, the integration of donor sports into sports practice requires careful and continuous transition between generality (non-target sport and activities) and specificity (engaging with specialised training in a target sport) of skill transfer (Travassos, Araújo, and Davids 2018). This process of skill transfer enriches performance in a target sport by developing higher levels of behavioural adaptability (Seifert et al. 2019). Hence, engagement with donor sports can be useful when functional behaviours, such as perception, action, and decision-making for a target sport are considered to be underdeveloped. It is the

overlap of fields of relevant affordances in a practice landscape with those of the donor sport which provides the platform for skill transfer (Ranganathan and Newell 2013; Wormhoudt et al. 2018; Kiverstein, van Dijk, and Rietveld 2019). This is illustrated, in the performance of stepping and reaching actions in parkour (as a donor sport), which could be specifically transferred to the side-step cutting manoeuvres required in soccer when dribblers have to drive past opponents during the 1v1 sub-phases of the game (Strafford et al. 2018).

Empirical evidence for the role of specific donor sports in enriching athletic behaviours is currently needed. Strafford et al. (2018) proposed Parkour as a suitable donor sport for team games, given the emphasis on enjoyment and creativity in movement exploration, rather than relying on rehearsing technical movement patterns in traditional drill-based, repetitive practices. Strafford et al. (2018) proposed that Parkour-specific techniques such as foot placement, landing, and turning ability share functional performance behaviours, transferable to the spatial-temporal requirements of team sports through a shared network of affordances (see also Travassos et al. 2013). Moreover, Parkour has potential psychological benefits, such as enhanced perception, cognition and emotional self-regulation, as athletes begin to regulate emotions when they need to control their performance behaviours under pressure (O'Grady 2012; Merrit and Tharp 2013). However, researchers and practitioners need to consider how affordances offered by a Parkour environment could be designed into practice landscapes, which facilitate their utilisation, and the transfer of behaviours through athletic skill (Rietveld and Kiverstein 2014; Kiverstein, van Dikj, and Rietveld 2019).

One approach to resolving this problem in recent applied sport science research has proposed supplementing understanding of the development and design of training and testing protocols emanating from empirical research by sampling the rich experiential knowledge of elite practitioners and athletes (e.g., Phillips et al. 2010; Greenwood, Davids, and Renshaw 2014; Burnie et al. 2017; Mckay and O'Connor 2018; Mccosker et al. 2019; Woods et al.

2019; Browne et al. 2019). These advances in applied scientific and theoretical knowledge are conceptualised as a symbolic process where scientists, theorists and coaches co-create new knowledge and understanding (Renshaw et al. 2019). As the Athletic Skills Model proposes the coach is an 'environmental designer', it is important to seek a transition from simply describing skills developed through certain donor sports, and instead move towards a contextualised understanding of how learning environments could be best designed and used to target the development of such skills. Therefore, to develop understanding of how Parkour could act as an appropriate donor sport for team sports, the aims of this study were twofold. Firstly, we sampled experiential knowledge of experienced Parkour Traceurs to identify the range of athletic skills and foundational performance behaviours (physical, perceptual, psychological and social skills) that they perceive to be developed during Parkour practice and performance. Following on from this, a second aim was to provide recommendations, based on the experiential knowledge of these experienced Parkour Traceurs, as to how Parkour environments could be best designed to facilitate the development of these athletic skills and foundational performance behaviours.

Methods

Research Design

To address the research aims, the authors adopted a pragmatic research paradigm (Creswell and Creswell 2017). In adopting pragmatism, the authors placed the research aim centrally; emphasising communication, shared meaning-making and transferability to consider the applications of research findings to advanced applied practice in sport (Morgan 2007; Shannon-Baker 2016). In line with pragmatism, qualitative inquiry in the form of semi-structured interviews was adopted, as the use of open-ended questions permits flexible observations of participants' perceptions and experiences (Sparkes and Smith 2016).

Participant Demographics and Recruitment

Fourteen experienced male Parkour Traceurs (Mean age: 26 ± 6 years) were interviewed. Participant recruitment occurred in person and online using a combination of purposive and snowball sampling (Tongco 2007). To ensure that participants were immersed in the Parkour culture and form of life, the authors employed criteria to guide purposive sampling (Palinkas et al. 2016). At the time of interview, participants had to be active in Parkour as a coach or athlete and have a minimum of three years Parkour training experience (mean experience 11 ± 4 years) (Jabnoun, Borji, and Sahli 2018). A summary of participants' demographic information is displayed in Table 1. From the lead author's experience in conducting Parkour research, experienced Parkour Traceurs are a 'hard-to-reach' group. Therefore, the combination of purposive and snowball sampling was a pragmatic decision to aid the recruitment of a nuanced sample immersed in parkour culture and form of life. Institutional ethical approval was granted by the university ethics committee of the lead author, with all participants providing informed written consent prior to the commencement of the interviews.

****Table 1.** Participant demographic information (insert about here)**

Data Collection

Development of a semi-structured interview guide ensured that each participant was asked the same set of central questions, while enabling participants to lead the conversation, and elaborate and discuss the skills they perceived to be developed through Parkour and how they designed Parkour practice landscapes. All interviews were conducted by the lead author over video call (n = 7), telephone (n = 1) or in person (n = 6) and lasted between 20-51 minutes (mean 34 minutes). The list of questions that formed the interview guide started with a

general warm up question that was relevant to each Parkour Traceur, to build rapport between the participant and interviewer and encourage the Parkour Traceurs to talk descriptively in the presence of the audio recording device (DiCico and Carbtree 2006). After that, the discussions moved on to specific questions about Parkour training philosophy, sporting experience, perceptions of skill developed through Parkour, and Parkour practice design. Probe questions were used to obtain further details (Sparkes and Smith 2016). All interviews were recorded in their entirety using a digital voice recorder and transcribed verbatim, using desktop transcription software (Audio Notetaker, Sonocent Ltd, Leeds, United Kingdom).

Data Analysis

A two-stage reflexive thematic analysis was employed to identify themes across the data set (Braun and Clarke 2006; Braun and Clarke, 2019). The interview transcripts were coded in Microsoft Excel (Version 16, Microsoft Cooperation, Washington, United States). During the thematic analysis, the research team did not adopt an 'either or approach' (i.e., deductive approach: use of structure, theory or a pre-determined framework, or inductive approach: with little pre-determined structure, theory or framework). Instead, a pragmatic form of enquiry was undertaken that included inductive and deductive approaches (Braun, Clarke, and Weate 2016; Robertson et al. 2013). The first coding stage followed a deductive analysis to organise the data into two dimensions (skills developed through Parkour environments and design features of Parkour environments). The first coding stage was initially undertaken by the lead author, who read the transcripts several times to identify language related to skills developed through Parkour environments or design features of Parkour environments. Peer consultation was conducted after the first coding stage, this involved the authors reading the transcripts independently to discuss the initial dimensions determined by lead author. The authors accepted that theory-free knowledge cannot be achieved, in that knowledge can be

both implicit (as with practical skill or expertise) or explicit (as with theoretical understanding of the subject) (Dewey 1938). Therefore, once data were organised into these two dimensions, both inductive and deductive analysis was undertaken in what represented a second coding stage (Guba and Lincon 2005). This collaborative and reflexive approach to the analytic process, was designed to develop richer and a more nuanced interpretation, rather than seeking consensus on meaning (Braun and Clarke 2019). For example, during the analysis several experiences articulated by the Parkour Traceurs expressed clear and appropriate meaning without the application of a theoretical lens to interpret the findings (inductive). In contrast, other experiences articulated by the Parkour Traceurs were interpreted from a theoretical position (deductive), as the findings represented appropriate meaning with regards to the functional relationship between the performer and environment. Codes were then grouped into higher order and lower order themes in relation to the research question. If a code had classification in one or more of the themes it was assigned to the best one that 'fit'. Additional discussion of the higher order and lower order themes took place between the authorship, to maintain analytic rigour (Tracy, 2010). Where any coding differences were identified, these were resolved through discussion and alteration of codes if appropriate.

Research Quality and Rigour

To ensure that research quality and rigour was upheld to the highest standard, this study was designed, conducted and reported in accordance with Journal Article Reporting Standard for Qualitative Research in Psychology, dictated by the American Psychological Association (see Levitt et al. 2018). Methodological rigour was facilitated by conducting a pilot interview with a member of the research group who had an extensive background in Parkour. This

consultation process allowed the authors to appraise the flexibility of the interview format in the context of the participant group.

In line with a pragmatic research paradigm, it is important to acknowledge the personal biography of the authors, given that their previous work was a motivation for undertaking the current study and that this past research may have played a role in the development of the study's methodology (Tracy 2010). All authors were, at the time of writing, academics at universities across the United Kingdom with varying experiences of working in research (4-40 years). Authors' previous work is underpinned by the ecological dynamics approach to motor learning. At the time of publication, the lead author was a PhD researcher who has several years' experience working in applied parkour research and is engaged with Parkour Traceurs from around the globe. Rather than categorising such influences as potential contamination of the data to be eschewed, the authors engaged with prospective (which concerns the effect of the whole-person-researcher on the research) and retrospective (which concerns the effect of the research on the researcher) reflexivity to confirm the significance of their knowledge, feelings, and values that they brought to the conceptualisation of the research questions and the analytical lens applied to the findings (Attia and Edge 2017; Braun and Clarke 2019). In accordance with recommendations from Smith and McGannon (2018), an independent critical friend was used during the data analysis process over alternatives like a triangulation consensus and inter-rater reliability conversations. The independent critical friend, who was a senior lecturer in sport and exercise science and external to the authors' research grouping, discussed with the authors about the interpretations made throughout the analysis process. During these discussions, the role of the critical friend was "not to agree" or achieve consensus but rather to encourage reflexivity by challenging the authors' construction of knowledge" (Cowan and Taylor, 2016, 508). In this way, independent critical friends construct, but do not find or discover through consensus, a

coherent and theoretically-sound argument to support and defend the case they are making in relation to the data generated in a particular study (Smith and McGannon 2018).

Results and Discussion

The thematic analysis highlighted a total of 21 lower order themes, 6 higher order themes and 2 dimensions. The 2 dimensions were: 1). Skills Developed Through Parkour, and 2) Recommendations for Designing Parkour Training Environments.

Skills Developed Through Parkour

Skills developed through Parkour was a dimension from the data set, with Parkour Traceurs discussing a variety of physical, perceptual, psychological and social performance behaviours developed through Parkour training (Figure 1).

Figure 1: Thematic map: Skills Developed Through Parkour (insert about here)**

Physical Skills

Parkour Traceurs described a series of physical capacities that are developed through Parkour training, including locomotor skills, endurance, strength, agility, and balance. Participants described that Parkour training develops an athlete's adaptive behaviours in interacting with variety in the environment:

> So that sort of thing, so if you do Parkour and go into a martial art, your body is going to be already used to that adapting to falling over so you're gonna be more adaptive to that sort of stuff. If you go into football, when you kick a football because you've done a running jump when you were doing Parkour, you are now going to have a good kick because you're used to that sort of stuff (Parkour Traceur 7).

Parkour and team sports often require athletes to perform dynamic tasks under high temporal demands in response to external constraints, such as variations in distances, and emerging spaces and gaps, the location of obstacles provided by the movement of teammates, location

of opponents and direction of the ball. These performance constraints mean team sport athletes must often adapt and use different movement strategies (guided through athletic and sport specific skills) and react to perturbations in the performance environment to achieve equivalent performance outcomes (Whitacre 2010; Seifert, Button, and Davids 2013; Seifert et al. 2016).

Parkour and team sports share an intermittent performance tempo, where athletes are often required to move slowly and then quickly (accelerating and decelerating), with maximal effort several times with limited rest as this Parkour Traceur explained:

> I think that by practicing the flows (from movement to movement), you are training the endurance in terms of like your muscles having to be constantly engaged, so you are metabolically more active and you are also getting the plyometric power from the sequencing and the reaction time and the spatial awareness (Parkour Traceur 6).

Hence, developing greater levels of endurance through the integration of Parkour-style training would be of benefit to team sport athletes to negate degradations in movement coordination and control which can occur through fatigue. In addition to developing endurance capabilities, Parkour Traceurs commented on how taking part in Parkour training affords strength gains:

> But it depends, like the great thing about Parkour is compared to other sports, it the different range of movement and strength types that you can work on which will help you like in loads of different aspects, so if you are going to do rugby and you want a stronger core so you can take the impact of other people, whatever, it's like so many different exercises in Parkour that will help you with that sort of stuff (Parkour Traceur 2).

Parkour Tracuers' experiences align closely with key proposals of the Athletic Skills Model in relation to transfer of movement skills from donor sports to a target sport (Wormhoudt et al. 2018). The suggestion is that Parkour could be particularly useful as a donor sport when a strength component is needed in the target sport or is considered to be under-developed in an athlete's current skillset. Parkour Traceurs also described how taking part in Parkour training has made them more agile:

> I would say like the agility. If you train Parkour in a diversified way, in that you practice lots of different abilities, different skills, and then I think you get a sense of agility. I don't know how else to describe it to be honest, I think it is agility is the one word I would use to sum it up. So, it's kind of like a transferable spatial awareness and proprioception to the other skills. Like now that I have improved in Parkour, when I go to other sports I tend to progress at them faster than people who don't do sports, but I don't know if that is just because of Parkour, or just because of developing some kind of like neuromuscular facilitation to certain movements (Parkour Traceur 6).

Agile athletes can react to perturbations in a performance environment by finding different movement solutions to tasks goals, which is an essential skill of Parkour and team sports. In Parkour, improvements in agility are targeted through specific movements such as the 'tic tac'. To execute the ‘tic tac’ activity, athletes have to approach obstacles and take off with a change of direction. The intention here is for the athlete to clear the obstacles or use perceptual variables, such as the remaining ‘time to contact’ with an object or surface, to regulate the next phase of movement (Strafford et al. 2018). In team sports practice, the 'tic tac' activity would target the compensatory athletic skills required during phase transitions where athletes require agility to couple their movements at various speeds relative to the movements of opponents, teammates and direction of the ball (Travassos, Araújo, and Davids 2018). In addition to agility, Parkour Traceurs explained how undertaking Parkour training affords greater balance, postural control and awareness of their body:

> So, I train precision jumps because they’re like my favourite kind of thing. But I find my balance is a lot better because you have to land and stay in control of movements a lot more with your legs. Compared to swinging and dangling off things are not as much preferred because the basis of my movement is through my legs (Parkour Traceur 10).

This enhanced awareness of body orientation, coupled with proprioceptive and haptic information from the soles of the feet and the lower limbs, would be of benefit in team sports given that the ability to regain balance and postural control following physical challenges is continually required to maintain and advance a sub-phase of play (Puddle and Maulder 2013; Maldonado, Soueres, and Waiter 2018).

Perceptual Skills

Parkour Traceurs described a series of perceptual skills that are developed through Parkour training, which were organised into the lower order themes of: multi-limb coordination, control precision, rate control and response orientation. Parkour Traceurs described on how Parkour training develops an athlete's multi-limb coordination:

> As I said, I would incorporate some rails and bars just to have a certain amount of precisions always as it is helpful to develop precision and also for the developing of swings and that would mean, for example, performing upper body and hand eye and of course feet eye coordination (Parkour Traceur 9).

Parkour actions are complex and require rapid (re) organisation of body segments to maintain movement coordination and control. Consistent with Bernstein's (1967) degrees of freedom problem, there are two main concepts that determine coordination of body segments during Parkour training: degeneracy and variability. Movement variability is the variance of movements generated by an individual under the same task conditions (Newell and Slifkin 1998) (i.e., repeated movements cannot be completely identical). The adaptive and functional role of movement variability is regulated by system 'degeneracy' which refers to an individual's ability to vary motor behaviour structurally to deal with information-rich, dynamic environments from moment to moment without compromising function (Seifert, Button, and Davids 2013; Komar et al. 2015). This is exemplified in body segment orientation during the cutting manoeuvres, which are commonly used in Parkour as Parkour Traceur 9 explained:

> I think I adapted my Parkour practice experiences a little bit when I started American football. Because American football consists of a lot of cuts and direction changes and those kinds of things. And I was not really familiar with that before I started, and it also consists of a lot of foot work which I under estimated. There is something called the agility ladder where you have to be able to move your feet through quite quickly and as soon as I realised that is something that I had to practice I adapted my training a little bit and for example in Parkour I did more foot work. So I would run on rails, I would do more precisions to be able to coordinate my feet better, and for the direction changes for example I would incorporate that into my runs, so for example all of sudden I would make a 90 degree cut to another direction to be able to practice that (Parkour Traceur 9).

With regards to performance in team sports, a certain level of movement variability may be desirable to evade an opponent and distribute joint loading (Dos Santos et al. 2019). Therefore, in team sports like rugby union, integrating Parkour activities into practice tasks that require precise foot placement and the ability to change direction quickly would, through shared coordination dynamics, transfer the skills needed in rugby union, such as cutting manoeuvres (Weir et al. 2019). In addition to being able to react to changes in the environment and change direction, participants also described how Parkour training affords functional and controlled landing strategies to bail out of movements safely when required, as this Parkour Traceur described:

> Yeah well in sort of recent years that has sort of become a big thing in Parkour is learning how to fail safely. So if you are doing a jump where either something goes a bit wrong on take-off like you slip a bit or it is just a bit out of your limit knowing how to bounce off the wall in way that you are not going to hurt yourself that can definitely apply to other sports (Parkour Traceur 5).

Developing safe landing strategies as a means of recovering balance, initiating dynamic changes of direction, use of 'soft feet' in running and landing, and postural control following physical challenges (perturbations) is critical for Parkour athletes to avoid injuries and maintain performance longevity (Puddle and Maulder 2013; Maldonado, Soueres, and Waiter 2018). The Parkour roll-landing strategy and the use of 'soft feet' are explored during the early stages of learning, as the capability to land safely, and then continue to move in a controlled manner, after being perturbed, is fundamental to an athlete's safety and wellbeing, as well as performance (Puddle and Maulder 2013). In team sports, the development in resourcefulness afforded through Parkour training, could help athletes recover from force landings in target sports, such as rugby union and rugby league, where players exert considerable force in tackles to regain ball possession (Puddle and Maulder 2013).

Psychological Skills

Parkour Traceurs described a series of psychological skills that are developed through Parkour training, which were organised into the lower order themes of: problem solving, stress relief, and self-efficacy risk management. Participants outlined how training Parkour affords opportunities to explore space and overcome problems presented in the environment, for example:

> I really love the problem solving as well, learning how things work so why does your body do that? Why does it work like that? Why doesn't this work? I love those mechanical aspects of it and to be able to understand all those things has added a great deal to my progression as an athlete because I progressed very very quickly as an athlete and as a coach (Parkour Traceur 7).

In Parkour, movement behaviours in the environment are refined through constant attraction to new challenges which offer new actions to emerge (Aggerholm and Højbjerre 2017). These opportunities for novel interactions with ledges, surfaces or obstacles may not have an immediately obvious solution, so athletes must use their creativity to interact with them and solve performance problems in innovative ways (Greenberg and Culver 2019). In terms of developing an athlete's mentality, through exposure to these environmental interactions, Parkour athletes may become more resilient to overcoming challenges in the environment by exploring their own body capabilities and learning how to regulate cognitive and somatic responses when these arise (Merrit and Tharp 2013), as this Parkour Traceur outlined:

> It's not just looking at the things you can do, it’s mostly looking at the things you cannot do and what needs to be done to get there. So, like I said this could be the physical, social or mental skills. But like it comes from the mental part, in that if I see a jump I cannot make, I always train from the real world perspective. So, do I need to be stronger? Ok, so I will need to train a few weeks (Parkour Traceur 8).

O'Grady (2012) outlined that the principal goal of Parkour athletes is to learn how to ‘let go’ physically and psychologically, which requires intense focus and unity of body and mind. Participants here described Parkour as a 'stress relieving' activity as it allows them to train while being in the moment:

> Psychologically it's fun, it's stress relieving you know I can go out and do that it's a break away from the norm. It keeps me fit and healthy in some ways, keeps me strong (Parkour Traceur 14).

Furthermore, when socially framed, Parkour has been described as potentially liberating with regards to learning through movement exploration (O'Grady 2012), which is concurrent with findings from the present study:

> Psychologically, I think it is really good fun destressing yourself… my attitude towards it now, is more like what I said - seeing what you can do in that moment because you are defined by what you can do in that moment and there is no way to regret it or be unhappy . So, in that sense it is very freeing because it's kind of like writing poetry or thinking of some kind of fictitious thing you create of your thoughts and expression of that which is very liberating (Parkour Traceur 6).

Implicit learning is augmented through the playful and exploratory nature of Parkour learning environments (O'Grady 2012). Therefore, exposure to Parkour learning environments could help regulate stress, reduce performance anxiety and increase resilience as athletes can become more proficient at utilising affordances of the environment with their athletic capabilities. In addition to regulating stress and performance anxiety, Parkour can also train an athlete's capabilities to manage fear and take risks, as this Parkour Traceur outlined:

> Yeah it gets pushed back obviously; fear is just an absence of familiarity like pretty much everything in life. So, if you don't understand something then you are more likely to be afraid of it. And obviously as you understand your body's capabilities and your potential in your limits what you can and can't do you are therefore less likely to be afraid of movements as you are more knowledgeable of what you can do, you are more familiar with them. You can choose them or not (Parkour Traceur 11).

These results suggest that a willingness to take risks in Parkour is affected by a person's cognitive appraisal of their own Parkour abilities (Merrit and Tharp 2013). This link between practising Parkour and cognitive appraisal has been identified previously by Taylor, Witt and Sugovic (2011) who demonstrated skilled Parkour athletes perceived a typical Parkour obstacle (such as the height of a wall to negotiate) as being shorter in comparison to a novice control group. This observation is consistent with Gibson's (1979) notion of reciprocity

between perception and action, given that performer's perception was scaled by their perceived capacities and abilities, known as effectivities in ecological psychology (Fajen, Riley, and Turvey 2008). Therefore, as self-efficacy refers to an individual's perception of their capabilities, this psychological function may also increase with Parkour practice and training (Baundura 1997; Llewellyn et al. 2008). Indeed, many of the Parkour Traceurs in this study suggested that the capacity to alter self-efficacy through exploration was missing in other sports, compared to Parkour:

> Like, I have trained martial arts, I have trained football; I went quite high up in football and judo. But you didn't get that kind of same fear management, you never got put on a high point and are told you have to do this, and you can do it. I think learning how manage and control fear that is such a big thing and people don't understand that's what we do a lot and why people think we are daredevils and reckless. It's because they don't understand that actually we mange that sort of stuff, because knowing you can do something and physically doing it are two separate things. So yeah those are the big psychological elements of it (Parkour Traceur 7).

An implication here is that, in the context of team sports, practitioners should exploit the creative and explorative nature of Parkour, to enable physical conditioning in athletes, whilst at the same time enhancing perceptual decision making and functionality of actions in an enjoyable way. Exposure to Parkour-style activities would allow team sport athletes to develop and utilise *effectivities* relative to both the actual and perceived capabilities of their movement system, which could aid the development of risk-benefit analysis abilities, both on and off the field (Jacobs and Michaels 2007; Immonen et al. 2017). For example, prohibiting the use of landing mats during parkour-style training may facilitate athletes' awareness of risk of falling, relative to their current abilities, allowing them to consider their intrinsic dynamics or effectivities during movement exploration (Strafford et al. 2018).

Social Skills

Parkour Traceurs described a series of social skills that are developed through Parkour training, which were organised into the lower order themes of: networking; initiative; social perceptiveness and receptiveness to feedback. In lifestyle sports (such as Parkour), individual sporting groups attempt to develop new skills and techniques through building and engaging with their sub-cultural values and identities (Ojala and Thorpe 2015; Ellmer and Ryne 2016). Parkour Traceurs described how the Parkour culture of training allows them to network and build relationships with others:

> So, there is sort of a social element. I also feel like I should train Parkour more than I currently do, so it is a good incentive to go. It is also nice to just keep one foot in the community, because obviously if you train less, you see the people less, so you get out of touch (Parkour Traceur 1).

Clegg and Butryn (2012) argued that the non-competitive culture of Parkour promotes a spirt of collaboration and inclusion. A feature of sports such as Parkour is the self-organised nature in which learning takes place in unstructured, informal settings, without external regulation by a coach. This approach contrasts with the more structured practice designs in traditional sports (e.g., football, rugby, tennis) which have a greater focus on formal teaching (Wheaton and O'Loughlin 2017). Parkour Traceurs described how they use feedback from peers to inform their own Parkour training:

> And then after that I got to know some of the other people in the area who did it and trained with them on Saturdays where they could show me everything in detail properly. Like proper techniques it was really just sort of experimenting with what you could do and just trying things out pretty much (Parkour Traceur 5).

In addition to giving feedback, participants discussed how they are receptive to receiving feedback from others during training due to the team element of working together to identify and solve challenges:

> So, it's kind of like although the sport is individual there is a team element of working together to spot and solve challenges. And then there's the sort of camaraderie like when someone makes a jump, and everyone is glad for them I guess (Participant 3).
>
> Yeah and like the Parkour community it is so welcome and friendly compared to other sports I have tried. Just because there's not that elitism there, nobody is going to one up anyone else, everyone is there to help each other grow. I think it's stemmed from that outcast community, where everyone has been pushed away and them come together to form a group (Parkour Traceur 4).

In this regard, integrating Parkour activities such as *'follow the leader'* games, where groups of athletes elicit and model creativity in movement as they explore the environment with coaches and peers. The social dimension of these interactions with coaches and peers can help athletes regulate emotional control, resilience and self-confidence through a shared network of affordances in a practice environment, rooted in a desire to interact with others while having fun (O'Grady 2012).

Recommendations for Designing Parkour Training Environments

Recommendations for designing Parkour training environments to develop physical, perceptual, psychological and social skills was the second dimension from the data set (Figure 2), with Parkour Traceurs providing insights into equipment properties and the methods for creating variability in indoor Parkour environments.

****Figure 2:** Thematic map: Recommendations for Designing Parkour Training Environments (insert about here)**

Equipment Properties

Parkour Traceurs described a series of features relating to equipment properties when designing practice environments, which were organised into two lower order themes, of replicating outdoor textures and properties of bars and block set ups. Despite the common public perception that Parkour solely involves participating in outdoor urban environments,

the majority of Parkour Traceurs here discussed that, dependent on the facilities available, coaching indoors was preferable, because indoor environments offer more control over the athletic skills targeted:

> I think I prefer to teach indoors. I predominantly teach outdoors because I don't have the facilities to teach indoors. I think I'd rather teach indoors if I had the equipment that sort of stuff just because it creates that safer environment and that environment where you are already in it learning (Parkour Traceur, 7).

A few Parkour Traceurs mentioned how, whilst it is preferable to teach indoors, they prefer the majority of their practice outdoors, with indoor practice perceived as an opportunity to train for new movement possibilities outdoors:

> There is new challenges and finding possibilities for ways of moving and it can open new possibilities outdoors as well because you might have spotted something outdoors that you can swing on and land on but it's quite big and you've never practiced that movement before so having this indoor environment where you could practice it and work on the technique that can give you the confidence and ability to go to this outdoor location and do the movement there (Parkour Traceur 7).

Parkour environments found in nature are typically fixed and environmental factors can influence surface properties. In this regard, Parkour Traceurs discussed how the equipment used in these indoor Parkour environments should share similar textures found in an outdoor Parkour environment to attain a sense of representativeness:

> I would like to have different textures as what I have not seen in many Parkour parks is a variety of texture. There are generally woods and metals but it doesn't seem that they have incorporated other kind of textures like a random solid place or something somewhere, which is what you would find outside…So I would say include different textures and lots of ascending and descending obstacles so you can practice the upper body and lower body and compound movements rather than just loads of jumps (Parkour Traceur 6).

In addition to discussing object texture, Parkour Traceurs outlined how bars and block set ups should be considered as a core feature when designing indoor Parkour environments:

> So, there were lots of these wooden blocks in load of different shapes and metal bars like scaffolding bars and they had a foam pit as well. That is the main thing we use indoors (Parkour Traceur 2).

> Bars like bar set ups. That's something you don't find outside much; you only find them in Parkour parks. And I love bar set ups, like swinging and that sort of stuff. So, I'd design a sick bar set up straight away that would be like first things first. So, I'd design a bar set and design walls around it with really really good grip and varying levels. So, the bars would have varying levels so high, medium and low and the walls would also have levels so high medium and low to makes sure that there is a nice mix in level (Parkour Traceur 7).

The focus on bars and block set ups, concurred with recommendations from Strafford et al. (2018) who proposed that Parkour actions may emerge from performance of basic athletic skills that an athlete can exploit in affordance landscapes which do not require specialist equipment. Moreover, having bars and blocks of varying levels and heights would manipulate the difficulty of the environment, potentially leading to increases in self-efficacy and resilience in movement exploration through heighted cognitive appraisal of the athletes' ability to act in that environment (Taylor, Witt and Sugovic 2011). In accordance with the Athletic Skills Model, the focus of training should be to first develop the athlete and then the specialist, so a safer environment, afforded through indoor environments of varying textures bar and block set ups could improve longevity in training allowing for this transition. Therefore, as long as organisations adhere to health and safety regulations, the modular aspects of this equipment could be integrated into training across a variety of different sports.

Creating Variability in Indoor Parkour Environments

Parkour Traceurs described a series of important features relating to the challenge of creating variability in indoor Parkour environments, which were organised into the lower order themes of: varying the position of objects in the environment and varying object heights and angles. When asked about the position of objects, participants discussed how the environment should be variable, with several participants suggesting that asymmetrical environments that have bars stimulate creativity:

> But we don't tend to look for, or need or require symmetry and in fact angles and not making everything perfectly perpendicular to everything else, having angles and different degrees and setting the bars at different angles and different gradients is really important. Because that creates again more variability, which in terms of movement health, you know variability of movement is healthy so you need to create spaces that allow for variations of movement and are moving people through different planes of movement at the same time whilst changing directions successfully (Parkour Traceur 11).
>
> Yeah so I think symmetry caters to power and speed a lot more…Whereas asymmetrical environments I think cater for more creative movements, slower, strength heavy in a way. But not power, controlled strength movements, I think (Parkour Traceur 14).

Changing the positioning of objects in the environment alters the affordance boundary (Croft and Bertram 2017), which may invite different actions and behaviours and stimulate creativity in movement exploration and feelings of enjoyment, as participants attempt to find movement solutions to task goals (e.g., symmetrical for developing speed and agility, and asymmetrical for controlled movements). To design affordances in a creative learning environment, participants discussed how they change the number of bars and vary the height and distance between each bar or bar cluster:

> So, if there is let's say for example 5 bars behind each other and they're perfect and the same distance I would not find that very interesting. But you would take these five bars and put them apart and maybe make them cross maybe have different levels and maybe put them in different angles and not the same distance, then I would find that very interesting. Because that's an environment that would simulate my creativity, so to say. Because these different angles, these different distances they all mean that I have to find a different solution to this particular situation. So, whereas when I have 5 bars which are in exactly the same distance and exactly the same height and angle it's always the same solution, which for me is relatively boring (Parkour Traceur 9).

Further, Parkour Traceurs articulated how the height and angles of objects should be scalable to allow for manipulation of task complexity, for example:

> Well the modular aspect of it means that is immediately scalable. So, we have everyone from five, six year olds training in the *** academy to elite adult athletes. And the modular nature of the structure means that you can totally scale it as you can move the boxes, move the rails so you can make the jumps bigger, smaller, higher, shorter, easier, less complex, and more complex. It's very easy and that's why we do it that way so you never get bored, no matter how good you get there will always be challenges you can find. And no matter how experienced or inexperienced you are there will always be stuff you can do to get on the first running ladder and progress your skills (Parkour Traceur 11).

This observation suggests that participant movement capabilities (effectivities) are informed by reciprocal features in the environment such as the geometric features. Whilst body scaling may be convenient for matching task difficulty to ability level, it should be used with caution given that the constraints during team sports performance are relative to the task and not the constraints of the individual's movement system (Chemero 2003). Instead, it is the relationship between the performers perceived dynamic capabilities and features of the environment that provide opportunities for manipulating behaviour through action-scaled affordances (Pepping and Li 2000; Ramenzoni et al. 2008; Fajen, Riley, and Turvey 2009). However, learning environments often provide combinations of body-scaled affordances and action-scaled affordances (see Fajen, Riley, and Turvey 2009) and these responses require careful consideration for the design of Parkour learning environments.

Conclusion

In conclusion, sampling the experiential knowledge of experienced Parkour Traceurs has provided rich insights into how affordances offered by the Parkour environment could be designed into practice landscapes in team sports, to facilitate their utilisation, and the transfer of skilful behaviours. Further, the identification of these skills provides impetus to the proposal set out in the Athletic Skills Model that Parkour could be a suitable donor sport to develop a range of athletic skills (Strafford et al. 2018; Savelsbergh and Wormhoudt 2019). It is anticipated that this experiential knowledge will complement the design of experimental research seeking to understand how Parkour training can be utilised as a donor sport to enrich practice and foster skill adaptation in team games. A mixture of experimental and applied interventions is needed in future research to elucidate how Parkour training may benefit the fundamental movement capacities and enhance sport performance. Here, it is proposed that

dynamic tasks exploring compensatory mechanisms in person-to-environment and player-to player relationships are needed to provide a more comprehensive understanding on the transfer of coordination dynamics and athletic skill in team sport athletes following Parkour training. Future investigations may seek to prioritise 1) an understanding of the physical, psychological and social profile of Parkour Traceurs and 2) an understanding of how the design of Parkour-style learning interventions (relative to 'traditional' practice environments) can improve perception, action, cognition and emotional control in developing team sport athletes. This will provide both theoretical insights and practical applications from the Athletic Skills Model and donor sport concept.

References

Aggerholm, Kenneth, and Højbjerre Larsen, Signe. 2017. "Parkour as acrobatics: an existential phenomenological study of movement in parkour." *Qualitative Research in Sport, Exercise and Health* 9(1): 69-86. doi:10.1080/2159676X.2016.1196387

Atkinson, Michael. 2009. "Parkour, anarcho-environmentalism, and poiesis." *Journal of Sport and Social Issues* 33(2): 169-194. doi:10.1177/0193723509332582

Attia, Mariam, and Edge, Julian. 2017. "Be(com)ing a reflexive researcher: a developmental approach to research methodology." *Open Review of Educational Research* 4 (1): 33–45. doi.org/10.1080/23265507.2017.1300068

Bandura, Albert. 1997. *Self-efficacy: The exercise of control*. New York, United States: Macmillan Publishers.

Bernstein, Nikolai. 1967. *The co-ordination and regulation of movements.* London, United Kingdom: Pergamon Press.

706 Braun, Virginia, and Clarke, Victoria. 2019. “Reflecting on reflexive thematic
707 analysis.” *Qualitative Research in Sport, Exercise and Health* 11 (4): 589–597.
708 doi.org/10.1080/2159676X.2019.1628806
709 Braun, Virginia, Clarke, Victoria, and Weate, Paul. 2016. Using thematic analysis in sport
710 and exercise research. In *Routledge handbook of Qualitative Research in Sport and*
711 *Exercise*, eds. Smith, Brett and Sparkes, Andrew (London, United Kingdom:
712 Routledge): 213-227.
713 Brown, Peter, Sweeting, Alice, Davids, Keith, and Robertson, Sam. 2018. “Prevalence of
714 interactions and influence of performance constraints on kick outcomes across
715 Australian Football tiers: Implications for representative practice designs.” *Human*
716 *Movement science* 66: 621-620. https://doi.org/10.1016/j.humov.2019.06.013.
717 Burnie, Louise, Barratt, Paul, Davids, Keith, Stone, Joseph, Worsfold, Paul, and Wheat, Jon.
718 2017. “Coaches’ philosophies on the transfer of strength training to elite sports
719 performance.” *International Journal of Sports Science and Coaching.*
720 doi:10.1177/1747954117747131
721 Chemero, Anthony. 2003. “An outline of a theory of affordances.” *Ecological*
722 *Psychology*, 15(2): 181-195. doi:10.1207/S15326969ECO1502_5
723 Chow, Jia.-Yi, Davids, Keith, Shuttleworth, Richard and Araújo, Duarte. 2019. Ecological
724 dynamics and transfer from practice to performance in sport. In *Skill Acquisition in*
725 *Sport: Research,* eds. Williams, Mark and Hodges, Nicola (London, United Kingdom:
726 Routledge).
727 Clegg, Jennifer, and Butryn, Ted. 2012. “An existential phenomenological examination of
728 parkour and freerunning.” *Qualitative Research in Sport, Exercise and Health*, 4(3):
729 320-340. doi:10.1080/2159676X.2012.693527

730 Coutinho, Patrícia, Mesquita, Isabel, and Fonseca, António 2016. “Talent development in
731 sport: A critical review of pathways to expert performance.” *International Journal of*
732 *Sports Science and Coaching,* 11(2): 279-293. doi:10.1177/1747954116637499
733 Cowan, Daryl, and Taylor, Ian (2016). ““I”m proud of what I achieved; I’m also ashamed of
734 what I done’: a soccer coach’s tale of sport, status, and criminal behaviour.”
735 *Qualitative Research in Sport, Exercise and Health*, 8 (5): 505–518.
736 doi.org/10.1080/2159676X.2016.1206608
737 Creswell, John, and Creswell, David. 2017. *Research design: Qualitative, quantitative, and*
738 *mixed methods approaches*. California, United States: SAGE Publications.
739 Croft, James, and Bertram, John. 2017. “Affordance boundaries are defined by dynamic
740 capabilities of parkour athletes in dropping from various heights.” *Frontiers in*
741 *Psychology*, 8:1571. doi: 10.3389/fpsyg.2017.01571
742 Dewey, John. 1938. *Experience And Education.* New York: Macmillan.
743 Dicicco-Bloom, Barbara, and Crabtree, Benjamin. 2006. “The qualitative research
744 interview.” *Medical Education*, 40 (4): 314–321. doi.org/10.1111/j.1365-
745 2929.2006.02418.x
746 Dos' Santos, Thomas., Thomas, Christopher, Comfort, P, and Jones, Paul. 2019. “Role of the
747 penultimate foot contact during change of direction: Implications on performance and
748 risk of injury.” *Strength and Conditioning Journal*, 41(1): 87-104.
749 doi:10.1519/SSC.0000000000000395
750 Dos’Santos, Thomas, McBurnie, Alistair, Thomas, Christopher, Comfort, Paul, and Jones,
751 Paul. 2019. “Biomechanical comparison of cutting techniques: A review and practical
752 applications.” *Strength and Conditioning Journal*. Advanced online publication.
753 doi:10.1519/SSC.0000000000000461

754 Ellmer, Eva, and Rynne, Steven. 2016. “Learning in action and adventure sports.” *Asia-*
755 *Pacific Journal of Health, Sport and Physical Education*, 7(2): 107-119.
756 doi.org/10.1080/18377122.2016.1196111
757 Fajen, Brett, Riley, Michael, and Turvey, Michael. 2009. “Information, affordances, and the
758 control of action in sport.” *International Journal of Sport Psychology*, 40(1): 79-107.
759 Gibson, James. 1979. *The Ecological Approach to Visual Perception.* Michigan, United
760 States: Lawrence Erlbaum Associates.
761 Greenberg, Ethan, and Culver, Diane. 2019. “How parkour coaches learn to coach: Coaches’
762 sources of learning in an unregulated sport.” *Journal of Adventure Education and*
763 *Outdoor Learning*. . Advanced online publication.
764 doi:10.1080/14729679.2018.1557060
765 Greenwood, Daniel, Davids, Keith, and Renshaw, Ian. 2014. “Experiential knowledge of
766 expert coaches can help identify informational constraints on performance of dynamic
767 interceptive actions.” *Journal of Sports Sciences,* 32(4): 328-335. doi:
768 10.1080/02640414.2013.824599
769 Guba, Egon, and Lincoln, Yvonna. 2005. Paradigmatic controversies, contradictions, and
770 emerging confluences. In Norman. Denzin and Yvonna Lincoln (Eds.), *The Sage*
771 *Handbook of Qualitative research* (3rd ed., pp. 191-216). Thousand Oaks, CA: SAGE
772 Güllich, Arne. 2017. “International medallists’ and non-medallists’ developmental sport
773 activities–a matched-pairs analysis.” *Journal of Sports Sciences,* 35(23): 2281-2288.
774 doi:10.1080/02640414.2016.1265662
775 Immonen, Tuomas, Brymer, Eric, Orth, Dominic, Davids, Keith, Feletti, Francesco,
776 Liukkonen, Jarmo, and Jaakkola, Timo. 2017. “Understanding action and adventure
777 sports participation—an ecological dynamics perspective.” *Sports Medicine-*
778 *Open*, 3(1). doi:10.1186/s40798-017-0084-1

779 Jabnoun, Salim, Borji, Rihab, and Sahli, Sonia. 2019. “Postural control of Parkour athletes
780 compared to recreationally active subjects under different sensory manipulations: A
781 pilot study.” *European Journal of Sport Science*, 19 (4): 461–470.
782 doi.org/10.1080/17461391.2018.1527948
783 Jacobs, David and Michaels, Claire. 2007. “Direct learning.” *Ecological Psychology*, 19(4):
784 321-349. doi:10.1080/10407410701432337
785 Kiverstein, Julian, van Dijk, Ludger, and Rietveld, Erik. 2019. “The field and landscape of
786 affordances: Koffka’s two environments revisited.” *Synthese*. doi:10.1007/s11229-
787 019-02123
788 Komar, John, Seifert, Ludovic., Thouvarecq, Régis. 2015. “What Variability tells us about
789 motor expertise: measurements and perspectives from a complex system approach.”
790 *Movement and Sport Sciences - Science and Motricité*, 89(89): 65–77.
791 doi:10.1051/sm/2015020
792 Levitt, Hedi, Bamberg, Michael, Creswell, John, Frost, David, Josselson, Ruthellen, and
793 Suárez-Orozco, Carol. 2018. “Journal article reporting standards for qualitative
794 primary, qualitative meta-analytic, and mixed methods research in psychology: The
795 APA Publications and Communications Board task force report.” *American*
796 *Psychologist*, 73(1): 26-46. doi:10.1037/amp0000151
797 Llewellyn, David, Sanchez, Xavier, Asghar, Amanda, and Jones, Gareth. 2008. “Self-
798 efficacy, risk taking and performance in rock climbing.” *Personality and Individual*
799 *Differences*, 45(1): 75-81. doi.org/10.1016/j.paid.2008.03.001
800 Maldonado, Galo, Soueres, Philippe, and Watier, Bruno. 2018. “Strategies of parkour
801 practitioners for executing soft precision landings.” *Journal of Sports*
802 *Sciences*, 36(22): 2551-2557. doi:10.1080/02640414.2018.1469226

803 Mccosker, Chris, Renshaw, Ian, Greenwood, Daniel, Davids, Keith, and Gosden, Edward.
804 2019. “How performance analysis of elite long jumping can inform representative
805 training through identification of key constraints on competitive behaviors.*”*
806 *European Journal of Sport Science,* 19(7): 913-921.
807 doi:10.1080/17461391.2018.1564797
808 Mckay, Jim, and O'Connor, Donna. 2018. “Practicing Unstructured Play in Team Ball Sports:
809 a Rugby Union Example.” *International Sport Coaching Journal,* 5 (3): 273-80.
810 doi:10.1123/iscj.2017-0095.
811 Merritt, Christopher, and Tharp, Ian. 2013. “Personality, self-efficacy and risk-taking in
812 parkour (free-running).” *Psychology of Sport and Exercise*, 14(5): 608-611.
813 doi:10.1016/j.psychsport.2013.03.001
814 Morgan, David. 2007. "Paradigms lost and pragmatism regained: Methodological
815 implications of combining qualitative and quantitative methods." *Journal of Mixed*
816 *Methods Research*, 1(1): 48-76. doi:10.1177/2345678906292462
817 O'Grady, Alice. 2012. “Tracing the city–parkour training, play and the practice of
818 collaborative learning.” *Theatre, Dance and Performance Training*, 3(2): 145-162.
819 doi:10.1080/19443927.2012.686450
820 Ojala, Anna-Liisa, and Thorpe, Holly. 2015. “The role of the coach in action sports: Using a
821 problem-based learning approach.” *International Sport Coaching Journal*, 2(1): 64-
822 71. doi:10.1123/iscj.2014-0096
823 Palinkas, Lawrence, Horwitz, Sarah, Green, Carla, Wisdom, Jennifer, Duan, Naihua, and
824 Hoagwood, Kimberly. 2015. “Purposeful Sampling for Qualitative Data Collection
825 and Analysis in Mixed Method Implementation Research.” *Administration and Policy*
826 *in Mental Health and Mental Health Services Research*, 42 (5): 533–544. doi:
827 10.1007/s10488-013-0528-y

828 Pepping, Gert-Jan, and Li, François-Xavier. 2000. “Changing action capabilities and the
829 perception of affordances.” *Journal of Human Movement Studies*, 39(2): 115-140.
830 Phillips, Elissa, Davids, Keith, Renshaw, Ian, and Portus, Marc. 2010. “Expert performance
831 in sport and the dynamics of talent development.” *Sports Medicine,* 40(4): 271-283.
832 doi:10.2165/11319430-000000000-00000
833 Puddle, Damien, and Maulder, Peter. 2013. “Ground reaction forces and loading rates
834 associated with parkour and traditional drop landing techniques.” *Journal of Sports*
835 *Science and Medicine*, 12(1): 122-129.
836 Ramenzoni, Verónica, Riley, Michael., Davis, Tehran, Shockley, Kevin, and Armstrong,
837 Rachel. 2008. “Tuning in to another person's action capabilities: Perceiving maximal
838 jumping-reach height from walking kinematics.” *Journal of Experimental*
839 *Psychology: Human Perception and Performance*, 34(4): 919-928. doi:10.1037/0096-
840 1523.34.4.919.
841 Ranganathan, Rajiv, and Newell, Karl. 2013. Changing up the routine: intervention-induced
842 variability in motor learning. *Exercise and Sport Sciences Reviews*, 41(1): 64-70.
843 doi:10.1097/JES.0b013e318259beb5
844 Renshaw, Ian, Davids, Keith, Newcombe, Daniel. and Roberts, Will. 2019. The Constraints-
845 Led Approach: Principles for Sports Coaching and Practice Design (1st Ed.).
846 Routledge Studies in Constraints-Based Methodologies in Sport. London, United
847 Kingdom: Routledge.
848 Rietveld, Erik, and Kiverstein, Julian. 2014. ‘‘A rich landscape of affordances.” *Ecological*
849 *Psychology,* 26(4): 325-352.doi: 10.1080/10407413.2014.958035
850 Robertson, Steve, Zwolinsky, Steve, Pringle, Andrew, McKenna, James, Daly-Smith,
851 Andrew., and White, Alan. 2013. “‘It is fun, fitness and football really’: a process

852 evaluation of a football-based health intervention for men." *Qualitative Research in*
853 *Sport, Exercise and Health*, 5: 419-439. doi:10.1080/2159676X.2013.831372
854 Savelsbergh, Geert, and Wormhoudt, Rene. 2019. "Creating adaptive athletes: the athletic
855 skills model for enhancing physical literacy as a foundation for expertise." *Movement*
856 *and Sport Sciences - Science and Motricité*. doi:10.1051/sm/2019004
857 Seifert, Ludovic, Button, Chris, and Davids, Keith. 2013. "Key Properties of Expert
858 Movement Systems in Sport." *Sports Medicine*, 43(3): 167-178. doi:10.1007/s40279-
859 012-0011-z
860 Seifert, Ludovic, Komar, John., Araújo, Duarte, and Davids, Keith. 2016. "Neurobiological
861 degeneracy: a key property for functional adaptations of perception and action to
862 constraints." *Neuroscience and Biobehavioral Reviews,* 69: 159-165.
863 doi:10.1016/j.neubiorev.2016.08.006
864 Seifert, Ludovic, Papet, Valentin., Strafford, Ben, Coughlan, Edward., and Davids Keith.
865 2019. "Skill transfer, expertise and talent development: An ecological dynamics
866 perspective." Advanced online publication. *Movement and Sport Sciences - Science*
867 *and Motricité*. doi:10.1051/sm/2019010
868 Shannon-Baker, Peggy. 2016. "Making paradigms meaningful in mixed methods
869 research." *Journal of Mixed Methods Research*, 10(4): 319-334.
870 doi:10.1177/1558689815575861
871 Smith, Brett, and McGannon, Kerry. 2018. "Developing rigor in qualitative research:
872 Problems and opportunities within sport and exercise psychology." *International*
873 *Review of Sport and Exercise Psychology*, 11(1): 101-121.
874 doi:10.1080/1750984X.2017.1317357

875 Smith, Brett, and Sparkes, Andrew. 2016. "Qualitative interviewing in the sport and exercise
876 sciences" In *Routledge Handbook of Qualitative Research in Sport and Exercise*, 103-
877 123. London, United Kingdom : Routledge.
878 Standing, Regan, and Maulder, Peter. 2015. “A comparison of the habitual landing strategies
879 from differing drop heights of parkour practitioners (traceurs) and recreationally
880 trained individuals.” *Journal of Sports Science and Medicine*, 14(4): 723-731.
881 https://doaj.org/article/a0ee74d1cd4b478fa671e13f235a4702
882 Strafford, Ben William, Van Der Steen, Pawel, Davids, Keith., and Stone, Joseph Antony .
883 2018. “Parkour as a donor sport for athletic development in youth team sports:
884 insights through an ecological dynamics lens.” *Sports Medicine-Open,* 4(1): 21.
885 doi:10.1186/s40798-018-0132-5.
886 Taylor, Eric, Witt, Jessica, and Sugovic, Mila. 2011. “When walls are no longer barriers:
887 Perception of wall height in parkour.” *Perception,* 40(6): 757-760. doi:10.1068/p6855
888 Tongco, Maria. 2006. “Purposive Sampling as a Tool for Informant Selection.” *Ethnobotany*
889 *Research Applied.* 5. doi: 10.17348/era.5.0.147-158.
890 Tracy, Sarah. 2010. “Qualitative Quality: Eight “Big-Tent” Criteria for Excellent Qualitative
891 Research.” *Qualitative Inquiry*, 16(10): 837-851. doi:10.1177/1077800410383121
892 Travassos, Bruni, Araújo, Duarte, and Davids, Keith. 2018. “Is futsal a donor sport for
893 football? exploiting complementarity for early diversification in talent
894 development.” *Science and Medicine in Football*, 2(1): 66-70.
895 doi:10.1080/24733938.2017.1390322
896 Travassos, Bruno, Davids, Keith, Araújo, Duarte, and Esteves, Pedro. 2013. “Performance
897 analysis in team sports: Advances from an ecological dynamics approach.”
898 *International Journal of Performance Analysis in Sport,* 13(1): 83-95.
899 doi:10.1080/24748668.2013.11868633

Wheaton, Belinda, and O'Loughlin, Alister. 2017. "Informal sport, institutionalisation, and sport policy: challenging the sportization of parkour in England." *International Jounal of Sport Policy and Politics*, 9(1): 71-88. doi:10.1080/19406940.2017.1291533

Whitacre, James. 2010. "Degeneracy: a link between evolvability, robustness and complexity in biological systems." *Theoretical Biology and Medical Modelling,* 7(1): 6. doi:10.1186/1742-4682-7-6

Woods, Carl, McKeown, Ian, Richard, Shuttleworth, Davids, Keith., and Robertson, Sam. 2019. "Training Programme Designs in Professional Team Sport: an Ecological Dynamics Exemplar." *Human Movement Science* 66: 318-26. doi:10.1016/j.humov.2019.05.015

Wormhoudt, Renè, Savelsbergh, Geert, Teunissen, Jan, and Davids, Keith. 2018. *The Athletic Skills Model: Optimizing Talent Development Through Movement Education.* London, United Kingdom: Routledge.

926 **Table 1.** Participant demographic information

Parkour Traceur ID[1]	Age (years)	Parkour experience (years)	Nationality
1	28	13	Dutch
2	26	12	French
3	21	3	British
4	25	14	British
5	26	12	British
6	24	9	British
7	20	5	British
8	24	13	Dutch
9	28	11	German
10	27	13	British
11	43	16	British
12	22	9	German
13	24	13	Dutch
14	23	10	British

927 [1]The names of the Parkour Traceurs have been transformed using a number prefix to protect
928 their anonymity.
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932
933

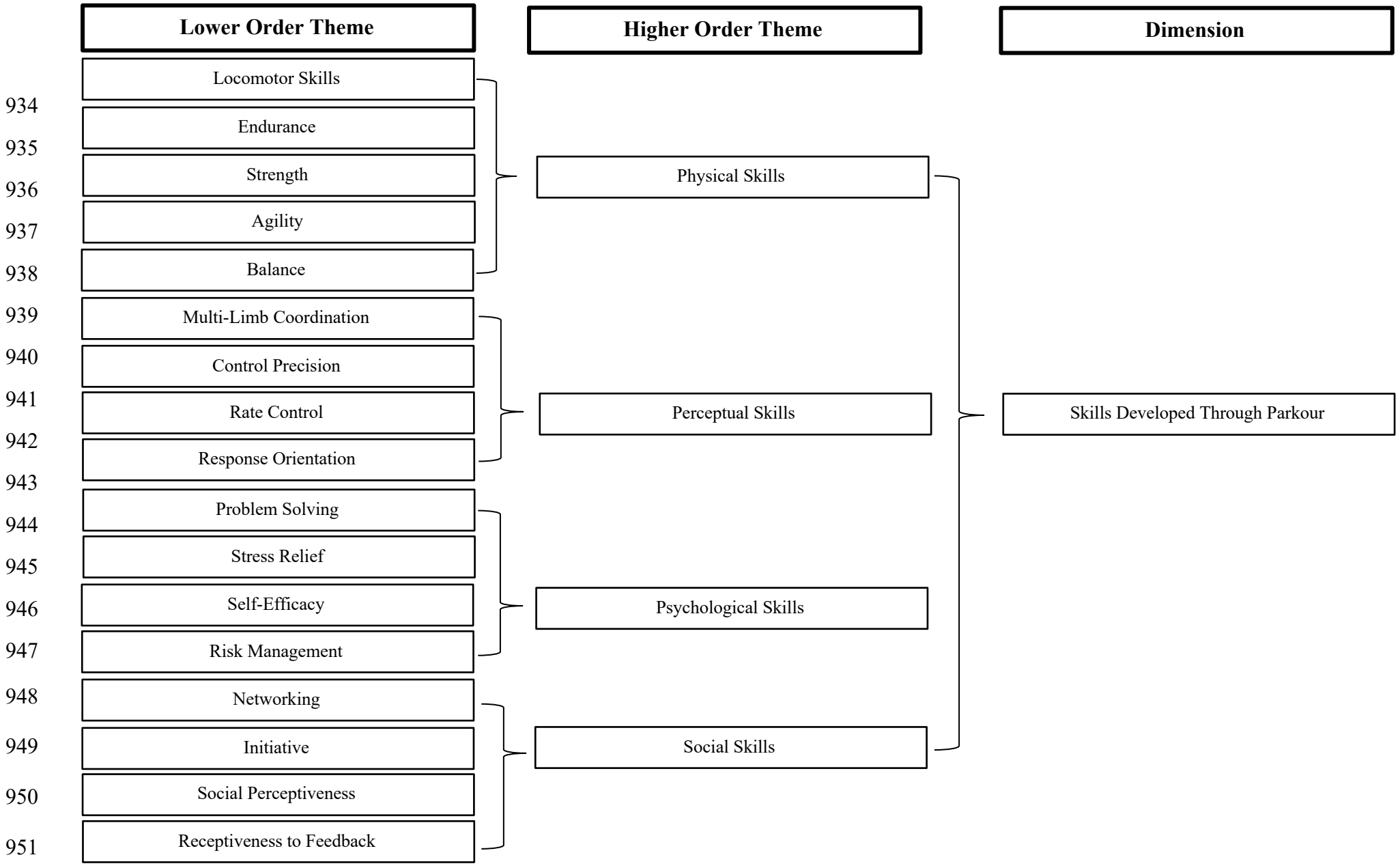

Figure 1: Thematic map: Skills Developed Through Parkour.

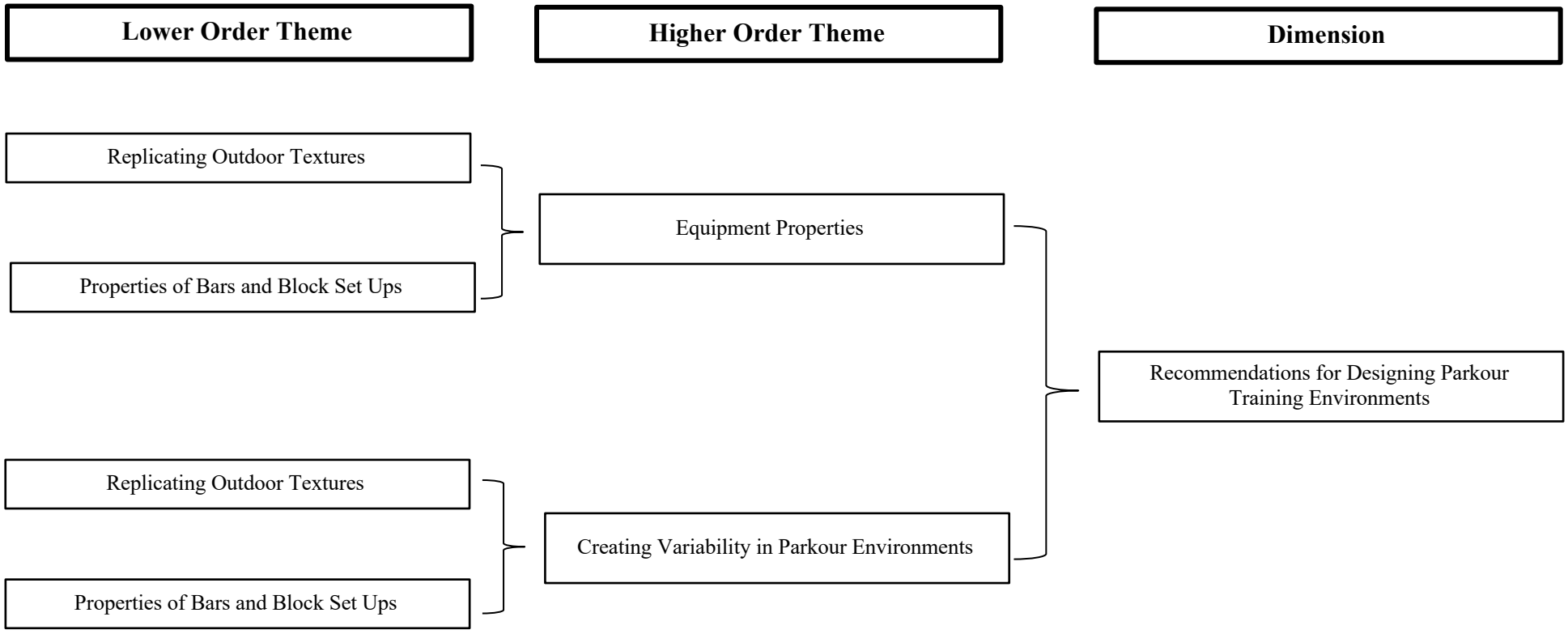

Figure 2: Thematic map: Recommendations for Designing Parkour Training Environments.