RUNNING, ATTENTION RESTORATION THEORY AND ENVIRONMENTAL COMPATIBILITY

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Abstract

The psychological responses to exercise have often taken place without a theoretical framework. Attention Restoration Theory (ART, Kaplan, 1995), previously used to explain the psychological responses to particular environments, most notably, nature, has been expanded beyond its current paradigm to incorporate activities, such as running (Norling *et al*., 2008, 2010). This paper qualitatively explores the experience of running within the ART paradigm through pre- and post-intervention interviews with 18 subjects, randomly allocated to three contrasting environments (green, urban and indoor). The data was subject to a theoretical thematic analysis by applying interview data to the framework of ART. The results provide insight into how running is able to achieve the four components of ART (fascination, being-away, extent and compatibility). Of particular importance was the environments influence over involuntary distractions; thoughts that emerge sub-consciously and are unrelated to running. Involuntary distractions closely align with involuntary attention; the attention system one must switch to enable restoration. The results are discussed in relation to previous literature on the exercise-environment interaction, and syntheses of four research areas (environmental psychology, exercise psychology, cognitive neuroscience and neurobiology) is provides a theoretical explanation behind running's ability to restore directed attention.

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Contents

Glossary

Active distraction: A term used to describe the consciously driven thought processes that occur during running that aim to distract the runner from associative fascinations that arise as a response to the behaviour. Active distractions require directed attention.

Active self-regulation: A term used in previous literature that encompasses a variety of thoughts a runner has related to running performance, such as: an awareness of running speed, technique and any other means that requires a conscious regulation when conducting this behaviour. Active self-regulation requires directed attention.

Associative fascinations: Termed "associative thoughts" in previous literature on attentional focus when running, these are thought processes that are directly related to the behaviour and include sub-categories: internal sensory monitoring and active self-regulation.

Attention Restoration Theory: Initially developed to explain the psychological responses to nature, Attention Restoration Theory (ART) proposes certain environments contribute to reducing the demand for directed attention, and thus propose a framework which explains how DAF can be restored. The theory suggests that directed attention can be restored if one enters an environment that contains four components: fascination, extent, being away and compatibility.

Being away: A component of ART, it has been proposed that in order to achieve a sense of being-away one must physically distance them self from the environment containing the stimuli that are taxing directed attention. However, in some cases, physical distance is not enough to create the sense of being away and therefore a conceptual shift towards different cognitive content must be achieved.

Compatibility: The match between the purposes and inclinations of the person and the environment's ability to support it, thus allowing one to achieve their objectives.

Default mode network: An attention network in the brain engaged when the brain is in a "resting state". The Default Mode Network (DMN) becomes active when a person engages in internally focused cognitive processes. These processes include non-attentive, but awake, mental states such as: rest, daydreaming, self-awareness, self-reflection, recollecting one's past or imagining one's personal future, scene construction and social cognition.

Dissociative fascinations: Previously termed "dissociative thoughts" in literature on attentional focus when running, these are thought processes defined by being unrelated to running. They include the sub-categories: active distraction and involuntary distraction.

Directed attention: The attention system required to carry out goal-directed tasks. Directed attention is, according to ART, a finite resource that is susceptible to fatigue. Utilising directed attention requires effort and plays a central role in concentration and the ability to ignore distractions.

Directed attention fatigue: A term used in ART to describe the point at which ones' directed attention resources have run out. Symptoms of directed attention fatigue (DAF) include an inability to concentrate, where one becomes easily distracted, and inefficiency in performing goal-directed tasks.

Endocannabinoids: A biochemical response to exercise that is thought to contribute to feelings of sedation, anxiolysis, a sense of well-being, reduced attentional capacity, impaired working memory ability, and difficulty in time estimation. Furthermore, this response is thought to be responsible for the effect of the "runners high".

Extent: A component of ART, extent refers to the size (scope) and density (coherence) of the environment. The environment must be large enough and have a sufficient density of natural elements that it creates a whole "other world" - like feel.

Fascination: Defined in ART, fascination is inherently interesting environmental stimuli that captures attention, and can range along a spectrum from soft fascinations to hard fascinations. When applied to running, fascination consists of inherently interesting internal or external stimuli that captures attention and too ranges from soft to hard fascinations.

Green exercise: The notion that the environment has an influence over the psychophysiological results achieved by the person exercising. It has been proposed that the green environment enables the person exercising to gain both the positive responses of the environment combined with the positive responses of exercise, thus producing a synergistic effect on the psychophysiological responses to exercise.

Hard fascinations: Originally described in ART as environmental stimuli that engage involuntary attention but block or inhibit the possibility for reflection. Such stimuli would include advertising and technology such as mobile phones, along with stimuli found in the urban environment that require one to consciously direct their attention towards it. With regard to running, hard fascinations incorporate their original description of environmental stimuli, but also relate to internal stimuli that engage involuntary attention and block or inhibit the possibility for reflection (i.e. associative fascinations)

Involuntary attention: An attention that is engaged in response to a stimulus; it is autonomous and therefore requires no conscious effort, it is less susceptible to fatigue and, according to ART, must be engaged in order to provide a break for directed attention, allowing directed attention an opportunity to restore.

Internal sensory monitoring: A sub-category of associative fascinations, internal sensory monitoring is derives from literature on attentional focus during exercise. It encapsulates the physiological responses that such as an increased heart rate, muscle soreness or an increase in breathing rate that all require the use of directed attention.

Involuntary distractions: A sub-category of dissociative fascinations, these are thoughts that are not consciously driven, they take place without a full awareness, and serve as a distraction from the run. These include irrelevant daydreams, self-referential thoughts or mind-wandering. As these thoughts are not conscious, they do not require directed attention and instead engage involuntary attention.

Soft fascinations: According to ART, soft fascinations are environmental stimuli that, in comparison to hard fascinations, gently engage involuntary attention. The gentle environmental stimuli found in restorative environments allow ones' involuntary attention to be attracted by the information but do not need to consciously direct attention towards it. According to the literature, soft fascinations include features such as trees, lakes, sunsets and clouds. While running, soft fascinations refer to the gentle internal or external stimuli that do not require directed attention; involuntary distractions are therefore soft fascinations.

Task Positive Network: The opposing attention network to the DMN, the task positive network (TPN) is generally associated with performing goal-directed tasks. Greatly associated with executive functioning, this network is engaged when one is conducts higher level cognitive tasks, makes conscious decisions or attempts to problem solve.

1. Introduction

Previous research has long established that exercise is beneficial for psychological health (Berger & Motl, 2000, Chang *et al.*, 2012; De Moor *et al.*, 2006; Hillman *et al.*, 2008; Vance *et al.*, 2005). However, studies observing positive psychological responses, such as reduced feelings of anxiety and depression and improvements in various mood states, have often been conducted without a clear theoretical underpinning (Ekkekakis & Petruzzello, 1999). While a number of proposed mechanisms have been reported, our understanding of this phenomenon remains somewhat elusive (Crone *et al.*, 2006).

One theory accounting for such psychological changes is the distraction hypothesis (Bahrke & Morgan, 1978). This theory posits that engaging in exercise provides a distraction from stressors which may, in turn, be responsible for changes in state anxiety. Another theory, taken from the seminal work by Bandura (1977) on self-efficacy, suggests that engaging in exercise builds ones self-confidence and improves their mood which then feeds into a person's life, leading to the improvements in psychological well-being (Craft, 2005; Crone *et al.*, 2006). More recently, a new theoretical proposal was made by adapting the conceptual framework of attention restoration theory (ART), formally used in environmental psychology literature, and expanding it beyond its current paradigm to incorporate behaviours such as exercise (Norling *et al.*, 2008; Norling *et al.*, 2010).

Attention Restoration Theory

ART is an influential theory in the environmental psychology literature (Kaplan, 1995; 2001). Developed from the early work of James (1892), Kaplan (1995; 2001) proposes that attention can be broken down into two forms; involuntary attention and directed attention, distinguished by the level of effort required in their use. Central to this theory is the idea that directed attention is a resource; *resource* implying that directed attention is finite in quantity and, if used in excess, can be susceptible to depletion (Kaplan & Berman, 2010). Overusing directed attention leads to directed attention fatigue (DAF). However, involuntary attention is thought to be less vulnerable to fatigue and by switching to this attention system, directed attention is given a break, providing it with an opportunity to restore.

A useful analogy of directed attention is a battery; when a battery is full of charge it performs optimally, when its charge runs out its performance decreases. Symptoms arise when one is suffering from DAF; most notably, people lose the ability to concentrate and become highly distractible. Irritability, anger and frustration are also common symptoms, along with a lack of patience (Kaplan, 1995). Other studies suggest directed attention is a vital component in the ability to self-regulate (the mechanism responsible for resisting temptation) and performance of higher level cognitive tasks, also known as executive functioning (Kaplan & Berman, 2010). Depleting this resource, therefore, leads to a reduced ability to utilise these mechanisms. However, like the battery, directed attention can also be recharged.

Research conducted within the discipline are of environmental psychology literature has demonstrated the ability of particular environments to replenish directed attention; most notably, but not exclusive to, nature (Berman *et al.,* 2008; Hartig *et al.,* 2003; Packer & Bond, 2010). ART outlines four components that are needed in an environment in order for restoration to occur: fascination, extent, being-away and compatibility (Kaplan, 1995).

Components of Attention Restoration Theory

With regard to restorative environments, *fascinations* are inherently interesting stimuli that capture involuntary attention. They range along a spectrum from *soft fascinations* to *hard fascinations*. Hard fascinations block or inhibit the possibility for reflection and require directed attention to overcome the stimuli (e.g., the sound of traffic grabs involuntary attention, but directed attention is required to maintain safety when crossing a road). Soft fascinations, on the other hand, are gentle stimuli that engage involuntary attention modestly (e.g., a sunset may hold attention effortlessly) providing an opportunity to give directed attention a break and offer chance for reflection. *Extent* refers to the scope (size) and the coherence (how well the environment fits together and can be understood) of the environment that help to create a sense that this place is a different to that which one is used to. According to Kaplan (1995), to achieve a sense of being-away one must physically distance them self from the environment containing the stimuli that are taxing directed attention. However, in some cases, physical distance is not enough to create the sense of being away and therefore a conceptual shift towards different cognitive content must be achieved. Finally, *compatibility* refers to the match between the purposes and inclinations of the person and the environment's ability to support it. Thus, for compatibility to be achieved, the environment must support the behaviour one is performing and allow one to achieve their desired objectives.

Impact of restorative environments

The impact of exposure to such restorative environments, and the subsequent effects on directed attention, can be seen in the work conducted by Kuo and Sullivan (2001a). Their work set out to assess the impact of natural elements (such as trees and grass) on levels of violence and aggression of 145 residents living in low-rise apartment buildings within a public housing complex in Chicago. A methodological strength of the study was that the residents were randomly assigned to their house within the apartment blocks, minimising any selection bias for their building or view. Of the total sample size, 76 had relatively high levels of nearby nature, while 69 had relatively low levels. All participants came from a similar section of society with characteristics associated with crime and violence; for example, low economic status, education and life circumstances. Assessment measures were 45-minute structured interviews conducted by trained residents from the housing project who shared similar backgrounds to the participants. Attentional capacity, level of aggression and other controlled variables likely to be associated with aggression were also assessed through the interviews.

Further tests were also conducted; firstly, to measure attentional fatigue and attentional functioning participants were asked to complete the Digit Span Backwards (DSB) test. This test requires the participants to remember, and repeat back, a series of numbers that have just been read aloud by the administrator (e.g., administrator: "3,7,6", then the participant would respond "6,7,3"). The series of numbers increase in length by an additional digit until a participant fails to repeat them back in the correct order. The participants are allowed two attempts at the same number of digits; however, if they fail at the series length on both occasions, then the longest series of correct numbers repeated is scored. Secondly, the Conflict Tactics Scale (CTS) test was administered aimed to measure aggressive behaviour. The test comprises of 14 items that provide an indication of the participants overall aggression. Scores are correlated to provide a picture of aggressive tactics used. Kuo and Sullivan (2001a) found residents with greater views to nearby nature were significantly less aggressive than residents overlooking low levels of nature. Furthermore, after controlling for a number of potential confounding factors, these results were put down to greater attentional functioning and memory capacity.

In a second study by Kuo and Sullivan, (2001b), the authors explored the relationship between vegetation and crime rates over a 2-year period for 98 apartment buildings within the same Chicago housing project. After analysing police records for property crimes, violent crimes, and total number of crimes, Kuo and Sullivan (2001b) found a consistent negative interaction emerged; the greater density in vegetation surrounding the apartment building the lower the reported level of crime.

The effect of viewing nature has also been demonstrated in the prison environment. Moore (1981) observed the attendance of inmates to the health clinic inside a prison in Michigan. Like the methodology of Kuo and Sullivan (2001a), inmates were randomly assigned to cells throughout the penitentiary. Moore noticed that inmates with a view out of their cell window overlooking farmland were significantly less likely to report to the medical clinic than inmates overlooking the prison courtyard. These studies by Kuo and Sullivan (2001a) and Moore (1981) demonstrate the effect nature can have on attentional resources and physical health.

Extending the Attention Restoration Theory paradigm

While the previous studies by Kuo and Sullivan (2001a; 2001b) and Moore (1981) have assessed the view of, and access to, nature, exercise has also been suggested as a method of restoring attention. As stated previously, the predominant focus of ART has been to provide an explanation for the cognitive responses to an environment (Kaplan, 1995; 2001). However, Norling *et al*. (2008) proposed to extend the framework of ART beyond its current restorative environment paradigm and to incorporate behaviours, such as running.

While measuring restorative environments from a quantitative stand point is well established, as is our understanding of how the environment can impact on the ability to direct attention, it remained to be

seen whether behaviours can restore attention too. Like the Perceived Restorativeness Scale (PRS, Hartig *et al*., 1997) – a questionnaire developed to assess the restorative potential of an environment – Norling *et al*. (2008) developed the Perceived Restorativeness of Activities Scale (PRAS) – a measure that could assess the potential for a behaviours ability to restore attention. The PRAS is a 12-item, 0-6 Likert scale questionnaire that aims measure the four components of ART in relation to activities, rather than environments. In regard to extent, the PRAS suggests extent is an activity that provides: (1) an experience contains qualities that draw a person in, (2) an experience that has the ability to retain ones interest for a sustained period of time, and (3) an experience that encourages one to explore it further (i.e. encourage long term participation in the activity).

Norling *et al*. (2010) then set out to test their idea and demonstrate that running, like nature, has the ability to restore attention. Recreational runners were recruited for the study and were assigned to one of four experimental groups and asked to run around an indoor track for 30-minutes. The four groups were categorised by intensity levels; a self-regulated speed determined by the participants in this group, low (60-70% HR max), high (80-90% HR max) and a control group (participants rested in the indoor lounge). Participants' attention was fatigued for 30 minutes prior to exercise by filling out a questionnaire, performing a demanding mental task on a computer for 15 minutes and through familiarisation of the CPT II test. The CPT II (an attention test measuring inattention, impulsivity and vigilance) was then administered at pre-intervention and post-intervention. The results revealed that running had the ability to restore attention. However, significant differences were only found between the the high intensity running group and the control group. Low and self-regulated conditions both resulted in restoring attention more than the control but results were not significant.

According to Norling *et al*. (2010) attention restoration, achieved by the high intensity runners, was done so because of "goal compatibility" (i.e. running at the correct intensity for this group). Goal compatibility allowed the runners to switch from "associative thinking" (thoughts associated with the run) to "dissociative thinking" (thoughts unrelated to the run). The authors suggest that "dissociative thinking" would have engaged the component fascination which, in turn, allowed participants to mentally escape any thoughts that were responsible for the depletion of directed attention, thus achieving the component being away. Although the authors suggest that the component fascination is closely related to associative and dissociative thinking, the interaction was not explored in detail due to their quantitative approach to the study. Thus, a qualitative exploration of how running achieves the components of ART is a priority in order to develop a more comprehensive understanding of running as a restorative behaviour.

Although ART has received little attention in the exercise arena beyond Norling *et al.*'s (2008; 2010) work, comparisons can be drawn between ART and other theoretical frameworks for running cognitions. A recent review paper by Brick *et al*. (2014) developed a new working model of

attentional focus during endurance exercise. In this paper the authors reviewed the literature base on this topic and devised a new system to categorise attentional thoughts. In keeping with the early categories of internal and external *associative thoughts* (thoughts related to running) and internal and external *dissociative thoughts* (thoughts unrelated to running), Brick and colleagues set out to further expand the categories of attentional focus during endurance exercise. Associative thoughts were remodelled and broken down into three categories; internal sensory monitoring (e.g., physiological cues such as breathing, muscle soreness, increased heart rate, etc.), active self-regulation (e.g., the regulation of running pace, technique, etc.) and outward monitoring (mile markers, weather conditions, etc.). External associative thoughts encompassed outward monitoring (e.g., split times, mile markers and other competitors). Meanwhile, dissociative thoughts were redefined as active distraction (e.g., thoughts requiring conscious effort that are used to distract the runner from the run; attention demanding tasks such as completing mental puzzles, conversing) and external dissociative thoughts were revised as involuntary distraction (e.g., sub-conscious thoughts that are unrelated to the run; reflective thoughts, irrelevant daydreams, mind wandering, imagining music, unimportant scenery, etc.). As suggested by Norling *et al*. (2010), the ART component fascination shares close ties with dissociative thoughts when running. For the purpose of this study, the terminology used by Brick *et al*. (2014) and Norling *et al*. (2010) has been adapted and aligned with the framework of ART; *associative thoughts* are referred to as *associative fascinations* and *dissociative thoughts* are now referred to as *dissociative fascinations.* Furthermore, as outward monitoring closely resembled the ART component compatibility, outward monitoring was removed from associative fascinations.

The exercise-environment interaction

In a study by Berman *et al*. (2008) the authors set out to document the impact of walking through contrasting environments (urban vs. nature) on one's ability to direct attention. Participants were administered the DSB test prior to the intervention and after completing the 2.8 mile route. Results revealed that completing the walk through the natural environment had a significant impact on DSB performance, whereas the urban environment did not. Results seen by Norling *et al.* (2010) who reported low intensity exercise had a non-significant effect on attention restoration, yet Berman *et al.* (2008) provide support for low intensity exercise on restoring directed attention. While it is unclear why exercise at similar intensity levels produced different results, the exercise-environment interaction may be a modulating factor on the restoration of directed attention through exercise.

As Atchley *et al*. (2012) note, modern environments are filled with numerous hard fascinations (see ART; Kaplan, 1995) that demand our attention (e.g., traffic, advertisements, phones, alarms, television etc.) and tax our directed attention resources. With this in mind, Atchley and colleagues set out to document the effect sustained exposure to the natural environment had on creativity. Subjects were randomly assigned to one of two groups categorised in accordance of time point of test

administration; participants were either required to complete the test pre-test (taken in the morning just prior to the intervention) or in-test (test was completed in the morning of day 4 of the intervention). Once randomly assigned to their group, the participants were asked to complete a 4-6 day backpacking trip through one of eight locations across America. They were also forbidden to use any form of technology on trip. Participants were asked to complete the Remote Associates Test (RAT) which set out to measure their ability to think creatively and problem solve. Results suggest that participants completing the RAT at the in-test time point demonstrated a 50% increase in performance than their pre-test counterparts. This suggests restoring attention also has an impact on creativity and problem solving.

While the experiment by Norling and colleagues (2010) controlled for the influence of environment by exercising indoors, other studies suggest environments can influence the degree to which psychological responses can be achieved. Research has compared a variety of environments against one another. For example, Hartig *et al.* (2003) compared urban vs. natural and found that walking in the nature reserve had a greater improvement on performance of an attention task than the walk in the urban environment. Focht (2009) compared walking in urban vs. laboratory environments and found that affective states such as revitalisation, tranquillity and basic pleasure of walking were significantly greater in the outdoor environment. Ceci and Hassmen (1991) compared laboratory vs. running track environments and found, when walking, participants exercised at a greater intensity outside, despite reporting the same rate of perceived exertion in each environment. Finally, Pretty *et al.* (2005) demonstrated that as exercising in a laboratory in front of a screen presenting images of rural pleasant, rural unpleasant, urban pleasant, urban unpleasant and control group (no scene) produced different psychological responses in the sample of participants. Exercise conduced in front of rural pleasant and urban pleasant scenes resulted in a more positive effect on self-esteem than exercise in front of no scene. These studies demonstrate the possible environmental influences on psychological responses to exercise.

"Green exercise", a term coined by Pretty *et al.* (2003), refers to the possible synergistic effects of combining exercise with the natural environment. For instance, Barton and Pretty (2010) completed a meta-analysis on the green exercise literature and reported psychological measures such as mood and self-esteem were subject to positive improvements after a duration of as little as five minutes. However, these results need to be taken with caution as many of the studies do not compare the responses to contrasting environments. Meanwhile, other studies have reported that, irrespective of environment, changes in psychological measures such as mood or emotion occur due to the behaviour and not the environment (e.g., Bodin & Hartig, 2003; Kerr *et al*., 2006), which may be due to endocannabinoid (eCB) release; a biochemical response to exercise thought to be associated with "runners-high" (Dietrich & McDaniel, 2004; Raichlen *et al*., 2012; Sparling *et al.*, 2003) that is released in highest concentrations when exercising at 70-80% HR max (Raichlen *et al*., 2013).

Conversely, others have reported enhanced benefits of the exercise-environment interaction. For instance, exercising in the natural environment as opposed to indoors may lead to some beneficial responses such as an increased feeling of revitalisation, feelings of energy, along with decreases in frustration, confusion, tension and tiredness, amongst others (Thompson Coon *et al*., 2011).

This work on the exercise-environment interaction is inconclusive and the mechanisms through which psychological changes occur whilst exercising in the natural environment are not yet fully understood (Gladwell *et al*., 2013). A partial explanation may be the effect of environmental "greenness" (Ackers *et al*., 2012). The term greenness encompasses a variety of outdoor settings; for example, simply put, the term refers to the level of vegetation in an environment (Almanza *et al*., 2012). Almanza and colleagues note that greenness refers to a range of environments; from tree-lines streets to streets containing few natural elements, to play fields and forested parks. However, in the study by Akers *et al*. (2012) the authors refer specifically to the effect of the colour green in the environment. Another is that stimuli from the outdoor environment distract the participant from the physiological responses to exercise, as opposed to the indoor environment (Focht, 2009). Work by Williams (2011) built on this idea and noted that exercise outdoors led to less distressing thoughts (i.e. wishing the activity would end). The author suggested this was due to the outdoor environment possessing a greater ability to take the participants mind off exercise.

This study aimed to explore the exercise-environment interaction in more detail. Additionally, this study aimed to build on the work of Norling and colleagues (2010) by qualitatively analysing the experience of running within the framework of ART and exploring how running may achieve ART's four components (fascination, being away, extent and compatibility).

Research questions (RQ) for this paper are:

1. How does running achieve the components of ART to enable restoration of attention?
2. How does the environment affect the way in which running achieves restoration of attention?

2. Methodology

2.1. Design

The research was conducted within an interpretivist paradigm, with the aim to explore the participants' subjective experiences of running within contrasting environments. An interpretivist paradigm takes the position that reality is created through experience, as opposed to natural reality (Grey, 2013). It was this paradigmatic stance that influenced the methodology of the current study by collecting and analysing interviews in order to understand the effect of running on attention, and the influence of the environment on the running experience. To ensure against researcher bias and to increase the chances of a diverse range of answers from the interviews (Shenton, 2004) participants were randomly

allocated to either the urban (U), green (G) or indoor (I) environment by picking numbers out of a hat. Each participant was required to run on three occasions in the same environment on separate days over a 10 day period (trial 1, 2 & 3; see Table 1). Running times were scheduled around the participants' free time and therefore were conducted at various time points, however, no participant ran when it was dark. All runs took place between March-August 2014 and although the weather conditions varied for the outdoor participants, only one trial in the urban environment was rescheduled due to heavy rain.

Group	Trial 1	Trial 2	Trial 3
Urban Group	Pre-intervention interview and 3 mile run	3 mile run	3 mile run and post-intervention interview
Green Group	Pre-intervention interview and 3 mile run	3 mile run	3 mile run and post-intervention interview
Indoor Group	Pre-intervention interview and 3 mile run	3 mile run	3 mile run and post-intervention interview

Table 1: The procedure of research for trial 1, 2 and 3

Participants took part in two semi-structured interviews, one before their first run and one after their final run. An advantage of this interview technique was that the researcher was able to pursue specific topics of interest to the research, yet simultaneously provide a level of freedom to explore experiences that may be of importance to the research, but were not covered in the interview guide (see Table 3). The pre-intervention interview aimed to gather information on previous running experiences and perception of the environment participants were running in. The post-intervention interview aimed to collect data on the experience of the three running trials and how the environment influenced where participants directed attention within their allocated environment.

2.2. Participants and recruitment

Eighteen recreational runners (11 male, 7 female) between the ages of 22-36 years took part in the study (see Table 2). Participants were recruited opportunistically and through snowball sampling; a method of recruiting potential participants to the study through contacts of the subjects (Biernacki & Waldorf, 1981). After initial expressions of interest, potential participants were sent an email containing a participant information sheet and contact information of the researcher. This encouraged a preliminary dialogue to take place between potential participant and researcher whereby any clarification over the procedure could be carried out. All subjects were informed that they reserved

the right to withdraw from the study without any justification at any point throughout the process. Prior to the intervention, all participants completed a readiness to exercise screening questionnaire to ensure they were eligible from a health perspective to take part. Written consent was obtained from participants confirming they had read and were comfortable with the research procedure.

Group	Participant	Age	Gender
Green	GP1	24	Male
	GP2	23	Female
	GP3	36	Female
	GP4	26	Male
	GP5	24	Male
	GP6	34	Female
Indoor	IP7	24	Male
	IP8	23	Male
	IP9	29	Male
	IP10	24	Male
	IP11	22	Female
	IP12	24	Female
Urban	UP13	27	Female
	UP14	23	Male
	UP15	22	Male
	UP16	28	Female
	UP17	23	Male
	UP18	24	Male

Table 2: Environnent groups, participant code and participant information.

2.3. Running routes and environments

Participants were required to run three miles on three separate occasions. The distance chosen was three miles based on a distance of 2.8 miles in a previous study observing the restorative effects on attention when walking in green and urban environments (Berman *et al*., 2008). Distance rather than time was selected for this particular study because that meant a clear start and end point for the runners. Furthermore, if time was selected, some participants may have completed the allocated time but found themselves half way through a lap of the outdoor environment in which case they would have needed to walk back to the researcher through the running environment, which may have

impacted their overall experience. To ensure the distance was comparable between all conditions, specific three-mile running routes were devised for the green and urban groups. To ensure participants were exercising at a comparable intensity, participants were fitted with Polar FT1 heart-rate monitors and asked to run within 70%-80% VO_2 max (calculated using the formula [208 – (0.7 + age] (Tanaka *et al*., 2001). This intensity range was selected because the eCB response is greatest within that intensity bracket (Raichlen *et al*., 2013),

2.3.1. Urban

The urban run comprised two laps of a one-and-a-half mile route around Liverpool city centre (mostly around the outskirts of the University of Liverpool campus). The selected route around the urban environment aimed to represent a common built environment found in the city i.e. one that did not possess any special natural features such as views over large bodies of water or parks. The participants were asked to run through a space populated predominantly with cars, cyclists, pedestrians, houses, shops and university buildings. The high ratio of man-made structures to natural elements defined this environment to the research team as urban.

2.3.2. Green

The green run comprised two laps of a one-and-a-half mile route through Sefton Park, Liverpool. The pre-determined route navigated participants along tree-lined pathways with views over large grassy areas, past the park café, and around a large lake. In order to complete the lap participants spent a short time on a tree lined road stretching approximately 30 meters, and as a result may have briefly encountered cars and pedestrians. Nonetheless, the size, natural features of the park and the fact the road connecting onto the park was rich in natural elements meant this environment was deemed suitable by the research team to represent the green route in this study.

2.3.3. Indoor

Participants in the indoor test condition performed the three mile run on a treadmill at Liverpool John Moores University, Tom Reilly Building laboratory. Differing from the urban and green environments, the treadmill was located in an isolated laboratory with restricted views outside little or no contact with anyone other than the researcher (in contrast to the urban and green conditions, where participants naturally came in contact with other members of the public).

2.4. Interview procedure

All interviews were conducted by the researcher. Interviews for the urban group took place on some seating outside the Liverpool John Moores University, Redmonds Building or in the cafeteria inside the building if the weather was too windy. Interview for the green group took place in a seating area outside the café in Sefton Park. Interviews for the indoor group took place in Tom Reilly Building

laboratories, Liverpool John Moores University. All pre-interviews lasted between 5-15 minutes and post-interviews lasted between 5-17 minutes. The researcher explained the themes that were going to be discussed and made clear to the participants that the interview was to collect information on their personal experiences, and that there were no right or wrong answers (Shenton, 2004). Additionally, it was made clear to the participants that they were able to refuse any questions asked if they so wished and were free to withdraw from participation at any point in the research process (Shenton, 2004). The researcher was also ready to answer any questions from the participant if they were unsure about any part of the research. Once the participants indicated they understood the procedure and were happy to continue, the interview began and was recorded on an Olympus WS-450S digital voice recorder.

The interview guide was developed using a similar structure to that used in Côté and Salmela (1996). For example, three types of questions were used: descriptive (can you talk about your previous running experiences?) to collect detailed insight into the experience of running, the running-environment interaction and detail of attentional focus when running, structured (what where you focusing your attention on during that run?) to collect specific information on the experience and contrasting (compared to all the other places you've run before, how does this place compare?) in order to gain insight into experiences of running in different environments and how they compare to the environment they were randomly assigned to. Furthermore, as the interview was semi-structured, flexibility to follow the participant through the topic was permitted. Within the interview a variety of probes were used. Probes are used as a method of deepening the response produced by the participant being interviewed (Patton, 2002). These included non-verbal elaboration probes, detail-orientated probes, clarification probes and contrast probes (Patton, 2002).

The interview guide for pre- and post-intervention is provided in Table 3.

Time of interview	**Rational**	**Research Question**	**Semi-structured interview questions**
Pre-intervention	Rational: Running was said to have the potential to restore attention (Norling *et al*., 2008) and was demonstrated to do so (Norling *et al*., 2010). Research needed: Qualitative data needed to show how running can be a restorative behaviour by framing it in attention restoration theory (ART)	RQ1: How does running achieve the components of ART to enable restoration of attention?	- Can you talk about your previous running experiences? - How often do you go running? - What are your motivations for going? - Where do you normally run? - Why do you choose that environment? - What do you tend to focus on when you're running?

	and its four components (fascination, being-away, compatibility and extent)		
Post-intervention	Rational: The environment is said to have an influence on the psychological gains acquired from exercise (Pretty *et al.*, 2005). Research needed: To gather qualitative data to better understand the exercise-environment interaction and how the relationship can effect ones running experience.	RQ2: How does the environment affect the way in which running achieves restoration of attention?	- How do you feel after the run? - What were you focusing your attention on during that run? - When you were running did you at any point "zone out" or stop thinking about the run and think about other things? - Can you describe your experience of running in this place? - Compared to all the places you've run before, how does this place compare to the others? - Can you describe the good and bad points of running here? - Is this a comfortable environment to run in? - Has running help you notice anything new about this place? - What is your opinion of this place? - Does this place give you a break from your day-to-day routine? - Does this place allow you do the things that you like doing? - Are there things in this place that you find interesting?

Table 3: Semi-structured interview guide.

2.5. Procedure

2.5.1. Trial one

Prior to the interviews the researcher met and introduced themselves to the participant at one of the following environments to begin the intervention: the Redmond Building, Liverpool John Moores University, prior to the urban run; The Oasis in the Park Café, Sefton Park prior to the green run; or in the Tom Reilly Building, Liverpool John Moores University. The researcher then went through the experimental procedure answering any questions the participant had regarding the research. All participants completed a readiness to exercise questionnaire, read the participant information sheet and provided written consent to say they were willing and eligible to take part in the study. The interview was conducted prior to any involvement in the run. Participants in the urban and green groups were familiarised with the route using a map and descriptions of landmarks and turnings. Participants were provided with a printed map clearly identifying the route and informed to run at their calculated heart rate range (70%-80% VO_2max). Subjects in the indoor environment were familiarised with the treadmill and brought up to a speed that corresponded with the same heart rate range as the outdoor groups. Once the heart rate monitor was verified to be working and the participant had identified they understood the instructions they began the run. Participants in the green

and urban groups set off on their route and the indoor participant was brought up to a pace that corresponded with their determined heart rate range. After the three-mile run the equipment was taken back and the participant was free to leave.

2.5.2. Trial two

Trial two began with participants meeting the researcher at their designated environment. The heart rate monitor was attached and verified as working, and the participant reminded of the heart rate range to run within, the participant set off on the three-mile run. Once completed, the equipment was returned to the researcher and the participant was free to leave.

2.5.3. Trial three

Participant and researcher met at the allocated sight to begin the trial. The participant was set up with the heart rate monitor, the equipment was verified to be working and they were reminded of their heart rate range. Once completed, the participant returned to the researcher and an interview was conducted.

2.6. Analysis

Interview data was audio-recorded and transcribed verbatim. Once transcribed, the researcher examined the answers in detail immersing themselves in the data in an attempt to fully understand the experiences of the various participants. A theoretical thematic analysis of the data was then completed (Braun & Clarke, 2006) by analysing the data in relation to the research questions. The data was mapped on to constructed frameworks for the components of ART to form categories, sub-categories and themes (see sections 2.7.1 – 2.7.4 for more detail). Data was analysed in the context of the transcript and, if necessary, was applied to multiple codes. In order to create a credible picture of the participants' experiences, pen profiles were used to display the results (Mackintosh *et al*., 2011). Pen profiles are a method of representing the categories, sub-categories and themes found in the data in a visual format; the pen profiles are further supported with verbatim quotes to help bring the results to life. Quantification of qualitative data was not included in this study as rare experiences were valued to be no less important to the results than common experiences (Krane *et al*., 1997). Throughout the analysis, triangulation via data sources was conducted, comparing the data gathered via interview to previous data and themes developed on the subject (Shenton, 2004). Frequent peer debriefing sessions took place with the researcher and supervisor(s) to review and revise subthemes, and discuss progress, which helped to ensure credibility of the research (Shenton, 2004). Finally, reflexivity was conducted at the end of the research using methods set out by Finlay (2002) to evaluate the research process from a personal development perspective and reveal to the reader how the researcher impacted on the research.

2.6.1. Fascination

Data in relation to fascination was mapped onto the pre-exiting framework created by Brick *et al*. (2014). Brick *et al*. (2014) reported that associative and dissociative fascinations could be divided into sub-categories: associative fascinations include internal sensory monitoring, active self-regulation and outward monitoring and dissociative fascinations include involuntary distraction and active distraction (for a more detailed description of the categories see page 12). These sub-categories formed the structure for coding themes in the data.

2.6.2. Extent

Unlike fascination, the component extent did not have a well-developed framework to map data themes on to. However, the work by Norling *et al*. (2008) had developed a questionnaire (the PRAS) that contained questions relating to this component. To help guide the theoretical thematic analysis for extent, these questions were interpreted which helped to define what was to be looked for in the data. As explained previously (see page 11), it is understood that the definition of extent in the context of a restorative behaviour is (1) an experience contains qualities that draw a person in, (2) an experience that has the ability to retain ones interest for a sustained period of time, and (3) an experience that encourages one to explore it further (i.e. encourage long term participation in the activity). Thus, when analysis of the data was conducted, examples of running achieving any of the three definitions were drawn out to support this component.

2.6.3. Being away

For data to be applied to the component being away the understanding of this component, produced from Kaplan (1995), was used as guidance to map interview data on to. For running to achieve the sense of being away it had to (1) have the ability to shift attention to different cognitive content, and (2) provide an opportunity to gain physical distance from psychologically demanding environment. The data was analysed and indications of running achieving the definitions for this component were collected.

2.6.4. Compatibility

Compatibility refers to the person-environment interaction. Like being away, for analysis for this component was guided by Kaplan's (1995) understanding of compatibility. Furthermore, it was guided not only by RQ1 (to gain an understanding of how running may achieve the components of ART) it was also guided by RQ2 (the potential ways in which the environment may influence attention restoration) which meant theoretical thematic analysis informed this process. Analysis of compatibility required an inductive element to discover and develop themes from the data. Any data relating to the exercise-environment interaction was initially coded. The data was then searched for

themes. The themes were then reviewed. This process of searching for themes and then reviewing them was repeated multiple times over the process of the research. Finally, once satisfied with the themes, they were named and defined and collected together to inform categories and sub-categories of compatibility factors and the impact of those factors on running experience.

3. Results

The results section begins by providing a brief introduction to the participants motivations in order to give context to the runners' experiences (section 3.1 and 3.2), and then moving on to report the main findings of the study by framing the experience of running within the four components of ART; fascination (section 3.3), being away (section 3.4), extent (section 3.5) and compatibility (section 3.6).

The results will be represented in a pen profile format. Subjects are referenced with a code that identifies the environmental group; green (G), indoor (I) or urban (U), participant number (P1-18) and time point of interview (pre/post). For example; GP1_Pre represents green group, participant one with the quote taken from the pre-intervention interview; IP7_Post represents indoor group, participant seven and the quote taken from the post-intervention interview; and UP13_Pre represents urban group, participant 13 with the quote taken from their pre-intervention interview.

Table 4: Overview of the results

Component	Theme	Sub-theme	Codes
Motivation	Psychological	N/A	Change environment, freedom, to avoid hypocrisy, distraction from stressors, to maintain well-being, improve mood, time alone to think, enjoyment and mental stimulation.
	Physical	N/A	For the feeling of exercise, perceived biochemical responses, improve appearance, general fitness and burn off excess energy.
Fascination	Associative fascinations	Internal sensory monitoring	Breathing, muscle soreness, general statements on internal sensory monitoring.
		Active self-regulation	Pacing, task based attention, internal motivation/drive.
	Dissociative fascinations	Active distraction	Environmental stimuli demanding attention (hard fascinations), mental puzzles and conversation.
		Involuntary distraction	Reflective thoughts, irrelevant daydreams, no thoughts, imagining other exercises and environment captures interest (soft fascinations).
Being away	Psychological distance	N/A	Refocus attention on a different task
	Physical distance	N/A	Relocate to a different environment

Extent			Running contains qualities that draw a person in, it encouraging further exploration of the behaviour and retains ones interest for a period of time.
Compatibility	Green	Low level of attention required	Soft fascinations and layout
		Supportive atmosphere	Likeminded people/environment for everyone and air quality
Impact of green compatibility		N/A	Comfortable in the environment, reduced self-consciousness/awareness, break from the usual environment, rhythm, opportunity for reflection, low attention/concentration and proximity and motivation.
Compatibility	Indoor	Lack of environmental stimuli	Hard fascinations such as dials and flashing information on the treadmill, and lack of soft fascinations/environmental stimuli.
		Supportive environment	Controlled environment reduces difficulty/ need for attention, and away from the public/people.
		Unsupportive environment	Restricted to the treadmill, and perception of poor air quality.
Impact of indoor compatibility		N/A	No distractions to facilitate mind wandering, increase in perceived effort, away from people reduces self-consciousness, actively distract oneself due to lack of environmental stimuli, ease of environment requires low attention, facilitative of running, provides information/feedback, and run becomes boring.
Compatibility	Urban	Attention required to maintain safety	Hard fascinations and environmental layout.
	Impact of urban compatibility	N/A	Increased self-awareness, restrictive environment due to the layout, high challenging environment helps to distract the runner, hard fascinations deter people from running in the environment, environmental influences thoughts and behaviours, and disruption to running rhythm/pace.

3.1. Psychological motivations for running

Due to the opportunistic nature of the sample, participants came from a range of running backgrounds with varying levels of experience. In the pre-intervention interview, participants were asked to

explain their motivations for running. Two categories of motivations emerged from these interviews; (a) psychological (see Figure 1) and (b) physical (see Figure 2).

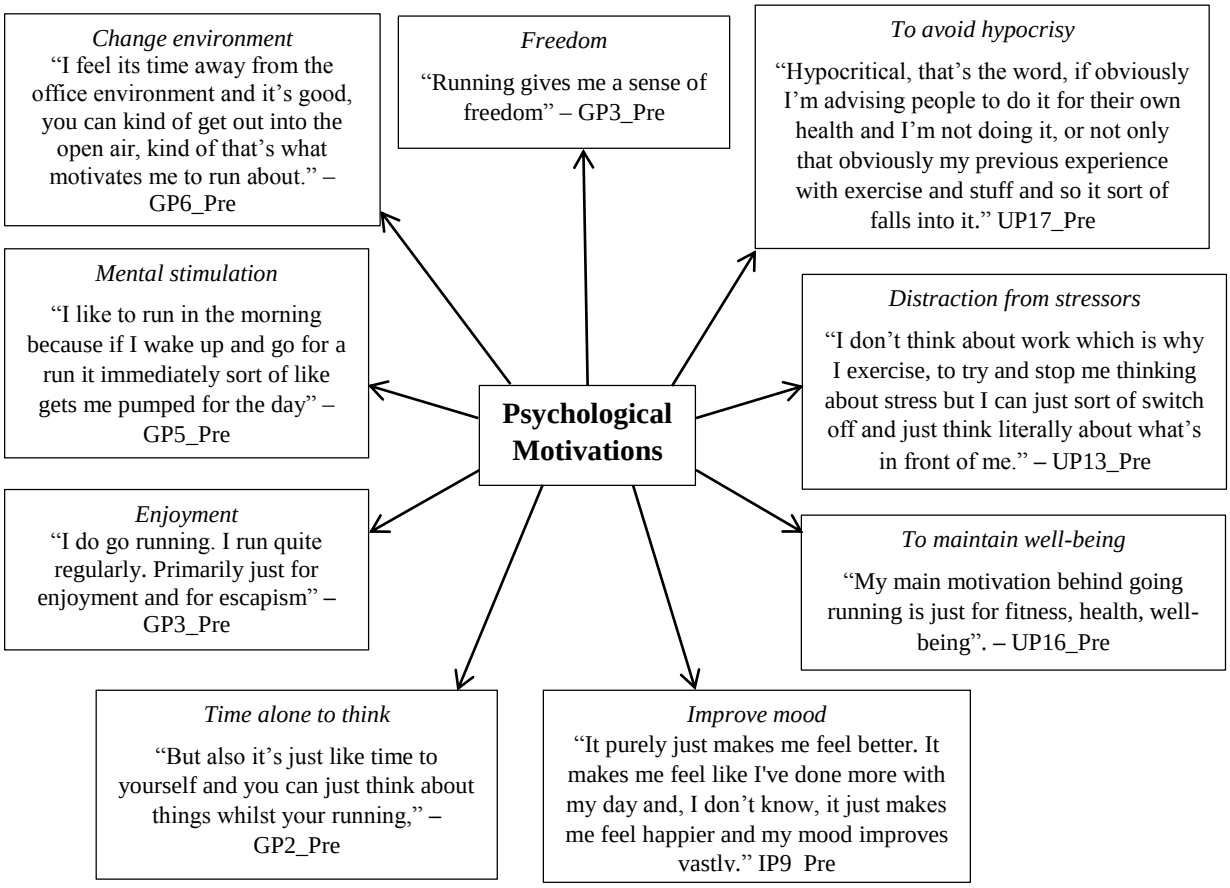

Figure 1: Psychological motivations for running.

As seen in Figure 1 participants chose to run for various psychological reasons. Participants described how running helped their well-being and improved their mood, with some participants seeing running as a distraction from stressors. Running also provided an opportunity to have some time alone and encouraged a sense of mental stimulation.

3.2. Physical motivations for running

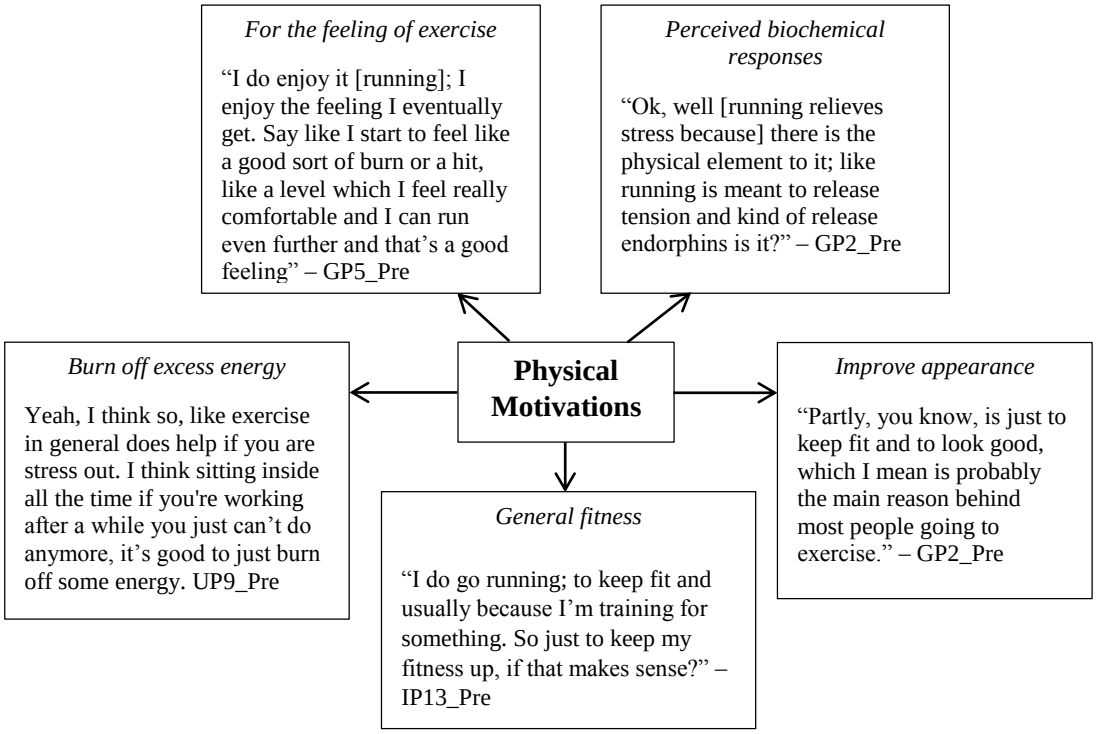

Figure 2: Physical motivations for running.

Participants were not only motivated for psychological reasons; the decision to run was also based on achieving physical objectives such as improving appearance or to improve their general fitness (see figure 2). Some participants felt running was a good way to burn off excess energy that has built up from a sedentary working lifestyle, while others ran simply for the feeling of exercise.

3.3. Fascination

Associative fascinations are represented in Figure 3 and dissociative fascinations are represented in Figure 4.

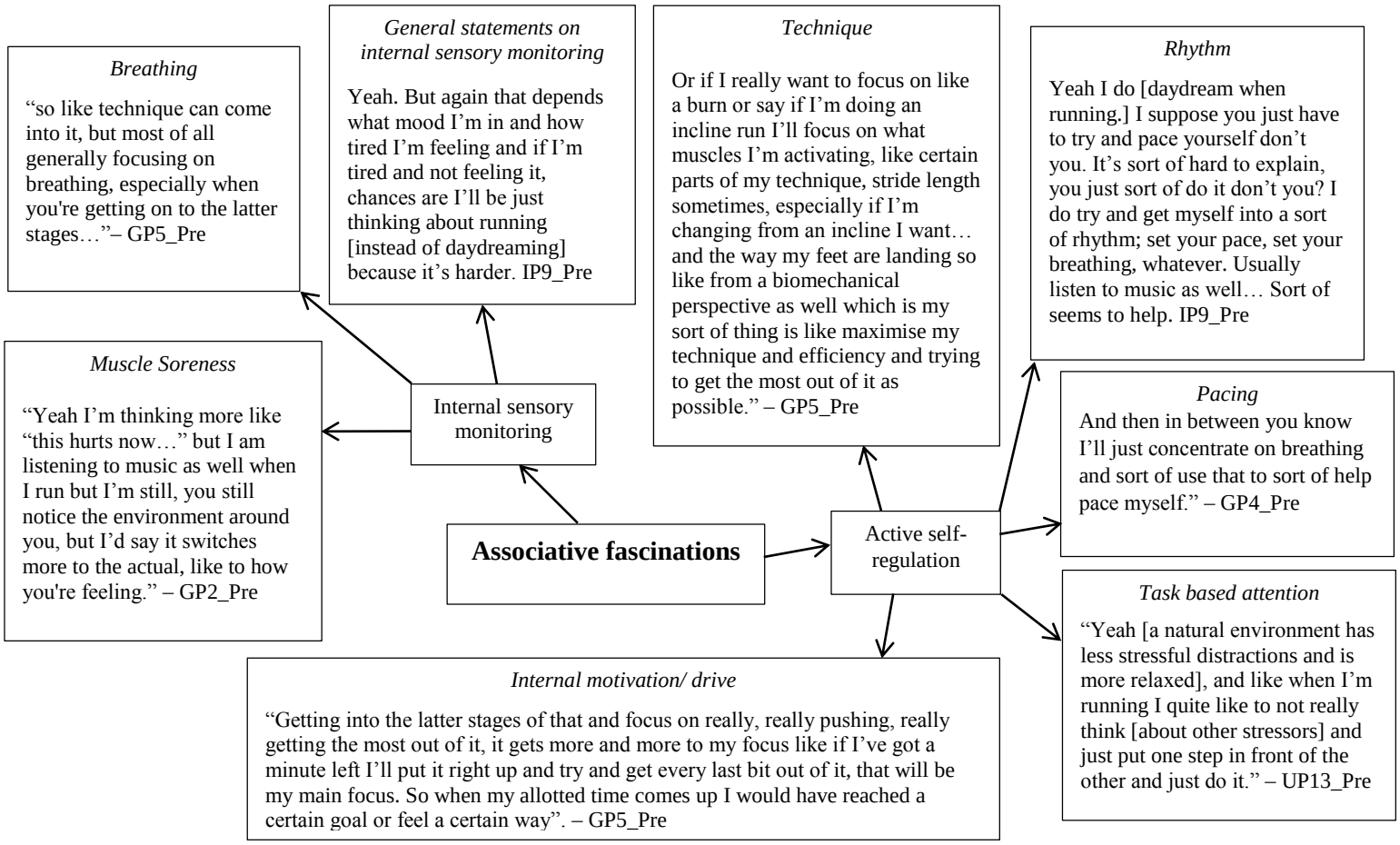

Figure 3: associative fascinations of running along with their themes and quotes.

As reported in Figure 3, associative fascinations emerged and captured attention as a direct response to running. These fascinations were found in participants across the three environmental groups but were subjective for each individual. Internal sensory monitoring of physiological changes such as a change in breathing pattern or sensations of muscle soreness was seen in many participants. For example, P8_Post explains what they were concentrating on throughout their run:

> *"Mainly trying to sort my breathing out because that seems to have a decent effect on heart rate… At least it did the first time anyway. Generally just trying to stay concentrated, make sure I was trying to stay at a good pace and not tire myself out."*

As this quote shows, internal sensory monitoring and active self-regulation are closely connected to one another; by controlling pace one can influence their breathing patterns.

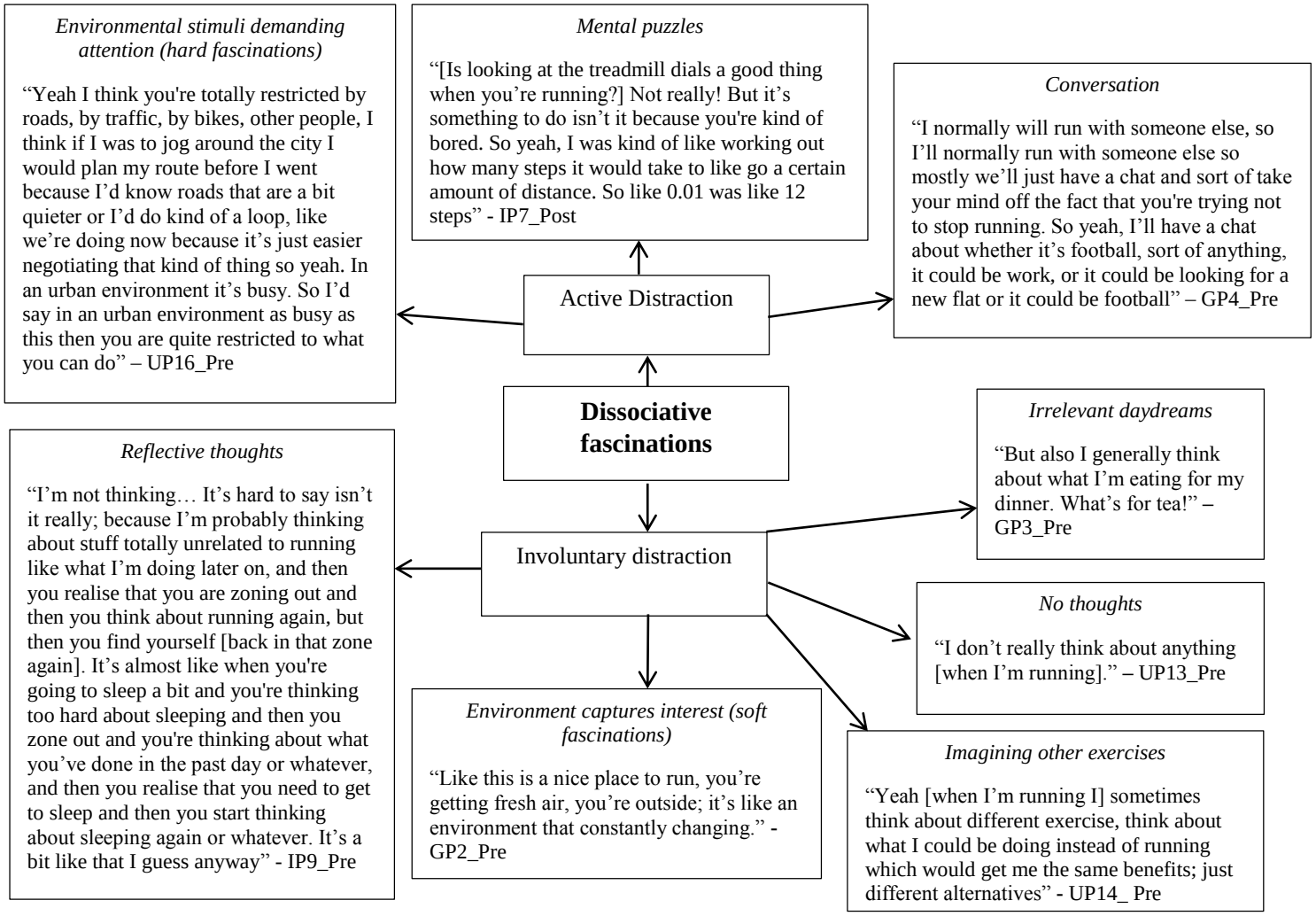

Figure 4: represents the dissociative fascinations of running along with its sub-categories.

In terms of dissociative fascinations, participants reported both active distractions (directed attention) and involuntary distractions (involuntary attention) when running. However, the fascinations the participants engaged in varied within the different environments. For example, when running in the indoor test environment, IP7_Post began to complete mathematical calculations to keep themselves entertained due to the lack of environmental stimuli. GP4_Pre reported conversation was a method of directing attention away from the associative fascinations of running in an attempt to reduce the sensations of the associative fascinations and keep running. While these subjective experiences were less commonly reported by the participants they were deemed by the researcher to be noteworthy.

Most notably, involuntary distractions were reported more often in the green environment than the indoor or urban. Involuntary distractions were episodes of internal reflection or irrelevant daydreaming that occupied the mind effortlessly and distracted the participants from running. This state of mind was deemed a significant experience and reason to go running by GP1_Post:

"For the first section it's usually how in pain I am and how exhausted I am. But then I break through that barrier my mind tends to sort of get into almost a meditative state of thinking about completely other things… I think that's another big, big part of the run."

Therefore, once GP1 had established their running rhythm they were able to switch their attention from associative fascinations to involuntary distractions.

GP1_Post continued to describe this mental state in more detail:

Well… I break out of it as well at points and realise, I sort of become aware that I am doing again. Or I'm becoming more tired so I become aware that I'm getting exhausted. But then I usually have a sort of realisation of how much distance I've covered since I last was aware of it. And towards the end of the run I am sort of so exhausted that the meditation is sort of broken because I'm focused on getting to the end by that point. But, yeah once I've broken past that initial barrier and being tired and I get a rhythm and I get my breathing like regulated at a certain level and I get my pace the same it's like… [I get myself into that state of mind]."

As the participant explains, involuntary distraction was disrupted by associative fascinations. However, at the beginning of the run, the aim for this participant is to maintain a running rhythm that enables the run to become more autonomous so involuntary distractions emerge. When asked about other activities achieving this state of involuntary distraction GP1_Post explains:

"Not to the same degree, I mean I get the same sort of detachment when I'm doing other… like playing football or other sports, because my mind is engaged. But that's more of an active… my mind is actually being engaged in doing other things. So it clears my mind but it's not the same sort of deeper thoughtful period… I get it when I'm cycling as well cos I think it's sort of a similar thing…"

Here the participant compares their experience between football and running and how, if the activity requires a greater level of attention or concentration, their ability to engage in involuntary distractions is impeded. As noted in an earlier quote GP1 suggests involuntary distractions are a *"big, big part of the run"*.

3.4. Being away

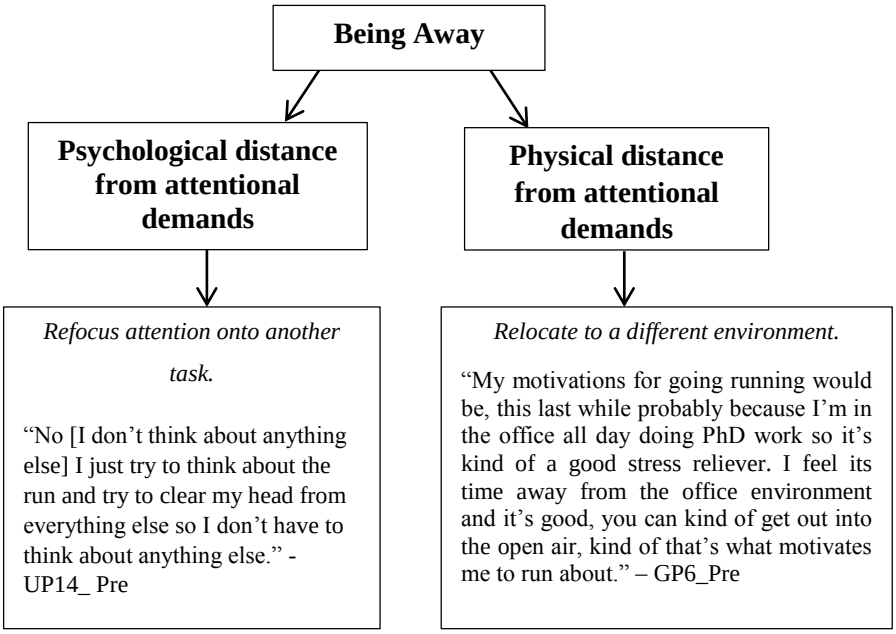

Figure 5: Physical and psychological ways running is able to achieve being away.

Participants in this study felt that the experience of running was able to provide psychological and physical distance from demanding thoughts and/or environments. Being away was centred on two themes: by refocusing attention on a different task provided the psychological distance and relocating to a different environment provided the physical distance. For some participants, concentrating their attention on running meant attention was re-directed away from content that may be responsible for depleted attention. For example, GP6_Pre stated: *"As you know, once you're out in the fresh air, for those 10-15 minutes you don't have to think about anything except getting around the park."* GP6__Pre mentioned earlier in their interview that running is was good stress reliever from their PhD work and the office environment.

Along with providing the psychological break, participants reported that running offers an opportunity to physically distance them from the attention demanding environment. GP2_Pre noted:

> *"But also it is nice to… like if I've been doing something like work all day, or something like that, it's nice to have a break from the routine, get out the house. It is a bit of a stress relief."*

GP2_Pre highlights the benefit of temporarily leaving the working environment, in this case their house, for a short break. It is important to note that the environment used for running can impact on the participants experience and sense of being away. For example, GP2_Pre reported:

"I am naturally drawn to this place [the park] because I want to be surrounded by nice things when I'm running. 'Cos if you're going to relieve stress then why are you going to want to run round loads of roads because there are loads of cars all around making noise and stressing you out?"

Here, GP2_Pre explained that as an objective of theirs when running was to relieve stress, taking a break and running in an urban environment may not achieve their desired objective. Achieving a sense of being away depends on the environment the break is taken in, which is why the participant was naturally drawn to the park as a place to run. This exercise-environment interaction is reported in more detail in compatibility (section 3.7), when observing the features of an environment that contributes to compatibility when running and the impact of the environment on experience.

3.5. Extent

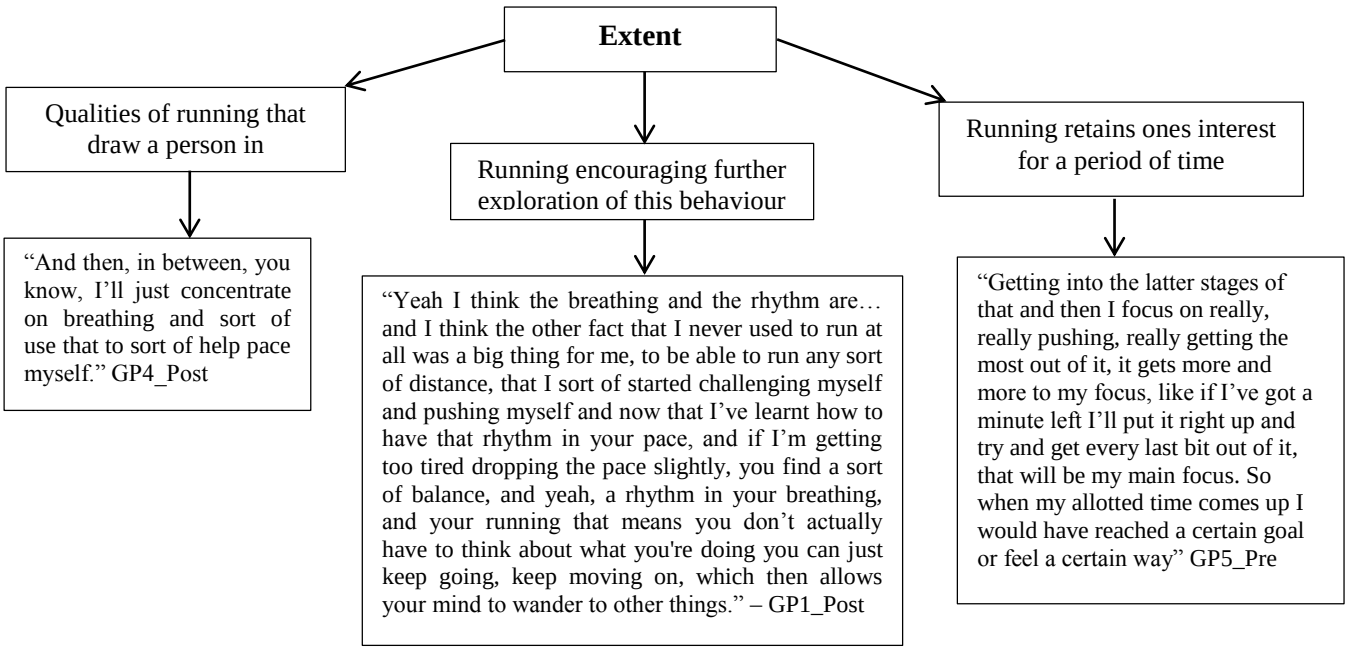

Figure 6: Provides a representation of how running was able to achieve a sense of extent.

Results from participants in this study demonstrate that running has the potential to achieve the component extent and is reported in three themes; qualities of running that draw a person in, running encouraging further exploration of this behaviour and retaining ones interest (see Figure 6). In the context of restorative behaviours, extent was not influenced by the environment; rather it was influenced by the behaviour itself. The subjective experiences that were reported reveal that running was capable of drawing a person into the activity. The qualities that draw the person in are linked closely with associative fascinations (see Figure 3). As UP16_Post explained:

> *"[I was focusing on] pace, to be honest; heart rate, not going to fast, slowing down on the hill 'cos my heart rate goes up on the hill… Technique as well. What I'd forgotten about street running was the terrain; it's quite hard, I get quite, like, tight shins, tight calf's, so I sort of adapt my technique a bit."*

How a person is drawn in to the behaviour, and thus how this category of extent is achieved, has a large part to do with the monitoring of associative fascination. Furthermore, the associative fascinations also contribute to achieving another category of extent; as the associative fascinations require attention they manage to retain ones interest, for instance UP13_Pre reported:

> *"you have to focus on your breathing and you have to focus on kind of literally just doing what you're doing and you can kind of focus on that rather than think about what's actually stressing you out or what's on your mind."*.

For the final category of extent running was able to encourage further exploration, as seen in the example quote by GP1_Post in Figure 6. Through time and practice this participant explored the behaviour and learnt how to monitor and regulate running's associative fascinations. As described, their exploration of this behaviour and knowledge of their bodies' response to the behaviour meant focusing attention on the associative fascinations was no longer completely necessary meaning they could run more autonomously and allow their mind to wander.

3.6. Compatibility

As the literature reports, compatibility is the match between the purposes and inclinations of the person (in this case, to achieve the objectives in section 3.1 and section 3.2) and the environments ability to support them, thus allowing the objectives to be achieved. In the following section, the results will be reported in environmental sub-sections: green (section 3.6.1), indoor (section 3.6.2) and urban (section 3.6.3). Within the three sub-sections, the results from each environment will be broken down into their environmental characteristics and the impact those characteristics had on the participants' experiences of running.

3.6.1. Green

Reported below are the compatibility themes of the green environment reported by the participants (Figure 7).

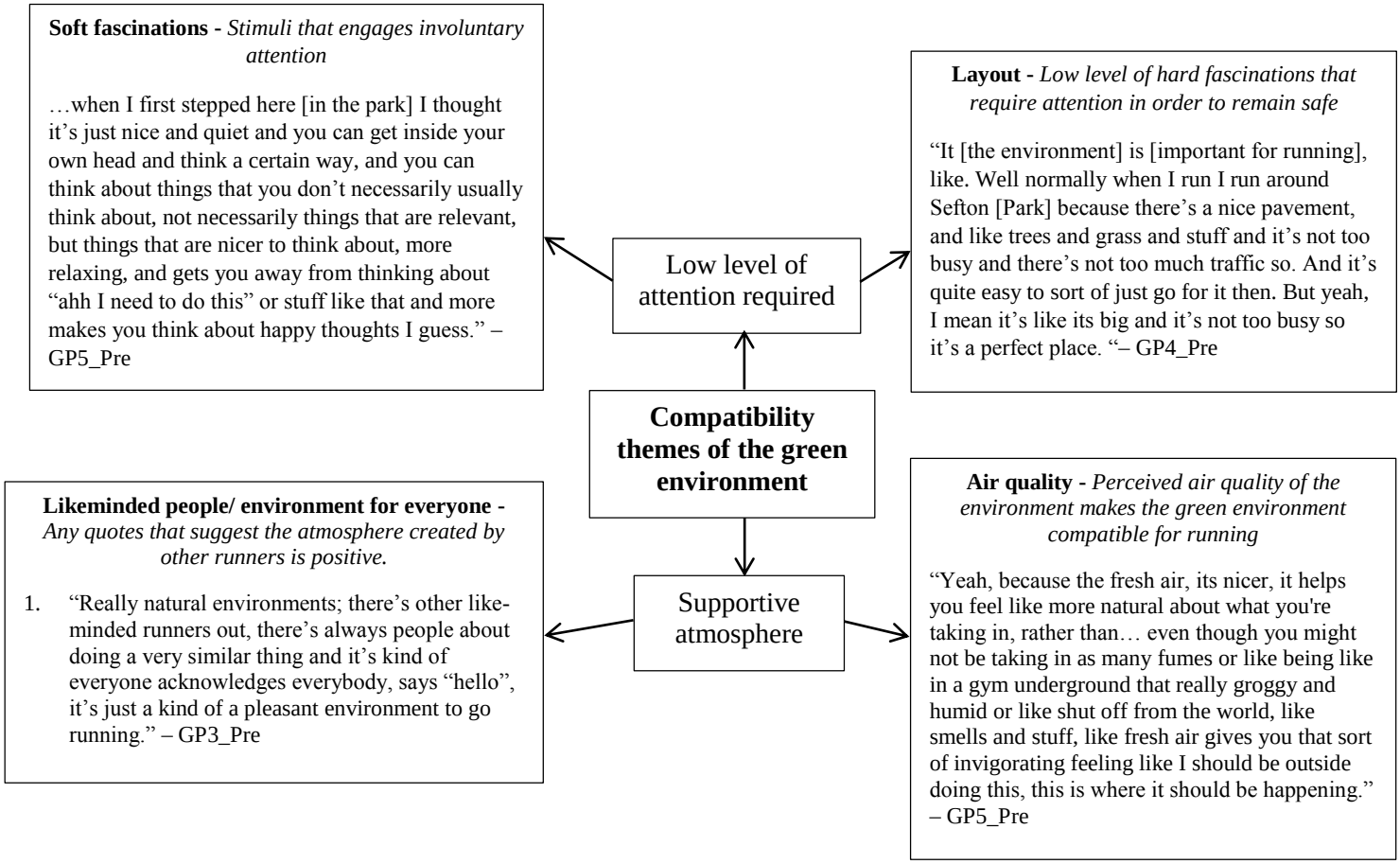

Figure 7: The green environments compatibility themes and sub-themes.

The findings from the interviews suggest two main themes of compatibility within the green environment (Figure 7). Firstly, the environment has a supportive atmosphere through the perception of good air quality and likeminded people performing similar activities. And secondly, participants needed to use less attention navigating their surroundings through a safe layout and stimuli that required low levels of attention and engaged involuntary attention such as soft fascinations. These features contribute to making the green environment a highly compatible place to run in, and thus had a positive impact on the participants running experiences. How the environment impacted the participant experiences can be seen in Figure 8 below.

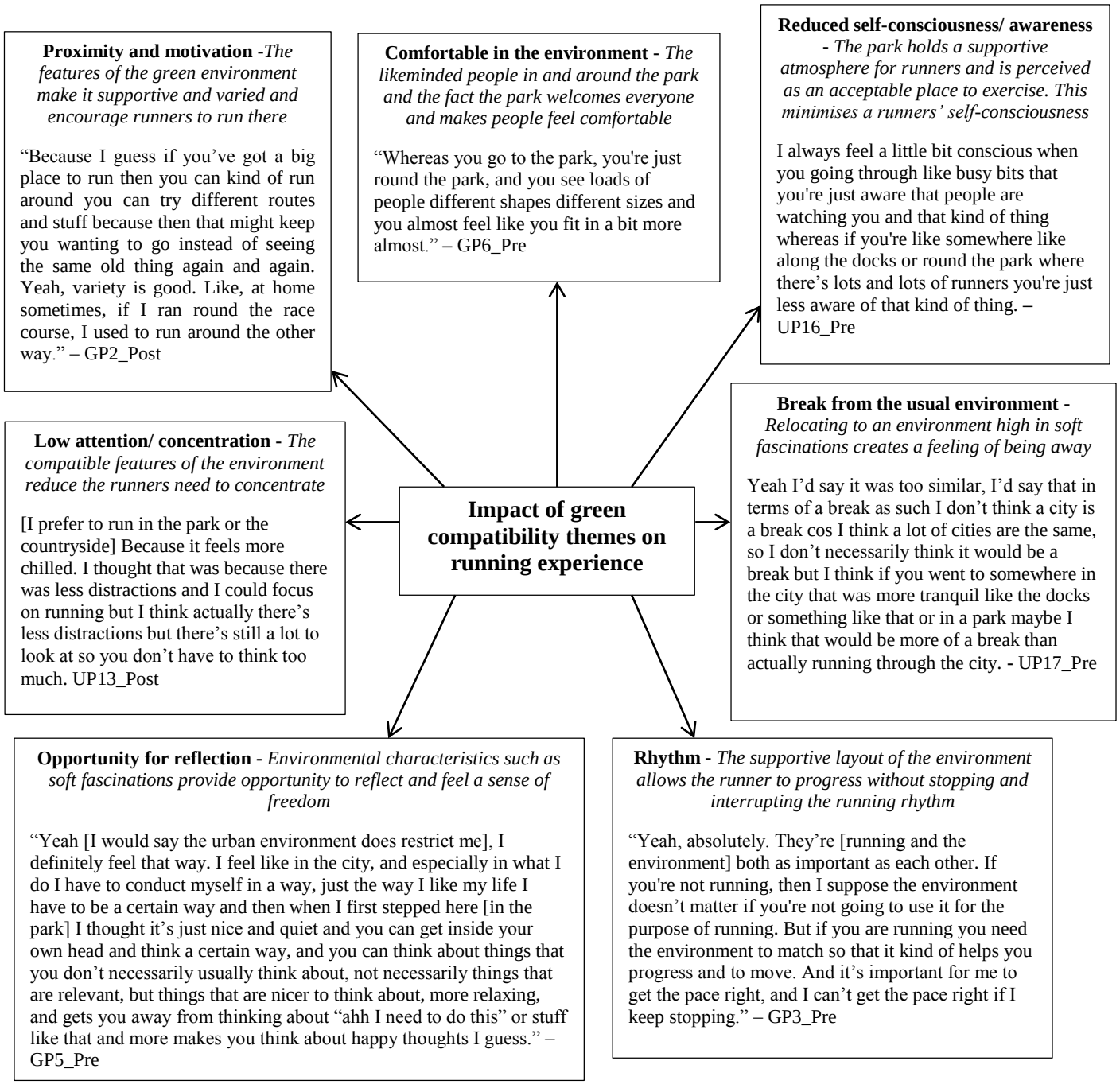

Figure 8: Impact of the green environment on running experience.

As seen in Figure 8, compatibility between running and the green environment had a number of impacts on the runners' subjective experience. Through the features contributing to a supportive atmosphere and the low level of attention required to navigate the setting, participants were able to

feel comfortable running in the environment. This reduced the participants' self-awareness when running and due to the likeminded runners, participants felt less self-conscious. The layout of the environment, away from fascinations that demand attention and concentration, provided the opportunity for the runner to enter an undisturbed running rhythm, helping them to find their pace and set their breathing (internal sensory monitoring and active self-regulation).

GP4_Pre explained the importance of environmental compatibility:

> *"It [the environment] is [important for running], like. Well normally when I run I run around Sefton [Park] because there's a nice pavement, and like trees and grass and stuff and it's not too busy and there's not too much traffic so. And it's quite easy to sort of just go for it then. But yeah, I mean it's like its big and it's not too busy so it's a perfect place."*

With the lower need to direct attention on demanding environmental stimuli such as navigating traffic, the high compatibility of the green environment provided the runners with the opportunity to run with a reduced need to pay attention to their route. As noted at the end of fascination (section 3.4.) reducing the need to pay attention or concentrate on a task facilitated GP1_Post to switch to involuntary attention, as explained when comparing running an football, allowing the participant a chance to mind wander about topics unrelated to running.

3.6.2. Indoor

Reported below are the compatibility themes of the indoor environment (Figure 9).

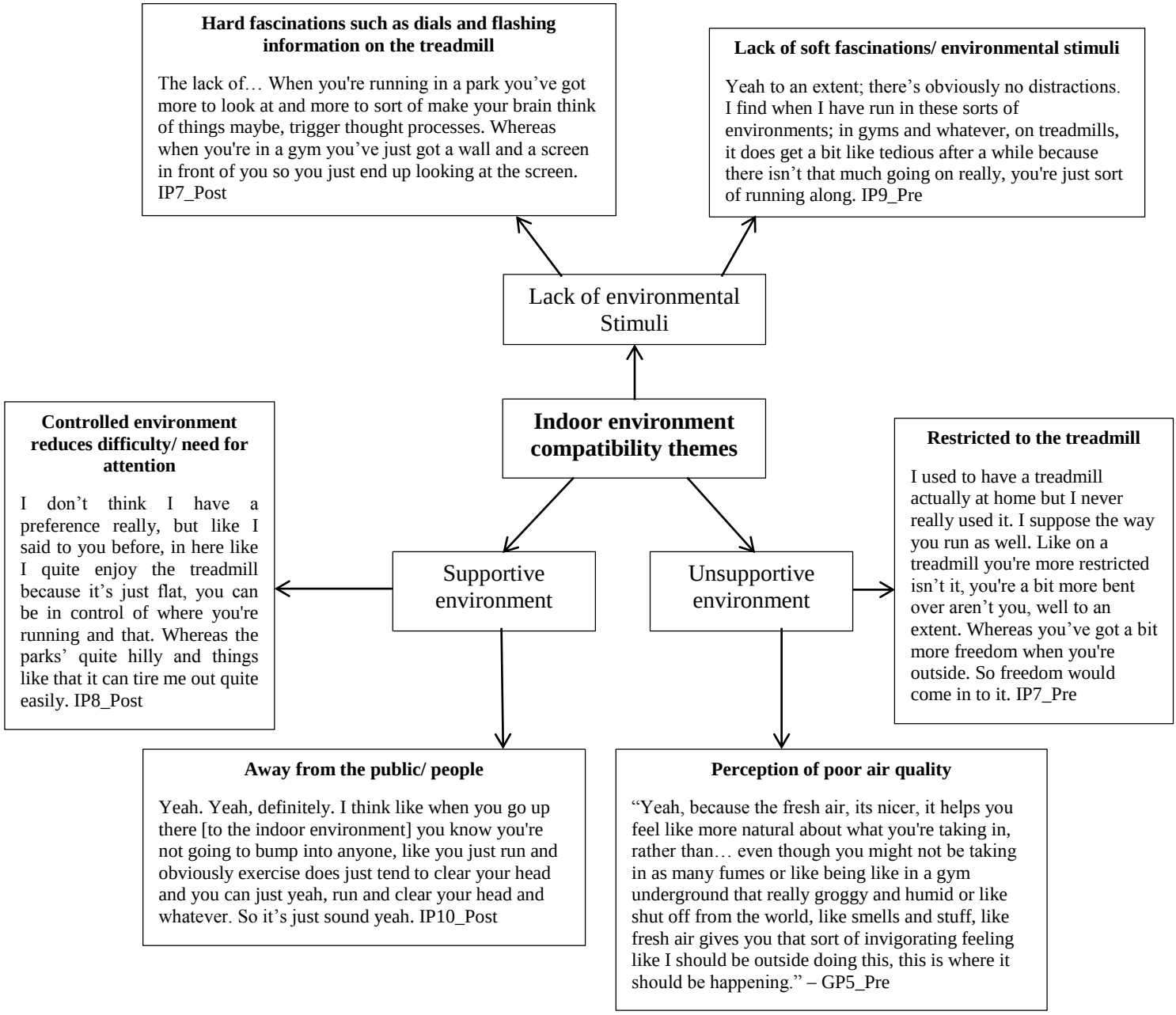

Figure 9: The indoor environments compatibility themes and sub-themes.

As seen in Figure 9 participants had a mixed opinion on whether an indoor environment was supportive or not. To some participants, running on the treadmill was a restrictive experience in comparison to moving freely through an external environment and felt perceptions of the indoor running environment were that of poor air quality. On the other hand, participants found some up sides to running indoors; participants felt that running in the indoor environment meant they were less

likely to bump into someone they knew, thus were more able to concentrate on their run. Furthermore, for others the ability to control ones' speed and not need to concentrate on navigating the environment made the experience less challenging and more relaxing.

In terms of environmental stimuli, the general feeling among the subjects was that the environment lacked interesting stimuli like the soft fascinations of the natural environment. In fact, because there was very little to concentrate on, participants had little else to look at but the dials on the treadmill. Below is the pen profile reporting the impact of the compatibility within the indoor environment. Figure 10 represents the influence of these environmental factors on their running experience.

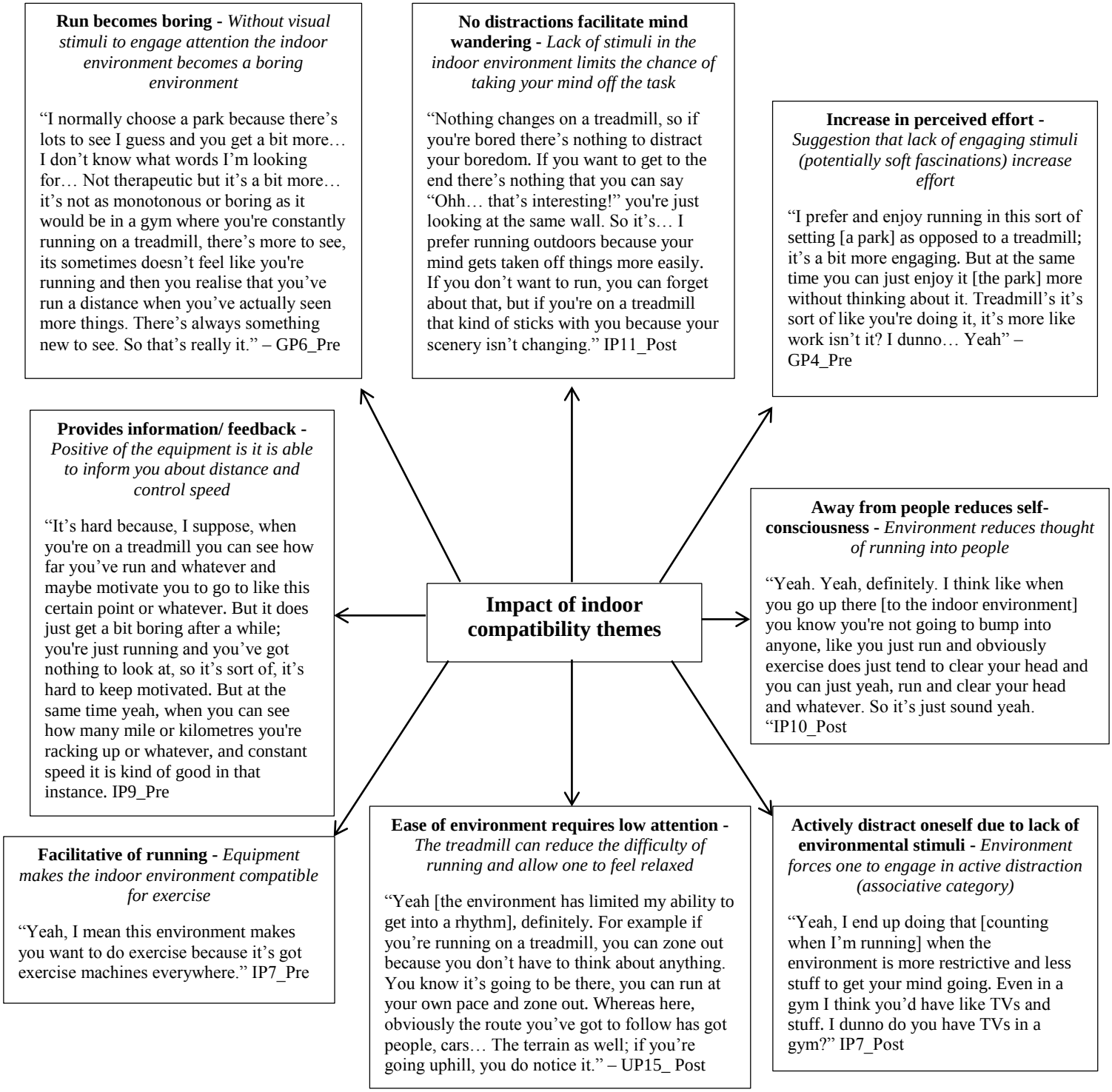

Figure 10: Impact of the indoor environment on running experience.

Some participants running in the indoor environment enjoyed its simplicity, allowing a low demanding running experience on attention due to the feeling of a controlled pace and a safe environment with little need to monitor the surroundings for potential hazards. As shown in Figure 10,

the indoor running also reduced the feelings of self-consciousness due to a reduced chance of encountering anyone they knew. The environment was also somewhere that was facilitative of running, actively encouraging it with the equipment and thus may have made the participants feel comfortable performing the behaviour in that environment. Information from the machine was also seen as a positive aspect along with the measurement of heart rate providing instant feedback.

However, for other participants, indoor environments had opposing effects on their running experience. Some subjects felt that indoor environments lack interesting stimuli that can distract their attention. This lack of environmental stimuli had an adverse effect on their running experience as attention was involuntarily directed towards the dials. When comparing running in a green environment to an indoor environment, UP16_Pre explained: "So being outside is definitely a winner over being on a treadmill. (a) for just fresh air, and (b) you're less aware about how far you've done and how long you've been going for, you're not as pre-occupied with that kind of thing, with the numbers in front of you." Due to the dials acting as a reminder of the task and the lack of changing scenery cannot engage their attention, the theme with some participants was that they felt they ended up concentrating too much on running.

3.6.3. Urban

The urban environment posed much more of a challenge on attention to the natural environment.

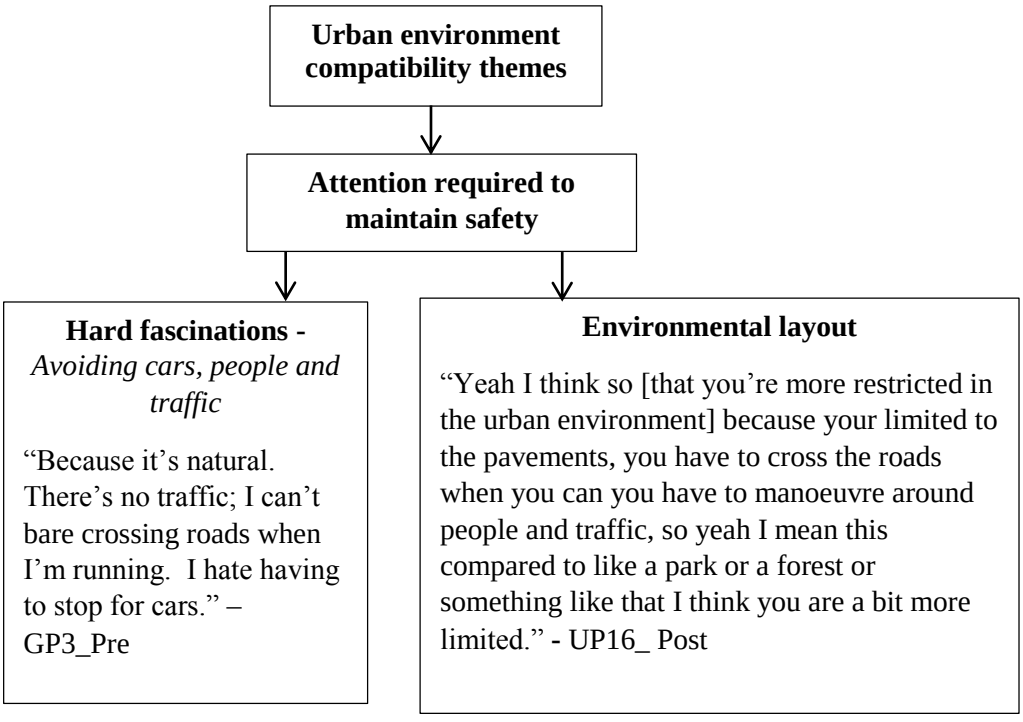

Figure 11: The urban environments compatibility themes and sub-themes.

Compatibility themes of the urban environment were found to centre on the high level of attention required to navigate the environment. Two main themes emerged from the data; hard fascinations of the urban environment and the environmental layout. Firstly, the urban environment posed various challenges to the runners. The participants were required to be highly vigilant when completing the circuit due to hard fascinations demanding attention in order to maintain ones safety. Throughout the route, runners encountered various obstacles such as crossing roads and avoiding people. Secondly, the environmental layout and the fact that the participants were sharing the environment with cars and other vehicles meant they were restricted to the pavements.

These person-environment interactions created a problem for the runners. This impacted the participants in the following ways:

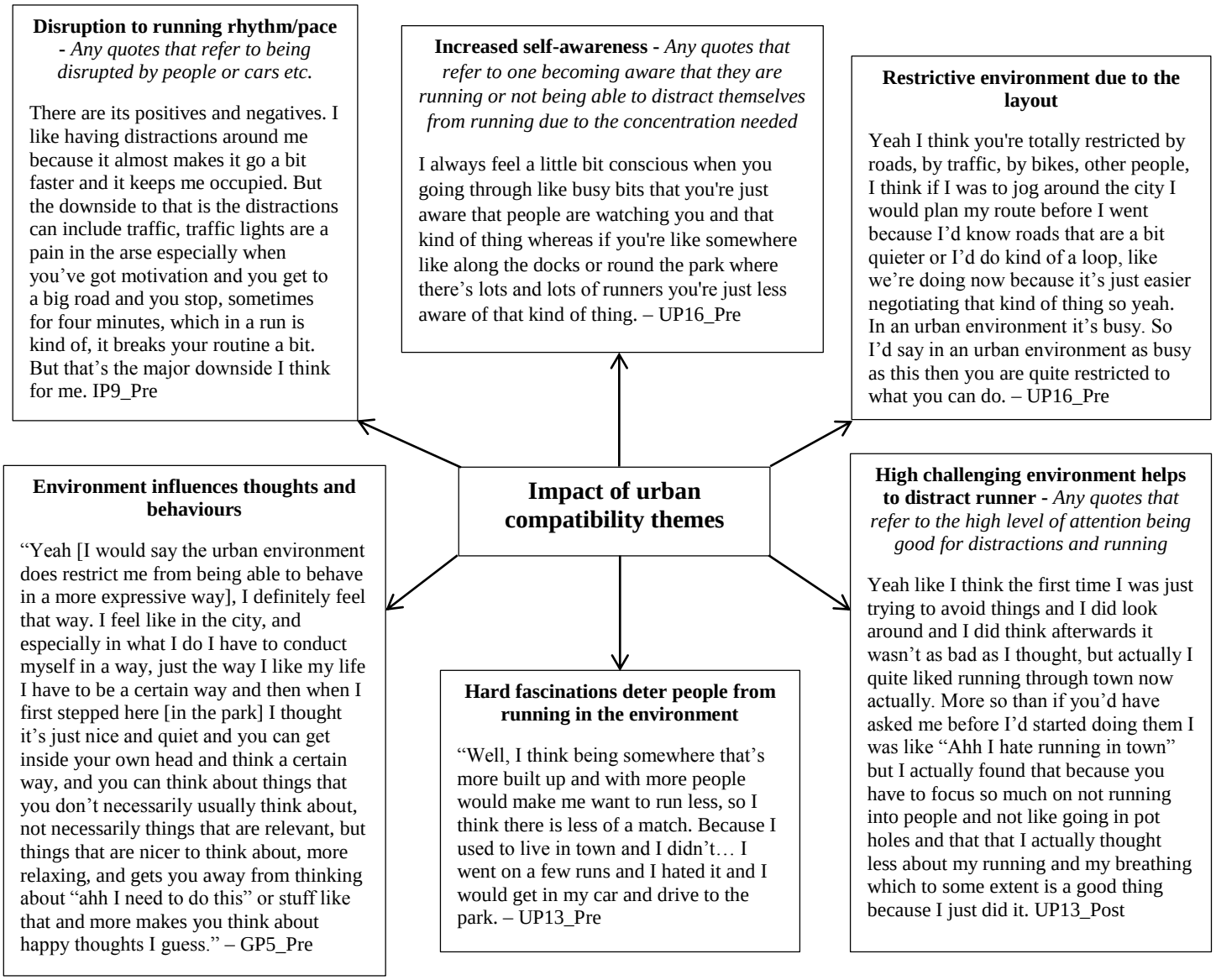

Figure 12: Impact of the urban environment on running experience.

The hard environmental fascinations and the layout of the urban setting impacted on the participants' experience by increasing the need to direct attention in order to maintain safety. Participants' opportunity to find their running rhythm and/or set their pace was reduced as they frequently encountered situations that required a level of conscious decision making (e.g. avoiding cars, people and crossing roads). Furthermore, participants felt self-conscious about the experience of running through an urban setting. When subjects were not thinking about navigating the environment safely or trying to settle into a rhythm, they were conscious about people watching them run.

Overall, these factors impacted on this environments compatibility to support running through the high demand for directed attention and through the high feeling of self-consciousness. As a result, the urban environment became a place where, due to the need to be highly engaged with the activity and environment, participants were unable to engage in dissociative fascinations, such as involuntary attention. However, it should be noted that some runners enjoyed the challenge of the environment. Some participants felt that the hard fascinations of the environment (stimuli that demanded directed attention such as avoiding pedestrians) actually created a distraction away from the run, although this view was infrequent.

4. Discussion

This study set out to explore the experience of running within the four components of ART and explore the exercise-environment interaction in detail. The focus of the research was to understand: (a) *how* running achieved the components of ART (fascination, being away, extent and compatibility) thus providing an opportunity for attention restoration, and (b) how the environment may impact the possibility of attention restoration. The findings demonstrate that running has the potential to achieve the four components of ART and outlined the mechanisms through which running is able to do so.

4.1. Key findings

Key findings from this study were that, irrespective of environment, participants at some stage in their run experienced associative fascinations whereby attention was directed towards physiological changes in the body (internal sensory monitoring) and also towards regulating pace and technique (active self-regulation). Additionally, the ART components extent and being away were closely linked to associative fascinations (see section 3.4 and 3.5). As attention was drawn to these associative fascinations in all environments, a sense of extent and being away was also achieved irrespective of environment.

In contrast, the use of dissociative fascinations was impacted upon by environmental conditions the participants were faced by. As reported in section 3.6.1, the green environment was the most compatible environment for running for the participants in this study and due to its high level of compatibility, involuntary distractions were more likely to occur. On the other hand, the emergence of

involuntary distractions in the indoor and urban environment was restricted due to environmental compatibility issues. For instance, the problem faced by the urban environment (see section 3.6.3) was that navigating it safely required a high level of directed attention. This inhibited the participants to freely engage in involuntary distractions. Issues of the indoor environment (see section 3.6.2) revolved around the lack of interesting stimuli in the laboratory that could serve as a distraction to the participants. As a result, one participant reported actively distracting themselves by completing a mental puzzle in an attempt to entertain their mind and divert attention away from the task. This form of dissociative fascinations requires the use of directed attention, as attention is required to complete the mental puzzle, which served to inhibit daydreams and mind-wandering when running (involuntary distractions). These findings suggest the environment has an influential role in running's ability to restore directed attention.

4.2. Running's influence on fascination, and fascinations influence on being away and extent

Fascination emerged as a key component of the restorative process for a number of reasons; firstly, associative fascinations (i.e. internal sensory monitoring and active self-regulation) were of sufficient strength to draw attention on to the task which served to divert attention away from taxing cognitive content (i.e. the unspecified cognitive content (objectives) that caused participants to go running in an attempt to clear their head, distract themselves stresses and improve mood). Although associative fascinations may have been considered of less importance to attention restoration by Norling *et al*. (2010), as the authors tended to lean towards the importance of dissociative fascinations, the associative fascinations seemed played a key role in achieving the ART components being away and extent. Associative fascinations contributed to a sense of being away by helping to shift from thoughts depleting attention resources and helping to creating a sense of distance by switching attention to a different subject. Associative fascinations also achieve extent by having the ability to draw a person in to the behaviour and sustain ones interest. This may suggest that associative fascinations may play an important role in the distraction hypothesis (Bahrke & Morgan, 1978) by diverting attention away from other stressors and may also align with research on running and mindfulness (De Petrillo *et al*., 2009) whereby becoming aware of one's physiological state in the present moment can be a positive aspect of running.

However, in line with the views of Norling and colleagues (2010), dissociative fascinations were an important part of the process of running for the participants in this study. When discussing their results, Norling *et al.* (2010) did not differentiate between the different sub-categories of dissociative fascinations; rather they discussed their findings under the umbrella of "dissociative thinking". In contrast, by using the framework produced by Brick *et al*. (2014) this study allowed a distinction to be made within dissociative fascinations (i.e., between involuntary and active distractions). The current study therefore makes the distinction that rather than the broad category of "dissociative thinking"

being important for restoration of directed attention, the sub-category *involuntary distraction* is of more importance in restoring attention than active distraction. This point can be made because the key principle of ART holds that to restore attention, involuntary attention needs to be engaged and directed attention needs to switch off. By engaging involuntary attention, directed attention is given the break it needs to recharge (Kaplan, 1995; 2001). Thus to restore attention by running involuntary distractions must be engaged.

As seen in the results, a key finding from the study was that involuntary distraction was influenced by the environments compatibility with running. Compatibility, representing the person-environment interaction, played an important role in providing the runners' with an opportunity to unconsciously engage in involuntary distractions (e.g. mind-wandering or daydreaming). The following section (4.3) will compare and contrast the findings regarding the three environments compatibility and demonstrate how compatibility impacted the participants' opportunity to engage in involuntary distractions.

4.3. Running and compatibility

As seen in the results, the green environments strength was its compatibility. The green environment was able to engage involuntary attention through its soft fascinations, to offer a supportive atmosphere allowing runners to reduce their self-awareness, and provide an environment low in potential hazards, meaning participants were not required to remain vigilant in order to navigate it safely. Combining these environmental factors together meant the need to directed attention in order to navigate the environment, and the level of awareness of the participant directed to performing the behaviour, was reduced. This created a set of conditions that allowed runners to engage in involuntary distractions because the need to directed attention was diminished. Ackers *et al*. (2012) suggest "greenness" is an influential factor in some psychological outcomes of exercise, thus it's possible that greenness may contribute to a sense that directed attention is not required, enabling an opportunity for involuntary distractions to emerge.

In contrast, as seen in the results, if there are stimuli in the environment that required conscious decision making (e.g., navigating traffic on the road or avoiding pedestrians in the urban environment), directed attention was required. The result of needing directed attention means involuntary distraction is inhibited, as the importance of maintaining safety takes priority over daydreaming or mind wandering. Berman *et al*. (2008) suggest peacefulness of the natural environment contributed to attention restoration when participants engaged in the 2.8-mile walk through contrasting environments, suggesting this element was missing from the urban environment. It's possible that the sounds of the urban environment in this study also inhibited involuntary distraction when running.

As reported in the results, the indoor environment faced a set of different compatibility issues. For example, participants in this study felt the environment was unsupportive to running, citing the

amount of environmental stimuli that could attract attention was limited, meaning the runner was unable to shift their focus away from the task. As a result, involuntary attention was instead attracted by the flashing dials on the treadmill reminding the participant of the activity they were performing. This served as a constant reminder that the participant was running which seemed to inhibit the participants' ability to engage in involuntary distractions. As reported by Focht (2009), when discussing the findings from his data, he suggested that changes in affective states influenced by the environment may have been down to the participants focusing more upon external, non-task-related thoughts in the outdoor environment compared with the indoor environment. This aligns with the findings in this study.

Another consequence of the lack of environmental stimuli in the indoor environment was that, to counter act the lack of environmental distractions, one participant engaged in a different form of dissociative fascination; rather than involuntary distraction, one of the subjects reported performing active distraction (e.g., consciously distracting themselves through performing mental tasks, such as solving a mental puzzle) to occupy attention and take their mind off the task. To restore attention when running, the aim is to engage in involuntary distractions; yet features of the indoor environment such as flashing dials may have served as a reminder of the task, speed and distance which may hinder those spontaneous, involuntary thought processes as attention is not free to wander.

The urban environment impacted the subjects' experience in a number of ways; it increased their self-consciousness about the activity they were performing, restricted their movement leading to a sense of confinement to the pavement, and increased the need for vigilance when navigating the setting due to hard fascinations and the need to maintain personal safety. These environmental factors meant participants were required to use high levels of directed attention, reducing its environmental compatibility. This environment then seemed to be the least facilitative in terms of providing an opportunity to engage involuntary distractions, thus restoring attention.

Therefore the findings from this study suggest the environment can facilitate or debilitate the ability to engage in involuntary distractions, which by the definition of ART is needed for restoration.

4.4. Running and the Default Mode Network

As reported so far, this study demonstrated that running has the potential to achieve the components of ART and, if the environment is compatible with running (see section 3.6.1), provide an opportunity to engage the involuntary distraction, giving directed attention a chance to rest and thus providing it with an opportunity to restore. However, involuntary distractions were least likely to emerge when the participant was running in an environment that required the use of directed attention to navigate the environment safely, such as the urban environment (see section 3.6.3) or required the use of alternative techniques such as active distractions to distract the participant from the run, like reported in the indoor environment (see section 3.6.2). By synthesising concepts from the areas of

environmental psychology, exercise psychology and cognitive neuroscience the proceeding section of the discussion hypothesises why such distractions might occur, and how this may impact on attention restoration.

In line with environmental psychology literature (Kaplan, 1995; 2001), literature from the field of cognitive neuroscience has also described two prominent networks in the brains anatomy associated with attention: the task-positive network (TPN) and the default mode network (DMN, Immordino-Yang *et al*., 2012). Buckner *et al*. (2008) reported that the TPN is engaged during goal-directed, externally focused tasks whereas the DMN is active when subjects engage in internally focused cognitive processes, in other words, when one shifts attention inwards. These processes include non-attentive, but awake, mental states such as: rest, daydreaming, self-awareness, self-reflection, recollecting one's past or imagining one's personal future, scene construction and social cognition (Immordino-Yang *et al.*, 2012; Spreng, 2012).

As the findings in the current study suggest, runners seem to engage in thought processes that are likely to engage both TPN and DMN networks. For example, when running in the urban environment, the subjects reported directing their attention more often outwards to the environment when navigating it in order to maintain safety and avoid traffic. In doing so, they were required to direct attention, which would likely have activated the TPN. In contrast, when running in a compatible environment like the green environment, the participants more readily entered a state of involuntary distraction (e.g., mind-wandering or reflective thoughts) because the need to remain highly vigilant when navigating was reduced. These thought processes reported by the participants in the current study closely reflect the cognitive content that activates the DMN. As discussed briefly by Atchley *et al*. (2012), activation of the DMN may be important to ART and restoration of directed attention.

Atchley and colleagues (2012) make the distinction that soft-fascinations (e.g., interesting, but low demanding, stimuli that capture involuntary attention) provide an opportunity for the DMN to engage. Although not suggested, the network anti-correlated with DMN activation is the TPN (Buckner *et al*., 2008). This means hard fascinations (interesting, but high demanding, stimuli that capture involuntary attention but require directed attention as a response) activate the TPN.

While Atchley *et al*. (2012) refer to environmental fascinations, this study demonstrates that running in its self creates its own set of fascinations. By using the same set of principles and data from the findings, it is possible to determine what fascinations are soft-fascinations when running and what fascinations are hard-fascinations when running by the participants need to direct their attention towards them. This also lets us determine what fascinations are likely to use the TPN and what are likely to use the DMN when running.

As found in this study, running engages the ART component fascination in a number of ways; through the rise of associative fascinations (internal sensory monitoring and active self-regulation) and

dissociative fascinations (involuntary distractions and active distractions). Fascinations that require directed attention when running include: internal sensory monitoring, active self-regulation and active distractions, thus, these are the hard fascinations of running that require activation of the TPN. On the other hand, the only soft fascination when running is involuntary distraction, as involuntary distraction requires no use of directed attention, and thus produces an activation of the DMN.

Figure 13 represents synthesis between exercise psychology, environmental psychology and cognitive neuroscience.

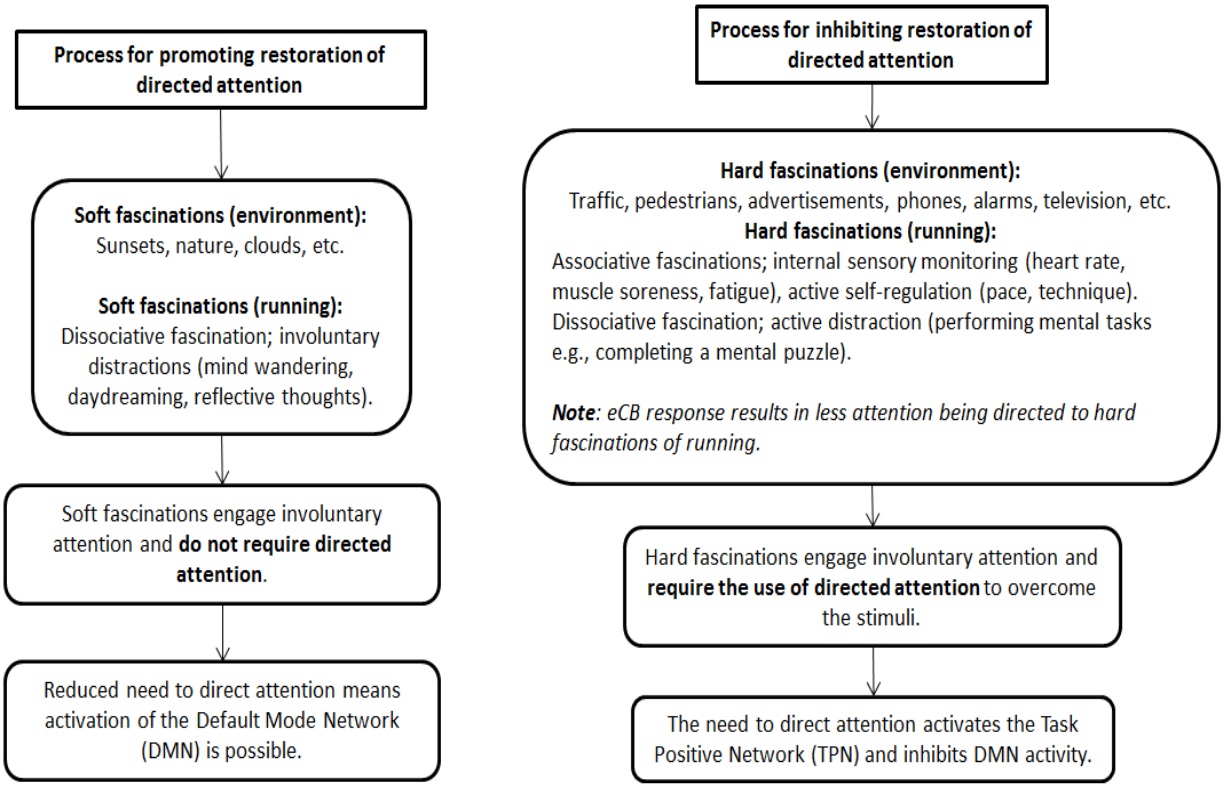

Figure 13: The synthesis of environmental psychology, exercise psychology and cognitive neuroscience: a theoretical model to how the soft fascinations of the environment and from running activate the DMN and provide opportunity to restore attention.

As stated previously, by definition, restoration of directed attention can only be achieved by switching to involuntary attention, providing directed attention with an opportunity to rest and recharge (Kaplan, 1995; 2001). Thus, to rest directed attention when running, one must switch their attention from the internal sensory monitoring, active self-regulation and active distractions and engage in involuntary distractions. However, consciously switching to involuntary distractions would be self-defeating as this would become active distraction. The switch must be sub-conscious; being aware of involuntary distractions defeats the point of being distracted involuntarily.

Findings from this study demonstrated that environmental compatibility is an important mechanism in the restorative process of running. If one is running in an environment that requires the use of directed attention, for example, an urban environment that contains hard fascinating stimuli, directed attention is required to navigate it safely which requires activation of the TPN. Thus, by activating the TPN directed attention is not able to rest, involuntary distractions are then unable to emerge and the DMN is not activated. This makes the environment less compatible with facilitating involuntary distraction (i.e. activating the DMN and restoring attention). In contrast, running in a more compatible environment, such as the green environment, means the runner does not need to utilise directed attention when navigating, as the environment contains few hard fascinations that demand this resource.

As the results in this study and from previous literature suggest (i.e. Brick *et al.*, 2014) runners frequently report involuntary distractions that bare close resemblance to the thought patterns which activate the DMN (Buckner *et al*., 2008; Immordino-Yang *et al.*, 2012; Spreng, 2012). However, they also frequently report thoughts that are likely to activate the TPN. How may it possible to down-regulate the hard fascinations that require directed attention (TPN) so that involuntary distractions (DMN) can engage and restore attention?

4.5. Exercise and endocannabinoids

Endocannabinoid release during exercise may explain down regulation of hard fascinations that require directed attention (TPN) so that involuntary distractions (DMN) can take place. Endocannabinoids are neuromodulatory lipids released during exercise (Dietrich & McDaniel, 2004; Raichlen *et al*., 2012; Sparling *et al.*, 2003) that modulates the DMN (Bossong *et al.* 2013). Dietrich and McDaniel (2004) state that "activation of the endocannabinoid system also produces sedation, anxiolysis, a sense of well-being, reduced attentional capacity, impaired working memory ability, and difficulty in time estimation" (p. 540) as well as reducing the sensation of pain. Endocannabinoids (eCB's) may have the ability to reduce the sensations muscle soreness or feeling of fatigue as reported by the participants and therefore reduce the need for directing attention towards internal sensory monitoring.

If eCB's can alleviate such sensations, the eCB response to exercise may be a mechanism to reduce the need to direct attention towards associative fascinations. eCB's, therefore, provide a chance to down-regulate the TPN and free up a possibility for the involuntary distractions that engage the DMN. Providing support for this idea, Bossong *et al*. (2013) demonstrated eCB's have the potential to modulate DMN activity. From this information, it could be put forward that the eCB response plays an important role in restoring attention.

Figure 14 provides a graphical representation of the results and demonstrates how the factors of running and the environment influence restoration of directed attention.

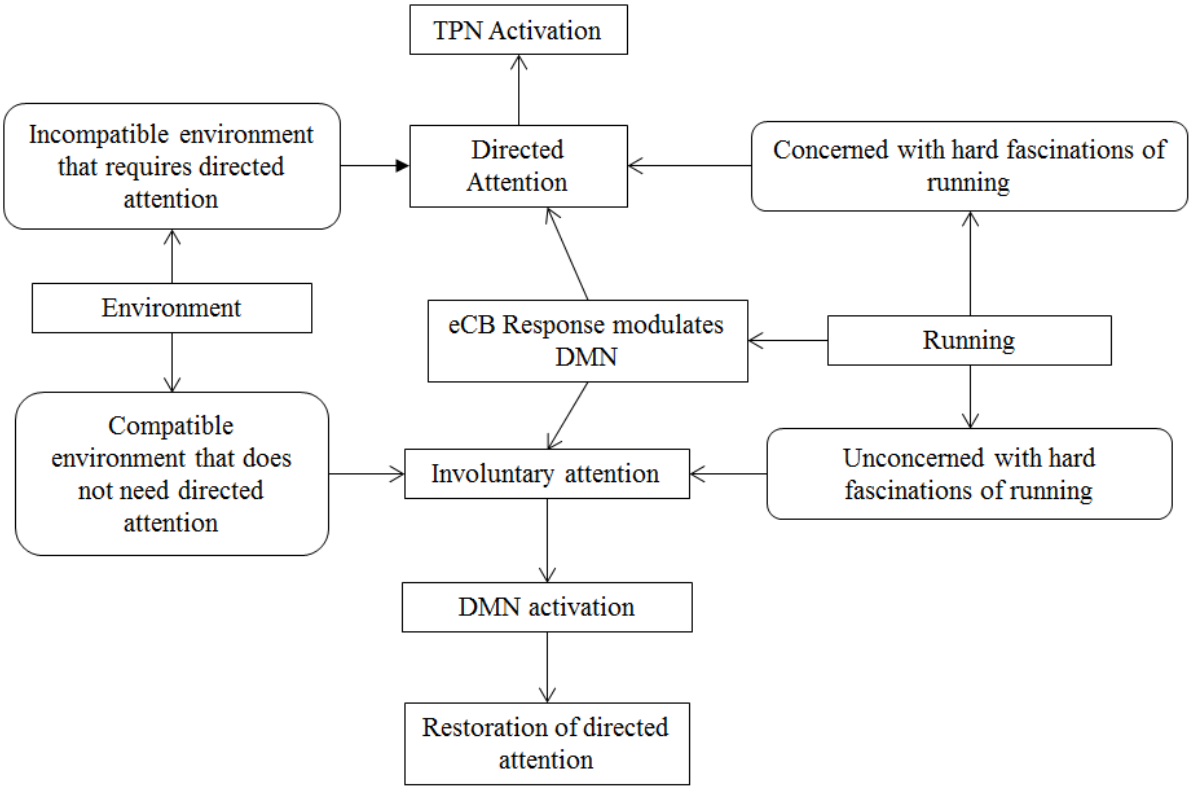

Figure 14: The representation of the influential factors impacting attention restoration via running.

Using the results from the study, and synthesis from the discussion, Figure 14 will be placed in context. The eCB response seems to be a mechanism for reducing the need to direct attention on the hard fascinations of running, such as internal sensory monitoring, and is a response that occurs irrespective of environment. However, if a runner remains concerned with the hard fascinations of running, they are unlikely to be daydreaming or engaging in reflective thoughts, because hard fascinations require directed attention. Additionally, if the runner is concerned with the demanding stimuli of the environment, or does not have enough interesting stimuli in the environment to distract attention from running, the runner will also be required to utilize directed attention. And in utilising directed attention, these factors will activate the TPN and inhibit the DMN, restricting attention restoration.

In contrast, if the runner is unconcerned with the hard-fascinations of running, does not need to actively distract themselves due to a lack of environmental stimuli and does not need to direct attention towards the environment in order to maintain safety during navigation, an opportunity for

involuntary distractions may emerge. By enabling the switch to involuntary distractions, the DMN may be activated and restoration of attention can be achieved.

Tomporowski (2003) notes that "aerobic exercise improves information-processing, processes involved in complex problem solving, and attentional processes that are involved in response inhibition" (p. 312). As these processes require directed attention, the improvements seen to executive functioning may be interpreted as attention restoration. Furthermore, as the eCB response results in changes such as a "reduced attentional capacity" (p. 540, Dietrich & McDaniel, 2004) this "reduced attentional capacity" may be in reference to directed attention (TPN activity) which is being down regulated.

4.6. Implications of research

As noted in the introduction, with an increasingly demanding modern environment and with increasingly demanding lifestyles, directed attention is a resource that must be utilised for efficient human performance (Kaplan & Berman, 2010). Yet, precisely for this reason, this resource is subject to much fatigue. By not restoring directed attention, a variety of symptoms that impact on cognitive performance and various negative mood states are likely to arise (Kaplan, 1995; Kaplan & Berman, 2010). While a significant body of work has been compiled on the effect of nature (e.g., Hartig *et al*., 2014, Kuo & Sullivan, 2001a, 2001b; Moore, 1981) the idea of restoring directed attention through behaviours such as running is relatively new (Norling *et al*., 2010).

This research, therefore, draws attention towards a new theoretical underpinning the psychological responses to exercise which, as reported by Norling *et al*. (2010), have often taken place without a conceptual framework. As the findings in this study demonstrate, exercising in a compatible environment, such as the green environment in this study, increases the opportunity to engage in involuntary distractions, thought processes that engage the DMN and thought to be responsible for restoring directed attention.

Furthermore, the results help to provide a better understanding of the person-environment interaction when running. In the future, this may help to guide the decisions of health practitioners when referring patients with symptoms of directed attention fatigue to exercise in environments that are likely to facilitate recovery of this resource. The findings may also have implications on schemes such as 'ParkRun'. ParkRun is a global initiative that aims to encourage people of all social demographics to take part in a 5-kilometer run around a safe, pleasant environment, such as a park or along a promenade. This study highlights the importance of the exercise-environment interaction on mental health and the default network and could provide an additional encouragement for the public to engage in such events.

4.7. Recommendations for future research

Firstly, as qualitative research aims to generate hypothesis for future studies, this paper provides support for an environmental influence on running's ability to restore attention. Future studies should quantitatively determine whether or not this hypothesis can be accepted. Secondly, this paper makes a number of educated assumptions revolving around the influence of endocannabinoids on the DMN. Although THC induced eCB release has been proven to modulate the DMN, to the knowledge of the researcher, little work has been conducted to identify whether eCB's, released as a response to exercise, produce a similar modulatory effect. Thirdly, although signs suggest it is plausible, this paper asserts that involuntary distractions lead to the internal cognitive processes responsible for activation of the DMN. Therefore, a clearer review and synthesis between involuntary distractions and functions of the DMN may be needed. Finally, this research supports the suggestions made by Atchley *et al*. (2012) that activation of the DMN may be a mechanism responsible for restoring directed attention; however, to the knowledge of the researcher, this again has yet to be proven in cognitive neuroscience.

4.8. Limitations

This paper contained a number of limitations. Firstly, the sample size was not very large; therefore it cannot be guaranteed that information provided by the participants covers all possible answers and opinions. Secondly, the weather may have had an influential factor on the participants' experiences of the outdoor environments (urban and green). As such, weather may have influenced participant experience, thus affecting the qualitative data produced by the subjects and collected by the researcher. Finally, runners in the study came from a range of abilities; although all runners were recreational, it was understood that of the participants were more experienced than others. This meant that experiences for such subjects would likely have differed in regard to level of attention directed towards associative and dissociative fascinations. For example, a less experienced participant may have experienced far more associative fascinations and for a longer duration, due to a lack of fitness or unfamiliarity with the sensations of running, than an experienced runner, who may have been more capable of active self-regulating and monitoring internal senses in a more autonomous nature. As a result, attention directed towards associative fascinations may have been more regularly reported by novice, as opposed to experienced, runners.

4.9. Reflexivity

Due to the very nature of this project (i.e. attempting to frame running in the framework of ART) I cannot state that this research was completely unbiased, as my very aim was determined by a conception that running could be a restorative behaviour. However, I attempted to collect the data in an unbiased manner and feel that the data I collected and reported truly represented the opinions of the

participants and not of my own. In fact, I was, if anything, surprised by how well the participants' experiences of running aligned with the framework of ART.

An initial pilot study was conducted in 2013 with a small number of participants (four) and a slightly different methodology; participants were asked to perform three runs in the three contrasting environments and then a long interview was conducted post-intervention. In the current study, the decision was made to randomly assign participants to one environment and ask them to perform the three runs in one place. The frequent exposure to an environment helped to create a clearer picture of the running experience within that environment and thus allowed participants to report back in their post-intervention interview with more detail and clarity. I believe that this methodological decision was successful in what it aimed to achieve and strengthened the study.

On the other hand, something I could have done better was to prepare a better interview guide and pilot it with someone not involved in the study. This would have helped prepare me for the task of conducting the semi-structured interviews and perhaps explore and capture the participants' experiences in even more detail. While I am pleased with the level of detail I was able to gather, I feel this is one area of my research skills that needs improving; however, considering the start of the research process and the point at which I am now, I feel I have made positive steps forward and look at this a part of my personal learning curve.

5. Conclusion

The findings from the current study qualitatively frame running within the four components of ART and demonstrate how the environment may influence the ability to restore attention through running. Associative fascinations appear to be important to the restorative process by enabling a sense of being-away (by switching focus to different cognitive content) and extent (by drawing a person into the experience). Involuntary distractions (e.g., mind wandering, irrelevant daydreams or reflective thoughts), seem to play a pivotal role in restoring directed attention by engaging the DMN and providing the TPN a chance to down-regulate, in turn, giving directed attention the opportunity to rest. However, environmental compatibility influences the ability for a runner to engage in involuntary distractions. As discussed, to enable DMN activation, the need to direct attention when navigating an environment must be lowered in order to facilitate involuntary distractions. This work helps to provide a supporting argument for green exercise and explores the underlying mechanism that may contribute to the beneficial psychological responses through the synergy between exercise and the natural environment (Pretty *et al*., 2003; Thompson Coon *et al*., 2011). Furthermore, it provides supporting evidence to the notion proposed by Norling *et al*. (2008, 2010) that running has the ability to engage the components of ART, suggesting that ART can be extended beyond its current restorative environment paradigm to include restorative behaviours such as running.

Furthermore, following the recommendation by Barrett (2009), this research attempted to link the descriptions of psychological experiences to explanations in cognitive neuroscience. It did so by linking anatomical regions of the brain associated is inward (DMN) and outward (TPN) attention (Buckner *et al*., 2008; Immordino-Yang *et al.*, 2012; Spreng, 2012) to directed and involuntary attention as seen in ART (Kaplan, 1995; 2001) and then applied the synthesis to running.

Finally, this research may contribute to a greater understanding of how the environment plays a role in the experience of running and how compatibility can have an influential role in the psychological outcomes of exercise. Implications of this research will support the extension of the ART paradigm, and a greater understanding of the exercise-environment interaction on running's ability to restore directed attention.

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