



UiT The Arctic University of Norway

Department of Psychology

Flow in Physical Activity and Exercise:

Exploring the Relevance of Mindfulness and Exertion

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Master's thesis in psychology - PSY-3900. May 2021



Foreword

To my supervisor Kjersti Thorsteinsen, whom I am grateful to have had the opportunity to work with during my master's degree. Thank you for guiding me steadily through the development of the idea and design for this thesis, through the many weeks of collecting and analyzing data and through the process of writing so that the thesis would reflect the work that has been done throughout this project. I am tremendously grateful for all the feedback, supervision and support you have provided. I have learned so much from you and from working on this thesis.

The idea for this thesis was developed based on my personal interest in physical activity and curiosity about what motivates people to be physically active. Researching the field of motivation lead me into the field of 'flow' and optimal experience. Fortunately, Kjersti Thorsteinsen wanted to collaborate with me when I reached out to her and was onboard with creating a project focusing on flow in physical activity. Together we developed a longitudinal study on flow experiences and running and managed to recruit a good number of participants which provided us with a great amount of data. The analyses were split between Kjersti and myself, where Kjersti guided me through my part of the analyses, for which I am very thankful for.

I want to thank everyone who participated in this study, for jogging weekly for several weeks and for answering long and short questionnaires, their effort and sweat laid the foundation for me to write this thesis. Finally, to my family and friends, thank you for believing in me and cheering me on to the finish line of this project.


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Tromsø, May 2021

Sammendrag

Flytopplevelser i fysisk aktivitet er assosiert med indre motivasjon og har vist seg å være en svært belønnende sinnstilstand (Csikszentmihalyi, 2008). Å legge til rette for flytopplevelser blant mosjonister kan være gunstig i arbeidet mot å fremme langsiktig treningsengasjement. I en longitudinell studie undersøkte vi mulige faktorer som predikerer flytopplevelser hos mosjonister. Dette gjorde vi ved å måle disposisjon for flyt i fysisk aktivitet, samt tilstander av flyt under løpeøkter. I tillegg inkluderte vi en mindre mindfulness intervensjon for å undersøke om hvorvidt mindfulness kunne predikere flytopplevelser. Vi rekrutterte 103 deltakere som vi inviterte til et løpeprosjekt som innebar at de skulle løpe en gang i uken i seks uker og rapportere i et kort spørreskjema etter hver treningsøkt. I aktivitetsrapporteringene ble det målt opplevd anstrengelse, flytopplevelser og kontekstuelle variabler. Utvalget ble randomisert til to grupper, en intervensjonsgruppe ($n = 51$) og en kontrollgruppe ($n = 52$). Intervensjonsgruppen ble instruert til å gjennomføre en kort mindfulness øvelse (i.e., pusteøvelse) i forkant av hver løpe økt. I tillegg til aktivitetsrapporteringene ble deltakerne bedt om å besvare et lengre spørreskjema som før- og etter-målinger, hvor vi målte disposisjon for flyt, aktivitetsnivå, generelle tendenser til mindfulness, generell helse, livstilfredshet, personlig vekst og demografiske variabler. Våre resultater indikerte at mosjonister definitivt kan oppleve flyt under en hard treningsøkt, så lenge helhetsopplevelsen med treningen er positiv.

Keywords: flow, physical activity, exercise, exertion, mindfulness, running

Abstract

Experiencing flow in physical activity is associated with intrinsic motivation and has proven to be a highly rewarding state of mind (Csikszentmihalyi, 2008). Facilitating flow experiences among regular exercisers can be beneficial in terms of promoting long-term physical activity engagement. In a longitudinal study we explored possible factors predicting flow experiences in exercisers by measuring dispositional flow in physical activity and flow state during running sessions. Additionally, we included a small mindfulness intervention to explore the relevance of mindfulness in flow experiences. We recruited a sample of 103 participants, inviting them to a running study where they were asked to conduct a running session once a week for a period of six weeks and reporting in a short questionnaire after every running session. The activity reports measured perceived exertion, flow, and contextual variables. The sample were randomly assigned into two groups, one intervention group ($n = 51$) and one control group ($n = 52$). The intervention group were given instructions to practice a short mindfulness-based exercise (i.e., breathing exercise) prior to every running session. In addition to the activity reports, participants were asked to answer a longer questionnaire as pre- and post-measures assessing flow dispositions, activity level, general tendencies to mindfulness, general health, life satisfaction, personal growth, and demographic variables. Our results indicated that regular exercisers certainly experience flow during strenuous exercise if the overall experience of the physical activity episode is positively evaluated.

Keywords: flow, physical activity, exercise, exertion, mindfulness, running

Flow in Physical Activity and Exercise: Exploring the Relevance of Mindfulness and Exertion

For many people, physical activity is a way of life. For others, being regularly physically active can be a challenge. The experience of physical activity differs greatly from individual to individual. For some people physical activity is related to discomfort and exhaustion, while for others being physically active is experienced as a joyous and positive leisure activity. Experiencing flow during physical activity can promote such positive emotions about exercising, generate optimal and rewarding experiences and increase intrinsic motivation (Csikszentmihalyi, 2008). Based on this knowledge, facilitating flow experiences among regular exercisers can be of great value to promote long-term exercise engagement. In doing so, it is fundamental to explore whether regular exercisers do experience flow while physically active and to study possible factors associated with such optimal experiences.

Research provides solid support for the importance of being physically active and exercising regularly, highlighting several positive health related outcomes, both physiological and psychological. Engagement in physical activity has proven to be an important factor in achieving a life enriched with good health and increased quality of life (Henriksson & Sundberg, 2015, p. 8). Being physically active and exercising on a regular basis can increase energy levels, improve quality of sleep, regulate blood pressure, and enhance blood sugar regulation, among other health effects (Helsedirektoratet, 2015). Which in turn associates physical activity and exercise with the prevention of various diseases and medical conditions such as cardiovascular disease, type 2 diabetes, hypertension, and stroke (Karlsen et al., 2017). Habitual exercise and physical activity have been associated with enhanced function of the immune system (Simpson et al., 2020) and has further been shown to reduce the risk of systemic inflammation (Fletcher et al., 2018). In terms of other health benefits, regular physical activity and exercise displays positive effects on psychological health and well-being

(Biddle & Mutrie, 2008, p. 24). Several studies indicate a relation between consistent exercise and lower stress reactivity, anxiety, and depression (Mikkelsen et al., 2017). It has been shown that physical activity can have a positive impact on people's cognitive functions, learning abilities and concentration (Hjelle, 2018). Furthermore, evidence supports exercise in improving the structure and function of the brain (ten Brinke et al., 2015).

Despite the many health effects one can achieve from being physically active and exercising on a regular basis, statistics indicate that people are not active enough to meet the recommendations for physical activity to achieve these health benefits. According to the Norwegian Directorate of Health, the recommended amount of physical activity for adults and the elderly is minimum 150 minutes per week with moderate intensity, or 75 minutes per week with high intensity to achieve health benefits (Helsedirektoratet, 2019). Of which a national survey of the level of physical activity in Norway shows that only 32% of the population complies with these recommendations (Helsedirektoratet, 2015). The World Health Organization (WHO) presents similar recommendations for physical activity, and when considering the figures for physical activity globally, 23% of the global population does not meet the recommendations for physical activity, which corresponds to 1 in 4 adults worldwide who are not active enough to achieve the health benefits (World Health Organization, 2010). What may be the reason that keeps this percentage of people from maintaining the recommendations for physical activity? What can be done to increase the activity levels? These are complicated questions with several different answers on different levels. The focus of the current research is on people's subjective experience and the potential role of flow experiences in physical activity and exercise.

There are various ways of being physically active to achieve health benefits. The different ways of being physically active may come in diverse forms of bodily movement, level of intensities and based on different objectives. For non-athletes, physical activity often

takes place during ‘free time’, when ones not occupied with work in daily life. However, the experience people have with physical activity and exercising can vary greatly. For some people, exercise can be a daunting task that requires a lot of effort. For others, exercising can be perceived as a joyous and rewarding leisure activity. Then there are probably many people who find themselves somewhere in between, where physical activity can be a demanding task, but during or after a workout, the experience is rewarding. It can be relevant to study individuals’ subjective experiences with exercising to explore if improving people’s overall experiences in this matter may contribute to promoting long-term engagement in physical activity. Therefore, we want in this study to explore non-athletes’ experiences with physical activity by examining their flow experiences. Based on existing research in the field of flow and its relevance to intrinsic motivation and optimal experiences (Csikszentmihalyi, 2008) it is relevant to investigate the role of flow in this context.

According to Nakamura & Csikszentmihalyi (2014), in the perspective of flow “a good life is one characterized by complete absorption in what ones does” (p. 239). Experiencing a state of flow during an activity or task can be described as an optimal experience which intensifies concentration, making no room for irrelevant thoughts, the feeling of time and place gets distorted, and self-consciousness disappears (Csikszentmihalyi, 2008, p. 71). A state of flow can be defined as an intrinsically rewarding optimal state that occurs as a result of complete focus and engagement in the task at hand (Kawabata, 2018). Research supports the potential of flow in enhancing exercise participation based on the associations between experiencing flow during physical activity and higher levels of enjoyment, sense of achievement and increasing intrinsic motivation (Franco et al., 2017; Jackman et al., 2019).

Another phenomenon which holds comparable features as flow is mindfulness. Mindfulness and flow are associated in terms of their similarities when it comes to achieving

an optimal and rewarding mental state where one is fully engaged in the present moment (Sheldon et al., 2014). Research suggests that implementing mindfulness-based practice in context with sports and exercise can be beneficial in enhancing flow during physical activity (Kee & John Wang, 2008). Accordingly, we are particularly interested in the association between mindfulness and flow in physical activity among non-athletes.

Physical Activity, Exercise and Perceived Exertion

There are countless different types of physical activity, with subsequent objectives behind why people choose to be physically active on a regular basis in life. The terms physical activity and exercise can be defined in various ways depending on the field of research and context. In this study we chose to refer to physical activity in line with the recommendations given by WHO (2010). Therefore, we define physical activity as moderate to high intensity bodily movement, where the body is activated enough to get a little breathless and sweaty. Further, we chose to use the definition of exercise proposed by Fletcher and colleagues' (2018) where exercise is defined as a more purposeful, structured, and planned activity where the main objective is to improve health and fitness. The concept of exertion and how this sensation is perceived can differ depending on the context as well. In the current study, when we are referring to exertion and perceived exertion it is in relation to physical activity and exercise, more specifically we defined perceived exertion as the subjective experience of how hard one feel like one's body is working when being physically active (Borg, 1998). Based on this, we ask participants in the current study to run once a week for six weeks and report their experiences during the running session, such as perceived exertion.

Flow

The concept of flow was initially described by Mihaly Csikszentmihalyi in 1975 in his book "Beyond Boredom and Anxiety" as an 'optimal experience' (Engeser et al., 2021) and

has been an important feature in the field of intrinsic motivation (Csikszentmihalyi & Csikszentmihalyi, 1992, p. 3) and positive psychology (Snyder & Lopez, 2009, p. 195). Flow is often characterized as a subjective intrinsically rewarding state where one's attention is fully involved in the present moment, giving the sense of action control and awareness, time distortion and loss of self-consciousness (Csikszentmihalyi et al., 2014; Nakamura & Csikszentmihalyi, 2014). The definition of flow evolved through Csikszentmihalyi's research on intrinsic motivation and what makes an activity enjoyable (Engeser et al., 2021). Today, we know that it is possible to achieve flow in several different activities, from reading, making music and playing chess to sports and physical activities such as rock climbing, running, and dancing (Csikszentmihalyi, 2008). Ever since the concept was firstly defined, flow has been widely studied over the years and has been mostly measured by using various self-reporting methods such as retrospective, summative measures, and measuring people's experiences while they are conducting a particular activity (i.e., Experience sampling method) (Engeser et al., 2021; Nakamura & Csikszentmihalyi, 2014).

In sport and exercise research, flow is generally conceptualized into nine dimensions that is believed to contribute to experiencing flow. The nine dimensions are as follows: challenge-skill balance, clear goals, action awareness, immediate feedback, concentration on the task at hand, a sense of control, loss of self-consciousness, transformation of time and autotelic experience (Jackman et al., 2019). Although, according to Csikszentmihalyi (2008), it is not necessary for all the nine dimensions to be present simultaneously for flow to occur. An individual can therefore be in flow even though not all the dimensions are present. There are especially three conditions of the nine dimensions that are more essential to initiate a state of flow, including balance between perceived challenges and perceived skills, having clear goals (knowing your intention) and getting immediate feedback on the task at hand (Kawabata & Mallett, 2011). When these three conditions are present, the remaining six

dimensions are characterized as the subjective experiences of flow (Jackman et al., 2017).

Flow can be divided into two different features, where the term flow state is when an individual is experiencing flow at that exact moment during an activity or task (Franco et al., 2017). Contrary, dispositional flow can be explained as an individual's propensity to experience flow (Kawabata, 2018). In the current study we are interested in examining both features of flow. Where flow state will be measured in relation to a physical activity episode (i.e., running session) and dispositional flow in relation to physical activity in general.

Flow and Exercise

The concept of flow has been displayed to be particularly relevant in sport and exercise where researchers have been studying the field since the 1990's (Swann et al., 2018). Research in this domain argue that flow in sport is associated with enhanced performance in athletes (Jackson et al., 2001). This optimal state of mind is often described as a time of peak performance, and is highly desired among athletes (Chen et al., 2019). It has been said that individuals experiencing flow while playing sports and engaging in similar activities often refer to be "in the zone" (Csikszentmihalyi, 2008). According to Csikszentmihalyi (2008), the chances of entering a state of flow heightens when there is a certain level of challenge and exertion that is put into the activity ones doing, which makes sport and physical activity relevant in fostering flow experiences because of the skills required to handle the challenges that comes with the activity. Even though flow is perceived as an optimal experience fostering pure enjoyment, the experience during an activity does not always have to be pleasant to be in a state of flow (Csikszentmihalyi, 2008). Based on flow research, it is due to the combination of complexity and enjoyment in achieving the balance between challenge and skills in an activity, in pushing limits and capacity, that flow experiences lead to growth (Csikszentmihalyi, 2008). In research on flow and sports, some argue that the reason flow is associated with superior performance is based on the positive psychological outcomes related

to flow, such as increased motivation regarding the activity itself, skill development, a greater sense of self and increased well-being (Anshel et al., 2019; Jackman et al., 2017).

Given the positive outcomes associated with experiencing flow in sport among athletes, it is desirable to investigate flow in relation to physical activity. Links between positive outcomes related to flow experience and regular exercise among non-athletes have been established as well. According to Jackman and colleagues (2019) existing research holds support that flow experience have potential to promote long-term exercise engagement based on findings associating flow and positive mental outcomes such as sense of achievement, enhanced intrinsic motivation and positive emotions after exercising (Jackman et al., 2019). Experiencing flow in physical activity is linked to higher levels of enjoyment while doing the particular activity, which in turn can lead to higher levels of exercise participation to recreate these positive emotions (Franco et al., 2017). This evidence supports what we intend to do in this study, creating additional investigations of flow and physical activity among non-athletes.

There have been several critics of the measurement of flow, despite general agreement on both definition and conceptualization of flow. Although, despite progressive findings linking flow and exercise, the dimensions of flow have been criticized to be imprecise and broad making it problematic to apply flow in sport and exercise (Swann et al., 2018). Further, the validity of the Flow State Scale, one of the most common tools to measure flow, has been questioned in a study by Swann and colleagues (2017). Additionally, Jackman et al. (2017) argues that one of the challenges when researching flow is assessing accurate subjective experiences. Therefore, establishing additional contributions of empirical evidence is highly needed to build a stronger base of evidence on the phenomenon of flow and to be able to increase the practice of flow experience in exercise settings. Although, transferring findings supporting flow in sports to physical activity and exercise might not be possible, given the differences in training as an athlete versus a non-athlete (Jackman et al., 2019), making

research focusing on non-athletes even more valuable. Given the research suggesting that flow experience in physical activity correlate with intrinsic motivation and long-term engagement in exercise settings (Jackman et al., 2019), developing a better understanding on the occurrence of flow in regular exercise would be valuable in promoting physical activity and preventing sedentary lifestyles. In addition, understanding the underlying mechanisms of flow is significant in making flow experience more attainable for future research and practitioners in the field. Thus, extensive research on the casual mechanisms underlying the occurrence of flow in physical activity settings is needed (Jackman et al., 2019).

In the current study, we are going to address this by measuring the propensity to experience flow in physical activity (i.e., dispositional flow) among non-athletes and by measuring flow state during running sessions over the course of six weeks. Exploring factors that may contribute to enhance flow such as environmental influences, exertion, and practicing mindfulness prior to exercising.

Mindfulness

Mindfulness displays several similarities to the experience of flow, where intense focus and complete presence in the moment are main features. Baer and colleagues (2019) states in a systematic review and meta-analysis that “*mindfulness* is typically defined as a particular form of present-focused attention and awareness. Many descriptions include two general elements: the attention itself and the qualities of the attention” (p. 1247). In another description, Bishop and colleagues (2004) suggests that mindfulness can be defined as a state of consciousness where the attention is towards the moment-by-moment experience. Additionally, mindfulness has been viewed as an attention-focus strategy for improving concentration (Chen et al., 2019). In other words, mindfulness is the ability to be fully present and engaged in what we are doing. In an attempt to conceptualize mindfulness, Bishop and colleagues (2004) propose a two-way component model to operationalize the concept of

mindfulness. The first component is explained as self-regulation of attention towards the present moment, while the second component involves adopting an orientation regarding one's experience in the present moment (Bishop et al., 2004).

Mindfulness and flow display similar characteristics in optimal experience and being fully focused on the present moment. Although, they differ in how these two mental states are obtained. Mindfulness on the one hand, is achieved by aiming attention and awareness toward a specific object, sensation (e.g., breath control) or mantra (West, 2016), a mental practice requiring self-discipline and commitment to maintain (Sheldon et al., 2014). Flow on the other hand, occurs in complete task absorption when perceived challenge and skill is balanced, when the intention of the task is clear and immediate feedback is available (Jackman et al., 2019). In which suggesting the difference between these two mental states where mindfulness is described as a controlled mental practice, and flow in contrast arises spontaneously during task absorption.

The Difference Between Mindfulness and Meditation

Originally, mindfulness branches from Buddhist traditions, where meditation is a key practice in achieving mindfulness (Shapiro et al., 2006). Meditation has been practiced across many different cultures for about 2500 years or more (West, 2016). According to West (2016) can meditation be defined as “an experience in which the individual turns attention or awareness to dwell upon a single object, concept, sound, image, or experience, with the intention of gaining greater spiritual or experiential and existential insight, or of achieving improved psychological well-being” (p. 4). Meditation relates to mindfulness by helping to establish the skill of mindfulness and can therefore be seen as a way of learning how to be mindful (Headspace, n.d.). Furthermore, Ortet et al. (2020) suggests that according to the differences in the experience of mindfulness states, there may exist a dispositional tendency toward mindfulness or stable differences in mindfulness on an individual level. The

dispositional tendencies to being mindful are substantiated by Baer et al. (2019), stating that dispositional mindfulness may be receptive to change with practice.

In his book of flow, Csikszentmihalyi (2008) states the strong similarities between yoga and flow, where he presents eight stages of increasing skills to achieve the basic text of yoga meaning "... making the body as a whole work together with consciousness as a part of an ordered system" (p. 104). Three of these stages are particularly interesting in the context of meditation and mindfulness, where stage four involves breath control, stage six involves concentration over longer periods of time on a single stimulus and stage seven involves meditation (Csikszentmihalyi, 2008).

Mindfulness, Flow and Exercise

Applying a present moment strategy such as mindfulness in sports has been associated with superior performance and is based on the assumptions that present moment focus suspends undesirable distractions and enhance concentration on the task at hand (Kee & John Wang, 2008). Suggesting the link between mindfulness and performance, in addition to displaying parallels between flow and mindfulness. Research proposes that there are associations between high traits of mindfulness and higher score in the dimensions of flow, such as balance in challenge and skills, having clear goals, concentration on the task at hand, sense of control and loss of self-consciousness (Kee & John Wang, 2008). A study by Chen and colleagues (2019) presented findings suggesting that flow state significantly increased among elite baseball players after the participants went through an intervention of the Mindful Sport Performance Enhancement (MSPE). In relation, Kee and Wang (2008) found that participants who were more inclined toward being mindful showed more likeliness to experience flow state when testing university student athletes. Despite the fact that these studies were based on athletes, there is reason to believe that these findings are transferable to non-athletes.

Aims of the Present Study

The aims of this study were four-fold. First, we wanted to explore the relationship between exercisers' dispositions for flow during physical activity and potential factors associated with such dispositions in a sample of non-athletes. We were especially interested in the role of mindfulness, physical activity level and indicators of general well-being (i.e., health, life satisfaction, growth orientation). Second, we were interested in whether dispositional flow would increase in the sample during the longitudinal study period. Our third aim was to test if a simple mindfulness-based exercise could have an effect on the occurrence of flow during physical activity and potential change in flow during the study. A fourth aim was to assess the associations between flow experiences and other aspects of a physical activity episode and to do so in close proximity to a physical activity episode. Here we were interested in experiences of flow in relation to overall evaluation of a physical activity episode, the perceived exertion and contextual factors such as running a predetermined trail, alone or with someone, inside or outside, wearing a heart monitor while running and running with or without music/podcast, that could influence flow experiences.

We designed a longitudinal study and invited participants to a running project where they were asked to complete a running session once a week over the period of six weeks. Additionally, they were asked to fill out one questionnaire at the beginning of the study period and one at the end as pre- and post-measures. Furthermore, they were asked to report in a shorter questionnaire after every running session as activity measures. After completing the pre-measure, participants were randomized into one intervention group and one control group. The intervention group were given instructions to perform a two-minute Box-breathing exercise prior to every running session (Webb et al., 2018) to test whether participants in the intervention group (that did the breathing exercise prior to running) would report more flow experiences during exercising than the participants in the control group.

Method

Participants and Design

A total of 103 Norwegian participants, between 19 and 62 years old ($M_{age} = 38.19$ years, $SD = 10.76$), registered for the longitudinal study and completed the first questionnaire (T1). The sample contained more women 72.8% ($n = 75$) than men, 27.2% ($n = 28$). Based on self-reports, participants can be described as having good general health ($Mdn = 4$ 'good' on a scale from very bad to very good) and normal weight with a mean Body Mass Index (BMI) of 24.72 ($n = 84$; $SD = 3.36$; Norsk Helseinformatikk, 2021). The majority of participants exercised moderately each week, when reporting how often they exercised with the options: "rarely", "less than once a week", "1-2 times per week", "3-5 times per week" and "5 times or more each week", the median category reported was exercising: "3-5 times per week" ($Mdn = 4$). The median activity level was: "regularly moderately physically active" ($Mdn = 3$), with the options: "physically inactive", "light physical activity", "regularly moderately physically active" and "regular hard strenuous physical activity". In an open-ended question, 12 different physical activity types were reported by more than a single respondent. The five most common activities reported were running, bicycling, strength training, hiking and Crossfit.

Participants were randomly assigned into two groups, one intervention group ($n = 52$) and one control group ($n = 51$). The intervention group was asked to perform a two-minute breathing exercise prior to every running session. Instructions for the Box breathing exercise were sent via email to participants in the intervention group (Webb et al., 2018). This exercise involved breathing in through the nose while counting to four, holding the breath and counting to four, breathing out with the mouth counting to four and then holding the breath counting to four. Participants were asked to repeat this cycle at least four times or for two minutes (the instructions given to participants can be found in Appendix A).

Throughout the study, one or more activity reports were filled out by 76 participants during the six-week experiment period and the post experiment questionnaire (T2) was completed by 50 participants. See participant flow chart in Figure 1.

Procedure

Participants were invited to a running study over the course of six weeks through several online announcements in social media (i.e., Facebook) and in a few cases by direct email requests. The inclusion criteria stated in the invitation were being 18 years or older and being able to conduct a 30-minute running session once a week for six weeks. Recruitment took place between September 17th, 2020 to November 2nd, 2020. All participants were informed of their ethical rights, assured of confidentiality, and signed informed consent prior to participating. Before data collection, the study was approved by the Norwegian Center for Research data (116768; see Appendix B) and exempted from review by the regional ethics committee (see Appendix C).

First, at startup participants completed a larger online questionnaire (T1) to assess baseline level flow dispositions, activity level, general tendencies to mindfulness, general health, life satisfaction, personal growth, and demographic variables. After completing T1, participants were asked to conduct a running session every week for six weeks. We chose to measure the participants' experiences for every running session using event-contingent sampling method (Reis & Gable, 2000), where the participants reported in a short questionnaire as soon as possible after every workout. The short questionnaires measured experiences with the running session such as perceived exertion, flow, and contextual information (i.e., predetermined trail or not, running alone or with someone, running inside or outside, outside environment, wearing a heart rate monitor or not, running with or without music/podcast). This shorter questionnaire was created to be compatible with smartphone devices to make it as easy as possible for the participants to complete. During the weeks of

running, each participant received a weekly reminder on Sundays via email with the link to the activity reporting questionnaire and instructions. The intervention group received a reminder and instructions for the breathing exercise as well. Lastly, at the end of the six-week period, participants were asked to answer a questionnaire (T2) similar to T1 as a post-experimental follow up.

Materials

Pre and Post Measures

Flow. Flow dispositions were measured with the Short Dispositional Flow Scale 2 (DFS-2), a self-report instrument designed for measuring flow experiences at a dispositional level (Jackson et al., 2008). Originally, the long version is a 36-item scale with four items for each of the nine dimensions of flow. For this study we used the short version of the DFS-2 including 9-items, one item for each of the nine flow dimensions. The items for each dimensions were: Challenge-skill balance: “I believe that my skills enable me to meet the challenge of the situation”; Action-awareness merging: “I perform the right movements without having to think”; Clear goals: “I have a strong sense of what I want to do”; Unambiguous feedback: “It is clear to me how I am performing at the task”; Concentration on task at hand: “My attention is fully focused on the task I am doing”; Sense of control: “I have a feeling of control over the task I am doing”; Loss of self-consciousness: “I focus freely on myself without no time for worrying of other aspects of my life”; Transformation of time: “It seems like time passes differently than normal”; Autotelic experience: “The experience is extremely rewarding”. Participants were asked to answer the nine statements relating to their experiences with exercising in general on a 5-point Likert scale from “1” (never) to “5” (always). Descriptive statistics and Cronbach’s Alpha can be found in Table 1 and 2 for T1 and T2 measures, respectively. The correlation between T1 and T2 measures were $r(49) = .667, p < .001$.

Physical Activity Level. Level of physical activity was measured with Saltin Grimby physical activity level scale (SGPALS) which is a 4-level activity scale, a self-report scale with one question: “How much do you move and exert yourself during leisure time? Choose one of the four options describing your activity level the last month” (Rödger et al., 2012).

The four options given were:

1. **Physically inactive:** I am completely inactive, where reading, watching television, using a computer or other sedentary activities during leisure time.
2. **Light physical activity:** I am physically active for at least 3-4 hours a week because I am cycling/walking to work, hiking, gardening or other simple forms of activity during leisure time.
3. **Regular moderate strenuous physical activity:** I spend a regular amount of time on physical activity during leisure time, in forms of running, cycling or other forms of planned exercise. At least 2-3 times every week.
4. **Regular hard strenuous physical activity:** I exercise often and hard several times every week, either at the gym or outdoors, on my own or through a sport/with a team.

As there were only three participants on the lowest activity level, we grouped the first and the second activity level together. Descriptive statistics and Cronbach’s Alpha can be found in Table 1 and 2 for T1 and T2 measures, respectively. The correlation between T1 and T2 measures were $r(49) = .866, p < .001$.

Mindfulness. Mindfulness was measured with the Five Facet Mindfulness Questionnaire (FFMQ), a self-report measure designed to assess the general propensity to be mindful in daily life (Baer et al., 2008). The original long version includes 39-items based on the five mindfulness facets: observing, describing, acting with awareness, non-judging of inner experience and non-reactivity to inner experience. We used the short version of the FFMQ including 15-items in this study, with three items for each of the five facets (Gu et al.,

2012). Example items for each of the facets are: “I pay attention to sensations” (observing), “I am good at finding words to describe my feelings” (describing), “I find myself doing things without paying attention” (acting with awareness), “I think some of my emotions are bad or inappropriate and I shouldn’t feel them” (non-judging) and “When I have distressing thought or images, I am able just to notice them without reacting (non-reactivity). Participants were asked to answer the 15 statements relating to what best describes their own perception of what generally applies for them on a 5-point Likert scale from “1” (never or very rarely true) to “5” (very often or always true). Descriptive statistics and Cronbach’s Alpha can be found in Table 1 and 2 for T1 and T2 measures, respectively. The correlation between T1 and T1 measures for FFMQ facet “observe” were $r(49) = .56, p < .001$, T1 and T2 correlation for facet “describe” were $r(49) = .76, p < .001$, for facet “acting with awareness” were the correlation $r(49) = .59, p < .001$, for facet “non-judging” $r(49) = .70, p < .001$, and the fifth facet “non-reactivity” the correlation were $r(49) = .56, p < .001$.

Personal Growth. For measuring personal growth, we used the Personal growth composite (PGC) as assessment tool (Vittersø et al., 2010). The PGC includes four subscales: Subscale A; Curiosity (Amabile et al., 1994), Subscale B; Absorption (Kashdan et al., 2004), Subscale C; Complexity (from Cattell’s 16PF, available from IPIP 2002) and Subscale D; Competence (from Cloninger’s TCI, available from IPIP 2002). Each of the four subscales contains three items (Vittersø et al., 2010). Items are scored on a 5-point Likert scale from “1” (totally disagree) to “5” (totally agree). Example items are: “I enjoy solving problems that are new to me” (curiosity), “When I try to solve complex problems, I get completely involved in what I am doing” (absorption), “I love to think up new ways of doing things” (complexity), “I know how to apply my knowledge” (competence). Descriptive statistics and Cronbach’s Alpha can be found in Table 1 and 2 for T1 and T2 measures, respectively. The correlation between T1 and T2 were $r(49) = .711, p < .001$.

Additional Variables. Life satisfaction was measured by asking participants to answer on a general level how satisfied they were with their life at that moment on a 10-point Likert scale from “1” (not satisfied) to “10” (very satisfied). Descriptive statistics and Cronbach’s Alpha can be found in Table 1 and 2 for T1 and T2 measures, respectively. The correlation between T1 and T2 were $r(49) = .568, p < .001$.

Physical activity satisfaction was measured by asking participants to answer on a general level how satisfied they were with their physical activity on a 10-point Likert scale from “1” (not satisfied) to “10” (very satisfied). Descriptive statistics and Cronbach’s Alpha can be found in Table 1 and 2 for T1 and T2 measures, respectively. The correlation between T1 and T2 were $r(49) = .743, p < .001$.

General health was measured by asking participants to assess their own health in general on a scale from “1” (very bad) to “5” (very good). Then by asking participants to assess their own health in comparison to other people their own age on a scale from “1” (much worse) to “5” (much better). Descriptive statistics and Cronbach’s Alpha can be found in Table 1 and 2 for T1 and T2 measures, respectively. The correlation between T1 and T2 were $r(49) = .595, p < .001$ for assessing one’s own health in general, and $r(49) = .653, p < .001$ for assessing one’s own health compared to others the same age.

Activity Measures

Flow. For measuring flow in the activity reports, participants were asked to relate their answers to the experience they had during the running session recently completed using the short version of the DFS-2. Descriptive statistics can be found in Table 3.

Perceived Exertion. For measuring perceived exertion, we used the Borg rating of perceived exertion (RPE), as a self-report measure to assess subjective physical activity intensity (Borg, 1998). Participants were asked to assess how strenuous the run they recently completed was, trying to assess their sense of exertion as sincerely as possible on a scale from

“6” (not strenuous at all) to “20” (maximum strenuous). Descriptive statistics can be found in Table 3.

Evaluation of Overall Running Experience. We measured the participants overall experience with the running session using two scales for evaluation; first assessing comfort during the run by asking the participants to rate their experience from “-3” (very uncomfortable) to “3” (very comfortable). Second, assessing how positive or negative the participants evaluated the run by asking them to rate the experience on a scale from “-3” (very negative) to “3” (very positive). Descriptive statistics can be found in Table 3.

Contextual Variables. Running a predetermined trail or not was measured by asking the participants: “Did you decide which route to run before you started the running session?”, with the answer options: “yes” or “no”. 76% of the control group reported “yes”, and 67.1% of the experiment group reported “yes” on determining on a specific trail prior to running.

Running alone or with someone was measured by asking participants: “Did you run alone or with someone?”, giving the participants two options: “alone” or “with someone”. For the control group 25.7% reported that they were was running with someone and 73% reported they were running alone. 9.4% of the experimental group reported they were running with someone and 89.9% was running alone.

Running inside or outside was measured by asking the participants to answer “outside” or “inside” in the activity reports on the question: “Did you run inside or outside?”. 79.5% of the control group and 81.2% of the experimental group answered they were running outside. If participants ticked the option “outside”, they got a follow-up question to assess the outdoor environment the running session mostly took place in, giving the participants three options: “in a park”, “in free nature” and “paved urban environment”. Of the participants from the control group reporting running outside 71.3% was running in a park and 27.5% was

running in free nature. Of the experimental group running outside 8.1% was running in a park, 35.6% was running in free nature and 37.6% was running in paved urban environment.

Wearing a heart rate monitor or not while running was measured by asking the participants “Did you use a heart rate monitor?”, giving them the options “yes” or “no”. 52% of the control group and 45% of the experimental group did wear a heart rate monitor while running.

Running with or without music/podcast was measured by asking participants to answer the question: “Did you listen to podcast/radio while running?”, giving them two options: “yes” or “no”. In the control group did 26.3% and 31.5% in the experimental group listen to podcast or radio. Then asking the participants: “Did you listen to music while running?” with the options: “yes” or “no”. 33.9% of the control group and 48.3% of the experimental group did listen to music while running.

Analyses

All the analyses were completed in SPSS version 26. In preliminary analyses, we checked whether those who finished the study differed from those who dropped out on any of the pre-measures using independent t-tests (reported in Table 4) and chi-square tests (reported in Table 5). There were only differences between those participants dropping out and those completing the study on how satisfied they were with their physical activity (see Table 4).

For the main analyses we assessed if flow differed from T1 and T2, using independent t-tests. Further, assessing if there were any differences in flow between the experimental group and the control group from T1 to T2 using a two-way ANOVA and checking that there were no substantial deviations from assumptions underlying the analyses.

To check if there were any associations between participants dispositional flow and main study variables (i.e., mindfulness tendencies, personal growth, life satisfaction, activity level, general health, and demographic variables) in both pre- and post-measures we used

Pearson's product-moment correlation (reported in Table 1 and Table 2). Additionally, we tested, using backward regression, which of the main study variables in T1 that were closest associated with dispositional flow (reported in Table 6).

Then, to examine flow during the running sessions we used the MIXED command in SPSS to check for differences in flow experiences between the experimental group and the control group, and to investigate associations between flow and the main study variables from the activity measures (presented in Table 7) and the contextual variables (i.e., predetermined trail or not, running alone or with someone, running inside or outside, outside environment, wearing a heart rate monitor or not, running with or without music/podcast).

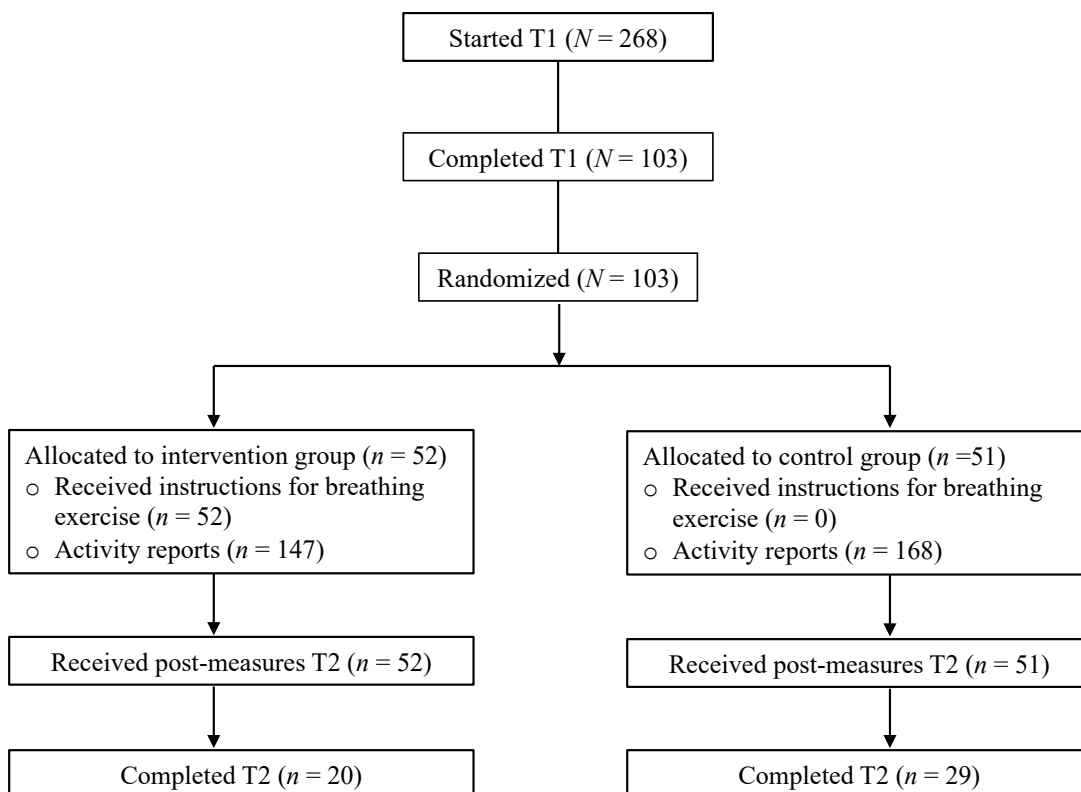


Figure 1

Participants Flow Chart.

Results

Descriptive Statistics and Correlations

The means, standard deviations, Cronbach's Alpha and correlations for T1 and T2 measures are presented in Table 1 and Table 2. Means and standard deviations for activity measures main study variables can be found in Table 3.

Association Between Dispositional Flow and Main Study Variables

First, a Pearson's product-moment correlation was run to assess the relationship between flow dispositions and the main study variables assessed at T1, see Table 1. There was a statistically significant, positive correlation between dispositional flow and the non-reactivity facet from the FFMQ, $r(101) = .41, p < .001$. A positive correlation was found between flow experiences and personal growth, $r(101) = .43, p < .001$. Further, both variables measuring life satisfaction displayed statistically significantly positive correlations with flow experiences, satisfaction with life in general, $r(101) = .24, p = .014$, and satisfaction with physical activity, $r(101) = .30, p = .001$. Self-report of participants' health in general and health compared to other people the same age group showed statistically significantly positive correlations, $r(101) = .31, p = .001$, $r(101) = .30, p = .002$, respectively. A statistically significant negative correlation was found between flow experiences and the dummy variable for low activity level, $r(101) = -.32, p < .001$, and, on the other hand, a positive statistically significant correlation between flow experiences and the dummy variable for high activity level, $r(101) = .45, p < .001$. Corresponding correlations for T2 can be found in Table 2.

In a next step we explored which of our study variables were closest associated with dispositional flow using backward regression. A backward multiple regression was conducted on T1 to predict flow experiences from mindfulness tendencies, personal growth, satisfaction with own life and physical activity, activity level, general health and demographics such as gender, age and level of education. The means, standard deviations, regression coefficients

and standard errors is presented in Table 6. The model with the most parsimonious predictor variables includes personal growth, non-reactivity, and both dummy variables for activity level, $F(5, 97) = 17.391, p < .001$, adjusted $R^2 = .446$. That indicates that 44.6% of the variance in flow experiences can be explained by this model, which is a medium effect size, according to Cohen (1988).

Changes in Flow During the Study

We were further interested in whether there were changes in dispositional flow during the study period. Dispositional flow increased descriptively from T1 ($M = 3.77, SD = .46$) to T2 ($M = 3.87, SD = .44$), however this difference was not statistically significant, $t(49) = -1.920, p = .061, d = -.271$. In a next step, we tested if there were group differences between the intervention group and the control group on dispositional flow from pre-measures (T1) to post-measures (T2). In a two-way repeated measures ANOVA we found no significant interaction between groups and flow experiences, $F(1, 48) = .007, p = .932$, meaning there was no differences in flow experiences from T1 to T2 between the two groups. In a last step, we wanted to investigate if the activity level of the participants affected changes in dispositional flow over the six-week study period. We found a trend effect indicating an increase in flow experiences from T1 to T2 among participants with low and moderate physical activity levels, and moreover flow experiences decreased from T1 to T2 among participants with high physical activity level, $F(2,47) = 6.501, p = .003$.

Table 1

Descriptive Statistics, Cronbach's Alpha and Correctional Analysis for Main Study Variables T1, N = 103.

T1 Variables	<i>n</i>	<i>M</i>	<i>SD</i>	<i>α</i>	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	
1. Flow Experiences Five Facets Mindfulness Questionnaire	103	3.73	0.44	.74	1																	
2. Observe	103	3.34	0.82	.61	.17	1																
3. Describe	103	3.58	0.87	.82	.23*	.13	1															
4. Acting with awareness	103	3.37	0.72	.65	.08	.25*	.35**	1														
5. Non-judging	103	3.82	0.88	.82	.08	-.04	.45**	.34**	1													
6. Non-reactivity Personal Growth	103	3.17	0.86	.73	.41**	.13	.38**	.16	.30**	1												
7. Personal growth Life Satisfaction	103	3.60	0.65	.87	.43**	.21*	.13	-.13	.01	.21*	1											
8. Satisfaction with life in general	103	7.21	1.63	-	.24*	.02	.45**	.09	.48**	.27**	.16	1										
9. Satisfaction with owns physical activity Activity Level	103	5.95	2.36	-	.30**	.30	.32*	.01	.25**	.08	.09	.33**	1									
10. Low activity	103	0.27	0.44	-	-.32**	-.08	-.02	-.11	.00	.03	-.06	-.14	-.59**	1								
11. High activity General Health	103	0.26	0.44	-	.45**	.03	.19	.03	.04	.14	.21*	.08	.48**	-.36**	1							
12. One's own health in general	103	3.97	0.70	-	.31**	.12	.22*	.11	.23*	.12	.27**	.26**	.60**	-.44**	.43**	1						
13. Health compared to others in the same age group	103	3.55	0.86	-	.30**	.04	.24*	.12	.15	.15	.16	.08	.45**	-.34**	.54**	.67**	1					
14. Body Mass Index Demographics	84	24.78	3.36	-	.00	-.14	.00	.07	.10	-.044	.02	.15	-.20	.09	-.04	-.19	-.32**	1				
15. Gender	103	0.27	0.44	-	.19	-.16	.00	.00	.00	.00	.27**	.04	.12	-.17	.18	.11	.16	.13	1			
16. Age	103	38.19	10.76	-	.10	.09	.13	-.02	.16	.07	.03	.11	-.09	.20*	-.21*	-.12	.04	.05	.01	1		
17. Level of education	103	4.38	0.84	-	-.14	.08	.07	-.00	.00	.12	-.03	-.00	.04	.11	-.05	.03	.12	-.28**	-.12	-.00	1	

Note. *M* = Mean; *SD* = Standard deviation; α = Cronbach's Alpha. FFMQ = Five Facet Mindfulness Questionnaire. Gender coded 0 = women, 1 = men. The three answer options for SGPALS were recoded into two dummy variables with moderate activity level as baseline category: low activity level = 1, other levels = 0, and high activity level = 1, other levels = 0. **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Table 2

Descriptive Statistics, Cronbach's Alpha and Correlational Analysis for Main Study Variables T2, N = 50.

T2 Variables	<i>n</i>	<i>M</i>	<i>SD</i>	<i>a</i>	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Flow Experiences	50	3.87	0.44	.81	1															
Five Facets Mindfulness Questionnaire																				
2. Observe	50	3.50	0.76	.63	.28*	1														
3. Describe	50	3.52	0.91	.88	.29*	.05	1													
4. Acting with awareness	50	3.08	0.63	.49	.09	.07	.33*	1												
5. Non-judging	50	3.72	0.89	.86	.15	-.17	.37**	.49**	1											
6. Non-reactivity	50	3.25	0.73	.64	.57**	.01	.30*	.19	.38**	1										
Personal Growth																				
7. Personal growth	50	3.70	0.65	.88	.48**	.18	.14	-.09	.02	.15	1									
Life Satisfaction																				
8. Satisfaction with life in general	50	7.36	1.72	-	.40**	.08	.54**	.27	.44**	.41**	.08	1								
9. Satisfaction with owns physical activity	50	6.84	2.13	-	.41**	.20	.31**	.11	.22	.32*	.34*	.21	1							
Activity Level																				
10. Low activity	50	0.18	0.38	-	-.26	-.13	-.21	-.00	-.14	-.30	-.19	-.31*	-.53**	1						
11. High activity	50	0.24	0.43	-	.37**	.09	.07	-.09	-.17	.10	.45**	-.00	.39**	-.26	1					
General Health																				
12. One's own health in general	50	4.08	0.69	-	.33**	.03	.25	-.01	.20	.38**	.40**	.43**	.46**	-.43**	.20	1				
13. Health compared to others in the same age group	50	3.70	0.81	-	.10	-.02	.26	.10	.18	.19	.12	.23	.47**	-.40**	.44**	.54**	1			
14. Body Mass Index	41	24.90	3.51	-	-.22	-.02	-.18	-.08	.00	-.20	-.17	-.19	-.244	.24	-.07	-.23	-.22	1		
Demographics																				
15. Gender	50	0.26	0.44	-	-.13	-.09	-.24	-.24	-.12	-.26	.05	-.15	.08	-.15	.20	-.06	.16	.24	1	
16. Age	50	39.50	10.33	-	-.23	.20	.14	.14	-.05	-.23	.05	-.04	.02	.17	-.16	.13	-.00	-.10	-.10	1

Note. *M* = Mean; *SD* = Standard deviation; *a* = Cronbach's Alpha. FFMQ = Five Facet Mindfulness Questionnaire. Gender coded 0 = women, 1 = men. The three answer options for SGPALS were recoded into two dummy variables with moderate activity level as baseline category: low activity level = 1, other levels = 0, and high activity level = 1, other levels = 0. **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Table 4

Frequencies and Independent t-tests between Main Study Variables and Dropouts versus Completers.

Main study variables	Dropout						Completed					
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>d</i>	<i>df</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>d</i>	<i>df</i>
Flow experiences T1	54	3.69	.42	-.94	.44	101	49	3.78	.46	-.94	.44	101
Personal growth	54	3.64	.71	.67	.66	101	49	3.55	.59	.67	.66	101
FFMQ:												
Observe	54	3.30	.86	-.56	.83	101	49	3.39	.78	-.56	.83	101
Describe	54	3.62	.85	.49	.87	101	49	3.53	.89	.49	.87	101
Acting with awareness	54	3.41	.78	.51	.72	101	49	3.34	.66	.51	.72	101
Non-judge	54	3.80	.96	-.16	.88	101	49	3.83	.79	-.16	.88	101
Non-reactivity	54	3.08	.90	-1.12	.86	101	49	3.27	.81	-1.12	.86	101
Life satisfaction:												
Satisfaction with life	54	6.96	1.80	-1.65	1.61	101	49	7.49	1.38	-1.65	1.61	101
Satisfaction with PA	54	5.44	2.39	-2.33*	2.31	101	49	6.51	2.22	-2.33*	2.31	101
General health:												
Own health in general	54	3.98	.71	.15	.71	101	49	3.96	.70	.15	.71	101
Health compared to others	54	3.59	.85	.48	.86	101	49	3.51	.86	.48	.86	101

Note. *M* = Mean; *SD* = Standard deviation; *t* = t-test; *d* = Cohen's *d*; *df* = degrees of freedom. FFMQ = Five Facet Mindfulness Questionnaire. **t* is significant on the 0.05 level (2-tailed).

Table 5

Chi Square Tests of Dropouts versus Completers.

Variables	<i>n</i> Dropout	<i>n</i> Completed	χ^2	<i>p</i>	<i>df</i>
Activity level:			3.134	.209	2
Low activity	18	10			
Moderate activity	21	27			
High activity	15	12			
BMI:			1.521	.467	2
Normal weight	34	26			
Overweight	18	19			
Obesity	2	4			

Note. χ^2 = Pearson Chi Square; *p* = p-value; *df* = degrees of freedom.

Table 6

Backward Multiple Regression Analysis Predicting Flow Experiences TI, N = 103.

Flow Experiences	<i>M</i>	<i>SD</i>	<i>B</i>	95% CI for <i>B</i>		<i>SE B</i>	β	<i>R</i> ²	ΔR^2
				LL	UL				
Model								.47	.44
Constant	3.73	.44	2.79***	2.28	3.31	.25			
Non-react	3.17	.86	.17***	.09	.25	.03	.34***		
Personal Growth	3.60	.65	.19***	.08	.29	.05	.28***		
Low activity	.27	.44	-.20*	-.35	-.04	.07	-.20*		
High Activity	.26	.44	.26**	.10	.42	.08	.26**		
Level of education	4.38	.84	-.07	-.14	.00	.03	-.13		

Note. Model = “Backward” method in SPSS Statistics; *B* = unstandardized regression coefficient; CI = confidence interval; LL = lower limit; UL = upper limit; *SE B* = standard error of the coefficient; β = standardized coefficient; *R*² = coefficient of determination; ΔR^2 = adjusted *R*². Removed variables = Observe, Describe, Awareness, Non-judge, Satisfaction with life, Satisfaction with PA, General health, Health compared to same age, BMI, Gender, Age. **p* < .05, ***p* < .01, ****p* < .001.

Flow Experiences During Running Session

For activity measures connected to a running session, the analysis data consisted of 320 reports from 76 participants. The interclass correlation coefficient for flow experiences was .55, meaning that flow experiences varied both within and between participants. First, we tested whether there were group differences in flow experiences between the group receiving the intervention and the control group. Using multilevel modelling, no group differences in flow experiences were detected, $B = -.13$, $p = .189$, $t(71.42) = -1.326$. Furthermore, when tested in a series of multilevel models, none of the contextual variables (i.e., predetermined trail or not, running alone or with someone, running inside or outside, outside environment, wearing a heart rate monitor or not, running with or without music/podcast) were associated with flow experiences during the running session and were not included in subsequent analyses.

Positive Evaluations, Perceived Exertion and Flow Experiences

When controlling for time and group, positive evaluation was positively associated with the experience of flow during the running session, $B_{\text{within}} = .20$, $p < .001$ and $B_{\text{between}} = .18$, $p < .001$, but there was no association between perceived effort and flow experiences, $B_{\text{within}} = .01$, $p = .692$ and $B_{\text{between}} = .04$, $p = .227$. However, the two multilevel models in Table 7 give support for a suppressor effect for exercise flow. It shows that flow was associated with higher perceived exertion during the running session, but only when the positive evaluation variable was included in the equation. Because perceived exertion is negatively associated with positive evaluation ($B_s = -.51$ and $-.50$ for within and between participants, respectively; both $ps < .01$), and positive evaluation for flow are positively correlated (see above; both $ps < .001$), a non-significant coefficient may be observed at the zero-level even when there is a relationship between perceived exertion and flow. We interpret the effect in the following way. Flow tends to occur when there is roughly a match

between skill and challenge (or the challenge slightly exceeds the skill), whereas a too strenuous workout would hinder flow. The combination of a negative association of flow and a too strenuous workout on the one hand, and the positive association between flow and positive evaluations on the other hand, leads to a zero correlation between flow and perceived exertion as long as positive evaluations are associated with lower perceived exertion.

Table 3

Descriptives for Main Study Variables, Activity Measures.

Activity Measures	Both Groups			Experimental Group			Control Group		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
Perceived exertion	318	12.81	2.21	148	12.68	2.34	170	12.92	2.10
Flow	317	3.79	.52	148	3.71	.53	169	3.86	.51
Evaluation of experience:									
Discomfort/comfort	315	1.03	1.39	147	1.03	1.38	168	1.04	1.40
Negative/postive	315	1.03	1.39	147	1.03	1.38	168	1.04	1.40

Note. *M* = Mean; *SD* = Standard deviation.

Table 7

Unstandardized Regression Coefficients, Their Standard Errors and p-values from Multilevel Models with Flow During Exercise as the Dependent Variable, and Time, Group, Perceived Exertion and Positive Experience as Independent Variables.

Predictor	Flow during Exercise					
	Model 1			Model 2		
	B	SE(B)	<i>p</i>	B	SE(B)	<i>p</i>
Intercept	3.85	0.06	< .001	3.84	0.06	< .001
Time	0.02	0.01	.083	0.02	0.01	.052
Group	-0.13	0.10	.174	-0.11	0.08	.203
Perceived Exertion_W	0.01	0.01	.629	0.03	0.01	.012
Perceived Exertion_B	0.04	0.03	.227	0.07	0.03	.008
Positive Evaluation_W				0.24	0.05	< .001
Positive Evaluation_B				0.20	0.02	< .001

Note. Group = 1 for the experimental group and Group = 0 for the control group. Perceived Exertion and Positive Experience was divided into a within (subscript_W) and between (subscript_B) participants component. P-values were calculated using the Satterthwaite method.

Discussion

The purpose of this study was to assess exercisers flow experiences in the context of a weekly running session over a period of six weeks to explore potential factors associated with flow experiences. The results of this study indicate among the main study variables positive associations between flow experiences and growth orientation, non-reactivity and high physical activity level. On the other hand, results showed a negative association between low physical activity level and flow experiences. The current study did not find any significant increase in dispositional flow during the six-week study period. Moreover, the study did not show any changes in flow between the intervention group that did the mindfulness exercise and the control group from pre-measures to post-measures. Lastly however, our results showed a tendency that flow experiences increased among participants with low and moderate activity levels and furthermore results showed a small decrease in flow among participants with higher activity levels.

The results from the activity measures show that flow experiences varied both within and between the participants. Although, results did not indicate any differences in flow experiences the between the intervention group and the control group during the running sessions. Additionally, analyses of the activity reports showed no associations between flow experiences and contextual factors indicating that none of the contextual variables we measured showed any relationship with flow experiences. The results showed a positive association between positive evaluations and flow experiences during the running sessions. However, the results did not indicate any association between perceived effort and flow experiences. One interesting finding is that when including the positive evaluation variable,

flow experiences were associated with higher perceived exertion. This supports the notion that flow state occurs when there is a balance of challenge and skill (Jackman et al., 2019). And on the contrary, a too strenuous workout could hinder flow from occurring.

As we have seen, results in this study provides us with limited findings regarding changes in flow over the study period. However, analyses indicated positive associations between flow dispositions assessed in the pre-measures and personal growth and additionally one of the FFMQ facets non-reactivity. Association between dispositional flow and personal growth indicates that the individuals that were more growth oriented tended to experience flow more often. When looking at the nine dimensions of flow there are several of these conditions that can be linked to a growth-oriented mindset. The four subscales of the PGC (i.e., A; Curiosity, B; Absorption, C; Complexity, D; Competence) have all similarities with the flow dimensions. The subscales Curiosity and Complexity such as enjoying solving new problems and thinking of new ways of doing things can be linked to the flow dimension challenge-skill balance where there must be something new or challenging about the task at hand, but it also requires a certain amount of skill for the activity to become neither boring nor create anxious feelings. The subscale Absorption shows similar traits to the dimension concentration on the task at hand and possibly the dimensions loss of self-consciousness, merging of action awareness and transformation of time. When ones completely involved and absorbed in a task it can possibly lead the activity to become automatic, where ones separating from the actions that are performed, which in turn can lead to loss of self-awareness and time distortion. Lastly, Competence subscale and knowing how to apply one's knowledge shows similarities to the flow dimensions clear goals and sense of control. These similarities support our finding associating flow dispositions and growth orientation in those individuals scoring high on personal growth probably scores high in dispositional flow.

From pre-measures, an association between dispositional flow and the FFMQ facet non-reactivity were found as well. The facet of non-reactivity refers to an individual being able to notice inner thoughts or images without reacting to them, which show similar features to the flow dimension sense of control in doing a particular task or activity.

The positive association between high activity level and flow dispositions and additionally the negative association between low activity level and flow dispositions supports the notion that individuals that reported high levels of physical activity experienced more flow when being physically active in general than individuals reporting lower physical activity levels. Moreover, results indicated a trend among participants with low and moderate activity levels experiencing an increase in flow from pre- to post-measures, and a small decrease of flow among participants with high activity levels. These findings raise the question if the participants with low to moderate activity levels at startup were affected by participating in this study and as a result exercised more than they usually would, leading to an increase in flow experiences during activity. Accordingly, the decrease in flow among participants with higher activity levels could be related to this group of participants being intrinsically motivated to exercise and were less affected by external factors such as participating in this study.

The results did not show any significant increase in dispositional flow from pre- to post-measures. This non-significant result was not affected by the mindfulness-based practice applied in the intervention group meaning that the breathing exercise we implemented in our experiment did not have any effect on participants' general tendency to experience flow during physical activity. Additionally, by assessing the activity reports, the mindfulness intervention did not have any influence on the intervention group's flow experiences during the running sessions. Based on research showing that implementing more advanced forms of mindfulness interventions to increase flow (Chen et al., 2019), it is possible that our results

are due to the length of the breathing exercise, in addition to not having controlled for the environment the mindfulness exercise were practiced in.

Results from the activity measures indicated a positive association between participants' positive evaluations of the running session and flow experiences during the running session. Which means that overall evaluations of the physical activity episode showed a tendency to predict higher flow experiences when the running session was evaluated as a positive experience. We did not find any associations between perceived exertion and flow experiences during the running sessions, however when the positive evaluation variable was included, exertion showed a small tendency to predict flow experiences during a physical activity episode. These findings are in line with previous research on the conceptualization of flow showing that when there was a balance between challenge and skill during running sessions flow state occurred. This finding raises the question if it is possible to experience flow while pushing limits in a strenuous workout, and according to our findings indicating the association between flow and perceived exertion, it is possible to enter a state of flow even when at maximal performance during physical activity. Furthermore, this finding can be related to the phenomenon of 'clutch' state, which refers to superior performance that occurs during a pressure situation and has been reported as a more effortful state of mind than flow (Swann et al., 2017). Both states are proposed to be intrinsically rewarding. Although, clutch state involves intense effort with exhaustion as a result, whereas flow state occurs more effortlessly and results in an energized feeling (Swann et al., 2017). Based on the parallels found between the occurrence of flow state and clutch state, another question is raised of whether we captured flow states in our measures or clutch states. On the contrary, in our findings, the running session had to be evaluated as a positive experience for exertion to predict flow experiences, which differs from the feelings of complete exhaustion in clutch states.

Limitations

The Study Sample

The study sample contained a large number of participants in our pre-measures, which gave us a good starting point for the way forward in the project. However, in our post-measures about half of the participants dropped out not responding on T2. Which is not too surprising considering the length of the study period. This number of dropouts from T1 to T2 could have possibly affected the results when assessing changes from pre- and post-measures. Another consideration is that all interaction between project leaders and the participants were done remotely through email correspondence. This choice was made because we wanted to make our study available for a larger group of people to increase the study sample. Additionally, with the Covid-19 situation, restrictions at the time this experiment took place would have made it challenging for us to weekly interact with a larger group of people. Consequently, this made it more challenging for us to follow up the participants them during the study period other than weekly email reminders. This could have created a feeling of distance leading the participants not feeling equally responsible for completing the whole study period. In line with the dropouts in our post-measures, several of the participants completing T1 did not complete all six activity measures and 76 participants reported at least one running session. Which again could have been the result of the length of the study and lack of in-person follow up. We chose not to offer the participants any rewards for participating in our study because we wanted a sample that was not motivated by external rewards such as gift cards etc., due to the concern that more participants would have dropped out earlier in the study period if they were not motivated by being physically active.

The study sample represented a limited part of the population as the group had an overrepresentation of female participants. This could have been a result of our recruiting method through social media platforms (i.e., Facebook), not reaching out to as many men as

women. Or the overrepresentation of women participating could have been due to our invitation being more appealing towards women. In the current study we have not focused on gender differences in neither running nor flow experience research which makes it challenging to consider the gender representation in our study.

Length of the study period

The length of the study period was chosen mainly based on the mindfulness intervention, for the intervention to possibly display any effect on flow experiences over time. Additionally, we chose this timeline based on the other possible factors predicting flow over time. This could have limited the results of the current study by being too long which could have affected the dropout rate. By developing a shorter study there is a possibility we could have managed to recruit a larger sample of participants making it more appealing for people to actively engage for a shorter amount of time. A shorter study period could also have lowered the dropout rate based on the same reason. On the other hand, a longer study period than six weeks with this design would probably not engage a larger sample and increasing the chances for a higher dropout rate. In addition, a longer study period than six weeks would probably been too long based on the limitations of a masters' program.

Running

In the current study we chose running as type of physical activity in measuring flow experiences. The main reason for this was based on running probably being one of the simplest ways of being physically active. Running does not require a gym membership, workout equipment or advanced skills. Furthermore, due to Covid-19 restrictions several gyms across Norway were closed at the time this study took place, which was another reason for us to choose running. Running as a type of activity could have limited the participants flow experiences because running does not require many skills. Based on flow research stating that one of the proximal conditions for entering a state of flow is a balance between

challenge and skills, questions are raised about running in being an activity that is too 'simple' in fostering flow experiences in exercisers. However, running as well as walking are both considered to be potential flow activities according to Csikszentmihalyi (2008).

Regardless of activity types, entering a state of flow depends on the level of perceived challenge and skill, a set of goals for the workout and finding ways of getting immediate feedback (e.g., speed or length of run).

Breathing Exercise

Participants in the intervention group were instructed to practice Box-breathing for about two minutes prior to running (see Appendix A). We chose two minutes to not make the breathing exercise time consuming for the participants to conduct. This could have possibly affected the outcome of the breathing exercise and possible effects on flow experiences during the running sessions. If the breathing exercise were to be longer it could have possibly influenced the samples' flow experiences. In our measures we did not control for the actual time spent on breathing prior to running, only if the participants completed it or not. Which makes it difficult for us to know to which extent the breathing exercise were practiced. Furthermore, in our activity measures we did not control for the environment the breathing exercise were completed in. In the instructions given we stated it as preferable to practice the breathing somewhere quiet, although it was not a requirement (see Appendix A). We chose to not require this because we did not want the breathing exercise to be too demanding for the participants to complete. Since the breathing exercise was to be a small intervention with a simple breathing exercise, we chose to not include any types of mindfulness-lessons prior to the study period.

Implications for Future Research

Based on the current study, for future research there are two issues to be considered of value when assessing factors predicting flow experiences in physical activity: first, to

consider the quality of mindfulness interventions and second, to consider the preconditions of flow when applying running in research on flow experiences.

The present results from the mindfulness intervention are rather disappointing, however, not surprising due to it being a minor experiment. The quality and length of the mindfulness intervention applied in this study have probably affected the outcome. Based on the complexity of mindfulness as a practice, we suggest for future research to include longer breathing exercise prior to running or engaging in other types of physical activity. Additionally, applying more advanced mindfulness interventions such as MSPE or other types of mindfulness learning courses. Providing the study sample lessons in mindfulness and in practicing their breathing prior to measuring its effect on flow experiences in exercise settings. Moreover, it could be beneficial to control for the environment where the mindfulness exercises are practiced, such as providing the sample with in-person breathing classes prior to physical activity.

Due to the limited findings of this study, questions have been raised about whether running is a suitable activity when researching factors predicting flow experiences among non-athletes. Research proposes that running have the same basis of being a flow activity as other more complex activities, however, the preconditions (i.e., challenge-skill balance, goal-orientation, immediate feedback) of flow are not obvious in running as they are in other, more complex activities such rock climbing or dancing. Achieving the balance between challenge and skill in running can be rather indistinct due to running being such a 'simple' activity, and for a regular exerciser running might not require many skills. On the other hand, for some exercisers running could be perceived as a great challenge making the challenge uneven with perceived skills. For future investigations applying running as activity in flow research, it might be of value to inform participants to consider ways of challenging themselves in line with their perceived skills prior to running. And furthermore, instruct participants to reflect

upon goals and subgoals for the running session, and lastly, inform them to be aware of immediate feedback on how they are doing by measuring running speed and/or distance of the run.

These issues underline the great complexity of flow experiences and studying factors predicting flow experiences in physical activity and exercise which makes future empirical investigations in the field of flow highly valuable to facilitate flow experiences in physical activity.

Conclusion

Regular physical activity has proven to be very beneficial in terms of health and well-being. Furthermore, research focusing on the subjective experiences in physical activity and exercise has shown to be valuable in the work to promote long-term exercise engagement. Subsequently, the purpose of this study was to examine flow experiences in physical activity among non-athletes. By which we wanted to investigate potential factors associated with flow experiences in physical activity, including the relevance of mindfulness and exertion. In summary, our study found that regular exercisers indeed can experience flow during a strenuous physical activity episode as long as the overall experience of the activity episode was positive. Flow experiences have proven to be highly rewarding and has the potential to increase intrinsic motivation. Therefore, in facilitating flow experiences based on the knowledge from this study it is clear that a person's overall experience with a physical activity episode should be taken into account. To foster flow experiences, the intensity of the workout should match the persons physical form and activity level in order to facilitate a positive overall experience with the physical activity episode, especially when the workout is very strenuous. However, there are still unanswered questions concerning possible factors predicting flow experiences in physical activity, a task left for future research.

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Appendix A

Instructions for Box-Breathing Exercise

Pusteøvelse

Før du starter øvelsen, se til at du sitter så komfortabelt som mulig enten om det er i en stol hjemme, i bilen eller på gulvet. Forsøk å holde en avslappet, men god holdning hvor skuldrene dine er senket og ryggen rak. Hendene dine legger du i fanget med håndflatene opp mot taket. Det er en fordel om du sitter på et stille sted slik at du kan fokusere uforstyrret på pusten din. Det er dog viktigere at du gjennomfører pusteøvelsen uavhengig av hvor du befinner deg, enn at du unnlater å gjøre den.

Steg 1:

Pust rolig og kontrollert ut gjennom munnen. Her er målet å forsøke å få tømt lungene dine for luft. Forsøk å være fullstendig til stede her og nå, med fokus på pusten.

Steg 2:

Pust dypt inn og ned i magen, sakte og kontrollert mens du teller til fire inni deg. Fokuser på pusten som fyller lungene og magen.

Steg 3:

Hold pusten mens du igjen teller til fire inni deg.

Steg 4:

Pust sakte og kontrollert ut gjennom munnen mens du teller til fire inni deg. Fokuser på hvordan luften tømmes fra lungene dine.

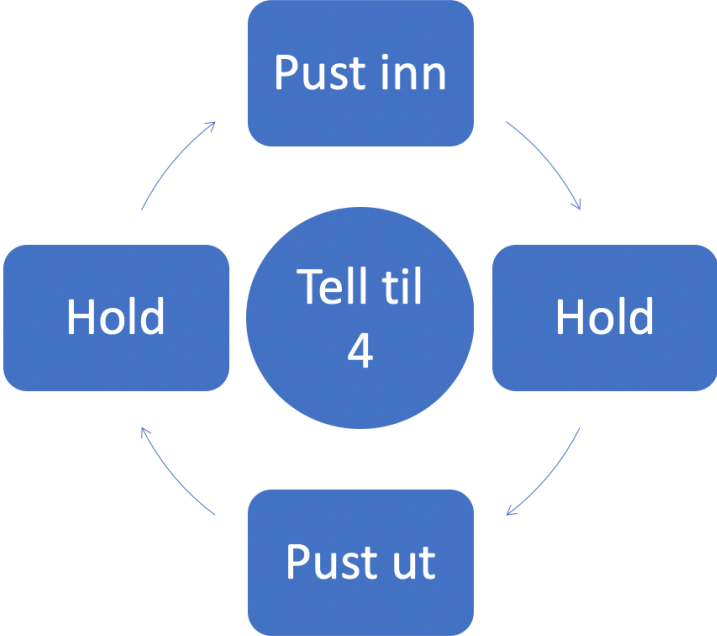
Steg 5:

Hold pusten mens du teller til fire inni deg.

Prosessen gjentas fire ganger etter hverandre. Dersom det er vanskelig å holde tellingen på hvor mange ganger du har gjennomført prosessen (pust inn-hold-pust ut-hold), så kan du ta tiden på deg selv og bruke 2 minutter sammenhengende på denne pusteøvelsen.

Appendix A

Instructions for Box-Breathing Exercise



Appendix B

Norwegian Center for Research Data Notification Form

Meldeskjema for behandling av personopplysninger

24.04.2021, 10:48



NSD sin vurdering

Prosjekttittel

Opplevelse av flyt i fysisk aktivitet: Undersøkelse av effekten mindfulness-basert trening har på opplevelsen av flyt hos mosjonister

Referansenummer

116768

Registrert

27.08.2020 av Karoline Annie Norum Karlsen - kka105@post.uit.no

Behandlingsansvarlig institusjon

UiT Norges Arktiske Universitet / Det helsevitenskapelige fakultet / Institutt for psykologi

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Kjærsti Thorsteinsen , kjarsti.thorsteinsen@uit.no, tlf: 77646269

Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

Karoline Karlsen, kka105@post.uit.no, tlf: 99569970

Prosjektperiode

24.08.2020 - 03.05.2021

Status

02.09.2020 - Vurdert

Vurdering (1)

02.09.2020 - Vurdert

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet

Appendix B

Norwegian Center for Research Data Notification Form

Meldeskjema for behandling av personopplysninger

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den 02.09.2020 med vedlegg, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER

Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:

https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html

Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET

Prosjektet vil behandle særlige kategorier av personopplysninger om helse og alminnelige kategorier av personopplysninger frem til 03.05.2021.

LOVLIG GRUNNLAG

Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 nr. 11 og art. 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse, som kan dokumenteres, og som den registrerte kan trekke tilbake.

Lovlig grunnlag for behandlingen vil dermed være den registrertes uttrykkelige samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a, jf. art. 9 nr. 2 bokstav a, jf. personopplysningsloven § 10, jf. § 9 (2).

PERSONVERNPRINSIPPER

NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER

Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER

NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1

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d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

Qualtrics er databehandler i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET

NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: Karin Lillevold
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

Appendix C

Review by the Reginal Ethics Committee



Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK nord	Monika Rydland	77620756	07.09.2020	179647

Deres referanse:

Kjærsti Thorsteinsen

179647 Opplevelse av flyt i fysisk aktivitet: Undersøkelse av effekten mindfulness-basert trening har på opplevelsen av flyt hos mosjonister

Forskningsansvarlig: UiT Norges arktiske universitet

Søker: Kjærsti Thorsteinsen

Søkers beskrivelse av formål:

Formålet med dette prosjektet er å undersøke effekten av en enkel mindfulness-øvelse (pusteøvelse) på opplevelsen av flyt hos vanlige mosjonister. I tillegg ønsker vi, mer generelt, å undersøke i hvilken grad vanlige mosjonister opplever flyt i løpet av en treningsøkt, og om individuelle forskjeller i fysisk form, generell helse, og ulike personlighetsfaktorer spiller inn. Forskningsspørsmålet er: vil en mindfulness-øvelse i forkant av fysisk aktivitet/trening øke sannsynligheten til å oppleve flyt i treningsøkta? Prosjektet vil ha en longitudinell, kvasi-eksperimentell tilnærming, hvor deltakerne randomiseres til enten en intervensjonsgruppe eller kontrollgruppe. Over seks uker skal alle deltakerne gjennomføre en 30minutters løpeøkt en gang i uka og besvare et kort elektronisk spørreskjema i etterkant av treningsøktene. Intervensjonsgruppen vil i tillegg bli bedt om å gjennomføre en 2 minutters pusteøvelse i forkant av løpeøkten.

REKs vurdering

Vi viser til forespørsel om fremleggingsplikt for ovennevnte forskningsprosjekt. Forespørselen er behandlet av sekretariatet i REK nord på delegert fullmakt fra komiteen, med hjemmel i forskningsetikkforskriften § 7, første ledd, tredje punktum. Søknaden er vurdert med hjemmel i helseforskningsloven § 10.

Veiledning vedrørende framleggingsplikt

De prosjektene som skal framlegges for REK er prosjekt som dreier seg om «*medisinsk og helsefaglig forskning på mennesker, humant biologisk materiale eller helseopplysninger*», jf. helseforskningsloven § 2. «*Medisinsk og helsefaglig forskning*» er i § 4 a), definert som «*virksomhet som utføres med vitenskapelig metodikk for å skaffe til veie ny kunnskap om helse og sykdom*». Det er altså formålet med studien som avgjør om et prosjekt skal anses som framleggelsespliktig for REK eller ikke.

Dette er et helt ufarlig prosjekt som skal utføres på friske mennesker og med en helt ufarlig intervensjon. REK vurderer at prosjektet er et greit studentprosjekt for å lære håndverket, men det vil ikke kunne fremskaffe ny, generaliserbar kunnskap om sykdom og helse og er ikke framleggelsespliktig for REK.

REK nord

Besøksadresse: MH-2, 12. etasje, UiT Norges arktiske universitet, Tromsø

Telefon: 77 64 61 40 | E-post: rek-nord@asp.uit.no

Web: <https://rekportalen.no>

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Vedtak

Ikke fremleggspliktig

Etter søknaden fremstår prosjektet ikke som et medisinsk og helsefaglig forskningsprosjekt som faller innenfor helseforskningsloven. Prosjektet er ikke framleggingspliktig, jf. helseforskningsloven § 2.

Vi gjør oppmerksom på at etter personopplysningsloven må det foreligge et behandlingsgrunnlag etter personvernforordningen. Dette må forankres i egen institusjon.

Med vennlig hilsen

May Britt Rossvoll
sekretariatsleder

Monika Rydland
rådgiver