



< Examining the effects of mindfulness training on
flow and self- perceived mindfulness in racing
drivers >

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Abstract

Mindfulness is recently gaining more traction as a viable way to enhance athletic performance. However, there is a lack of research concerning this approach in the field of motorsports. The aim of the present pilot- study is to examine the effectiveness of mindfulness training for racing drivers. The mindfulness intervention was based on Mindful Sport Performance Enhancement (MSPE) and consisted of three sessions. Two female racing drivers (n= 2, ages 27 and 31) attended the sessions and were measured on self- perceived mindfulness and flow pre and post- intervention. The descriptive results revealed slight positive changes on the refocusing subscale on the mindfulness questionnaire but no notable changes in the total score. One participant had a noticeable decrease on the flow score, while the other participant had an increase in the results on the flow scale. Qualitative data about the perceptions of the drivers on the intervention were gathered after the intervention. Qualitative data revealed that the participants found the intervention to be positive and useful for their racing performance. More research is needed to learn about the effectiveness of mindfulness in motorsports.

Keywords: motorsport, racing drivers, mindfulness, flow, intervention

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Nico Rosberg, the 2016 Formula 1 World Champion once said in an interview when talking about his mental training:

My main focus was on meditation, which is a word that is often misinterpreted. In my case it was about concentration practice and learning to control your mind. You can't switch off negative emotions but you can change the way you react to them. If you're aware, you can slow them down and move your mind towards more positive thoughts. I worked on this for 20 minutes every morning and evening and it was beneficial both for my racing and my life as a whole throughout the year (Brolin, 2017).

One subfamily of meditation techniques is the practice of mindfulness. Mindfulness has been used as a psychological and a spiritual phenomenon in the Eastern cultures for more than 2 millennia and has its roots in the Buddhist tradition (Kuan, 2004). Recently, mindfulness- based approaches are gaining more and more momentum in the field of elite sport (Henriksen, 2020). The aim of this study is to explore the effects of a mindfulness- based intervention on flow and self- perceived mindfulness in racing drivers.

Mindfulness

The word mindfulness is found in early Buddhist teachings, emphasizing awareness and presence of mind, where all the transient external and internal human phenomena are viewed as they exist at a given moment (Chiesa & Malinowski, 2011). Kabat- Zin (2013) defines mindfulness as “awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment”. While there is a consensus among researchers that mindfulness is fundamentally the quality of awareness, there are some differences in how they frame and define it (Holas & Jankowski,

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2011). For example, Bishop et al. (2014) conceptualize it as a metacognitive skill, Brown & Ryan (2003) see it as a self-regulatory capacity and Linehan (1994) frames it as an acceptance skill.

Mindfulness interventions have been empirically related in both clinical and non-clinical populations, with multiple positive outcomes, such as lower levels of stress, higher levels of well-being, decreased anxiety, depression, and negative emotions, more efficacious emotion regulation, less rumination, heightened self-compassion, and increased empathy (Eberth & Sedlmeier, 2012; Verhaeghen 2017). The biggest part of the mindfulness scientific research has focused on mental health and overall well-being. Other than that, mindfulness has been empirically investigated with other concepts such as attention. For example, Verhaeghen (2020) found in his meta-review that mindfulness-based interventions and long-term mindfulness practice is associated with reliable changes in objective attention performance. And as Peter Haberl, a senior sport psychologist at the US Olympic Committee says: “Attention is the currency of performance” (Haberl, 2016).

Mindfulness in sport

With the recent explosion of interest in mindfulness, it is no wonder that it has found a place in competitive sports as well. However, a question may arise as to why bring mindfulness into sports? Gordhamer (2014) answers that “The benefits of mindfulness practice as applied to sports are almost blindingly obvious. Focus, awareness, clarity of thought, and the ability to stay in the present moment are basic skills for any great athlete—and meditator.” Kristofer Henriksen and the Danish sport psychology team came to understand that athletes become anxious as they think about their anxiety, rather than their own performance (Henriksen et al. 2020). This is an example of a well-known paradoxical effect of thought suppression, whereby attempting to suppress or change thoughts, people

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produce the very obsession and preoccupation, which they are trying to get rid of (Wegner et al. 1987). So rather than looking to change the form or frequency of all of our emotions, thoughts, sensations etc., mindfulness- based interventions aim to promote an altered relationship with them (Gardner & Moore, 2012).

There are now several structured mindfulness- based interventions designed specifically for athletes. Some of these are: Mindfulness- Acceptance- Commitment Approach (MAC) developed by Gardner & Moore (2007), Mindfulness Meditation Training for Sport (MMTS; Baltzell & Akhtar, 2014), Mindful Sport Performance Enhancement (MSPE; Kaufman et al. 2018). Regarding the scientific research, the evidence for the effectiveness of these interventions is starting to accumulate. Henriksen, Hansen & Hvid Larsen (2020) state several limitations for studies done on elite level athletes, such as the small scale of the studies, the fact they are conducted in the field and rarely use RCTs, difficulties of conducting research in applied sport culture, as well as the lack of government funding. However, there are a few meta- analytical reviews present in the literature. For example, Bühlmayer, Birrer, Röthlin, Faude & Donath (2017) found some positive impacts for mindfulness- based interventions in sport. Reviewing the relationship between mindfulness and athlete burnout Li et al. (2019) conclude there is some evidence indicating a negative relationship between these two constructs, however, they add the evidence is limited due to qualitative studies and a small number of interventions. In a more recent review of the relationship between mindfulness and athletic performance, Wang et al. (2023) found that mindfulness- based interventions were effective in promoting athletic performances (by narrative synthesis), mindfulness levels (post- intervention mindfulness scores) and mindfulness- related psychological components such as flow. These findings offer a preliminary support for the effectiveness of mindfulness- based interventions, but also call for more future research.

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Motorsport

“There are only three sports: bullfighting, motor racing, and mountaineering; all the rest are merely games.”

- Ernest Hemingway

In the recent years, there is a surge in popularity regarding motorsport. Formula 1 (F1), the biggest motorsport competition in the world saw record attendance in 2022 with a total of 5.7 million people during 23 races across 5 continents (Brown, 2023). F1 saw total revenues in 2022 exceed 2.5 billion dollars and in 2021, F1 reported a global TV audience of 1.55 billion people (Brown, 2023). However, despite the popularity and the revenues, there is a surprisingly low amount of research on the topic of racing drivers and performance. Erickson and Gould (2018) go on to say that there is arguably more existing literature on the spectators of motorsports events than on the drivers and the racing teams themselves. Potkanowicz & Mendel (2013) find the stereotype where racing drivers are not considered athletes responsible for this, and with little regard for them as athletes, they are hardly ever the focus of scientific research. Potkanowicz & Mendel (2013) also emphasize the unique stressors experienced by racing drivers such as: (1) high speed and the multi-tasking nature of driving (braking, steering, etc.); (2) extended and continual periods of performance (sometimes 2-3 hours); (3) persistent thermal stress; (4) repetitive G-loading (up to 6G); (5) physiological, psychological, and emotional stress; (6) lastly, as one can tell from Ernest Hemingway's quote, the ever-present risk of death. Consequently, there has been only a handful of research papers on the psychology and mental training for racing drivers (e. g. Kozuma 2011). This paper will focus on an intervention to improve racing performance through flow and mindfulness. To the authors knowledge, it would be the first to explore effects of mindfulness training in racing drivers.

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Flow

That day I suddenly realized that I was no longer driving conscious, and I was in a different dimension for me. The circuit for me was a tunnel through which I was just going, going, going, and I realized I was well beyond my conscious understanding.

– Ayrton Senna on racing in 1988 Monaco Grand Prix (Kapadia, 2010)

The experience described here by the renowned Brazilian champion can be attributed to that of a flow state. Csikszentmihalyi (1990) refers to flow as the state in which a person gets so involved in an activity and it is so completely enjoyable that nothing else seems to matter. In the context of sport, Swann, Keegan, Piggott, & Crust (2012) define flow as an intense, rewarding, undistracted absorption in the activity. In a systematic review of the relationship between flow and performance in sports and gaming tasks, Harris et al. (2021) found a medium-sized positive relationship. Many people in the areas of sport or performance have had these kinds of experiences and it is usually considered a rare and desired state.

Csikszentmihalyi (1990) defines 9 characteristics or dimensions that conceptualize flow. These are: (1) a balance between a challenge faced and the skills required to meet it, (2) the presence of clear goals, (3) unambiguous feedback on the pursuit of those goals, (4) a merging of action and awareness such that the activity almost feels automatic, (5) total concentration on the task at hand, (6) a sense of control, (7) a loss of self-consciousness (lack of self-scrutiny), (8) the transformation of time in the sense that it either speeds up or slows down, and (9) autotelic experience (the activity is intrinsically rewarding, rewarding by itself). The first three characteristics are considered necessary settings for experiencing flow, and when these are present, an individual can experience a state of flow characterized by either some or all of the remaining six dimensions (Swann et al., 2012). Kaufman et al. (2018) state

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that there is still a debate going on if attaining this state of flow is under our control. Most of the college athletes in Chavez (2008), and most elite figure skaters in Jackson (1992) perceived flow state to be controllable. Kaufman et al. (2018) conclude there are many factors included in achieving this state, both internal and external. They add that individuals can increase their chances of getting into flow state, and that one way to do it is with the practice of mindfulness.

Mindfulness and flow

Kaufman et al. (2018) emphasize the clear theoretical connection between mindfulness and flow. Acceptance and awareness, two of the underlying elements of mindfulness, overlap with some of the primary characteristics of flow such as total concentration on the task at hand, merging of action and awareness, unambiguous feedback, transformation of time, and loss of self-consciousness (Gardner & Moore, 2004)

Plenty of research supports the proposition that greater mindfulness level increases flow. This has been studied and empirically demonstrated both with non-athletes (Moore, 2013) and with athletes (Chavez, 2008; Cathcart, McGregor, & Groundwater, 2014; Scott-Hamilton, Schutte & Brown, 2016). Indeed, in a recent review comprising of 17 studies and 10,102 individuals, Schutte & Malouff (2023) found that greater mindfulness is associated with higher levels of flow ($r=0.38$, $p=.0001$). They have also found mindfulness to be more strongly associated with a dispositional flow, or flow as a trait, in comparison to flow as a state. Thus, the hypothesis is that the mindfulness intervention will increase the dispositional trait of flow in racing drivers, together with increased self-perceived mindfulness. However, due to the small sample size and with this being the first study to include mindfulness training in motorsports to the author's knowledge, qualitative data was also collected in order to expand the findings of this pilot-study.

Method

Participants

The planned sample size for this study was 7-9 participants. However, with the season starting and due to the unavailability of the drivers to regularly attend sessions and difficulties with scheduling, only 2 of the drivers agreed to participate and attended every session. Two female racing drivers aged 31 and 27 were participants in this research. Their experience in racing was 6 years and 6 months respectively. Participants were a part of a motorsport training program in a specialized gym in Netherlands. The less experienced driver competed in karting, while the more experienced driver was entering the car racing scene with previous experience in karting.

Procedure

Data collection

The participants completed the questionnaires pre- intervention and post-intervention. Pre- intervention assessment was completed before the season in April and post-intervention assessment was completed during the season in July. Before filling out the questionnaires the participants were given information about the research and were instructed to read it carefully. After that, they were instructed to sign the informed consent form if they agree to participate in the research.

Brief description of the mindfulness intervention

The mindfulness intervention was based on MSPE (Mindful Sport Performance Enhancement) by Kaufman et al. (2018). MSPE is a six- session program adapted for athletes and based on MBSR (Mindfulness Based Stress Reduction; Kabat- Zinn, 1982) and on the Mindfulness- based cognitive therapy (MBCT; Segal, Williams & Teasdale, 2002). This

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program includes educational, experiential, discussion and homework components. During MSPE, athletes are taught about mindfulness from their own experience and the experience of others in the group through a systematic protocol (Kaufman et al. 2018). The goal of MSPE is to teach the fundamentals of mindfulness and to integrate it in the real- world training and competitive routines with athletes (Kaufman et al. 2018). The intervention for the current study comprised of three sessions, with each session lasting from 60- 90 minutes. The sessions were conducted in the time span of 6 weeks. The intervention was led by the author, a master's program student with a degree in psychology. In the following sections, the content of the intervention will be described.

Session 1

The first session was dedicated to defining the concept of mindfulness and the concept of flow and how it is relevant for racing and performance. The participants did two exercises in the first session: a 3- minute diaphragmatic breathing exercise and the 10- minute sitting meditation exercise. 10- minute video clips with guided mindfulness meditation exercises were shared with the participants to be used as daily homework.

Session 2

The second session was held two weeks after the first meeting. The main theme of Session 2 were the five core performance facilitators that are targeted with MSPE (concentration, letting go, relaxation, establishing a sense of harmony and rhythm, forming key associations). The session started with the 3- minute diaphragmatic breathing exercise. After that the teacher led the discussion of home practice, obstacles and challenges that were encountered and the aforementioned performance facilitators. The participants then did two more exercises: a 12- minute body scan meditation and another 10- minute sitting meditation.

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In the end the participants were given the body scan meditation video as daily homework for the upcoming period.

Session 3

The last session was held four weeks after the previous meeting. This session introduces the sense of body as a whole and bodily movements to the practice of mindfulness. The main theme of this session was understanding and exploring the roles of expectations and limits. We further discussed the pressure experienced by the participants, and how they can use what we practice in their racing. The participants then did a 10- minute sitting meditation with a focus on the body as a whole, and were given instructions at the end of the session to practice mindfulness yoga and 10- minute sitting meditations at home.

Measures

Mindfulness

To measure the drivers' level of mindfulness, the Mindfulness Inventory for Sport (MIS) was used (Thienot, Jackson, Dimmock, Grove, Bernier & Fournier, 2014). The inventory consists of 15 items across three subscales: (1) awareness, (2) non- judgmental attitude and (3) refocusing, with each subscale comprised of five items. The items were rated on a six-point format with responses ranging from 1 (not at all) to 6 (very much). An example of a question is: "I am aware of the thoughts that are passing through my mind." The scores on the subscales comprised of a sum of the items and ranged from 5 to 30. The total score was calculated by adding all the scores on the subscales, ranging from 15 to 90 and with the non- judgmental subscale being reverse- scored. Higher scores on the questionnaire indicated a higher level of mindfulness. The internal consistency for each of the subscales was found to be acceptable in the sample of elite athletes (N= 343), with awareness: $\alpha = .77$, non-

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judgmental: $\alpha = .78$, refocusing: $\alpha = .77$ in the initial validation of the questionnaire by Thienot et al. (2014).

Flow

To measure flow as a trait, or the general tendency to experience flow characteristics in the racing setting, the Dispositional Flow Scale- 2 (DFS- 2) was used (Jackson & Eklund, 2004). The DFS- 2 contains 36 items. There are nine subscales, one for each dimension of flow defined by Csikszentmihalyi (1990), and each subscale is comprised of four items. The items were rated on a 5 point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scores on the subscales comprised of a sum of the items and ranged from 4 to 20. An example of a question is: "I am challenged, but I believe my skills will allow me to meet the challenge." Total score was calculated by adding all the scores on the subscales and ranged from 36 to 180, with higher scores indicating increased levels of attaining the state of flow. Internal consistency estimates for this scale ranged from .81 to .90 (Jackson & Eklund, 2004).

Qualitative measures

Because of the small sample size that was able to attend the mindfulness training sessions, qualitative measures were included in the post- intervention reflections. The reflections were assessed by answering the following questions: (1) Do you think the mindfulness sessions were useful for your racing? If so, in what ways? (2) Did you experience any challenges during the sessions or during practice? (3) On average, how many times did you practice mindfulness weekly? The goal of the qualitative reflections was to gain more insight in the applicability of mindfulness in racing.

Results

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Quantitative measures

The statistical analysis planned for the current research was a paired sample t- test. The paired sample t- test is a statistical test used to compare the means of two related variables (Petz, Kolesaric & Ivanec, 2012). However, the paired sample t-test requires the assumption that the differences between the paired observations follow a normal distribution. This assumption is necessary for the t- test to provide accurate results (Petz et al., 2012). With only two participants, there is not enough data to make reliable conclusions about the normality of the distribution and thus the assumption required for the analysis is violated and the validity of the results would be affected. Without the normality assumption, non-parametric Wilcoxon signed rank test is usually used, however, this test can only be used if the sample size is equal or greater than six (

The Mindfulness Inventory for Sport

Table 1. shows no notable trends of increases or decreases in the total scores in the mindfulness questionnaire for both participants. For participant 1, the total score went down 2 points (from 75 to 73). For participant 2, the total score on the mindfulness scale went up 2 points (from 68 to 70). Concerning the subscales, with participant 1 the awareness subscale decreased by 4 points, the non- judgmental attitude remained the same score, and refocusing increased by 2 points. Participant 2 scores increased both on subscales of awareness by 3 points and refocusing by 4 points, but there was a decrease in the score of the non- judgmental attitude by 5 points.

Table 1

Subscale scores and the total score on the Mindfulness Inventory for Sport (MIS) pre and post- intervention

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Participant		Awareness	Non- judgmental attitude	Refocusing	Mindfulness
1	pre	27	29	19	75
	post	23	29	21	73
2	pre	27	23	18	68
	post	30	18	22	70

The Dispositional Flow Scale- 2

Table 2 shows the scores of both participants on the total score of the Dispositional Flow Scale- 2 and its subscales. There is an evident loss on the total score of the DFS- 2 for participant 1, where the total score went from 140 pre- intervention to 108 post- intervention. The largest drops in scores were on the Challenge/ Skill balance subscale (from 17 to 11), loss of self- consciousness subscale (from 17 to 8) and on the autotelic experience subscale (from 14 to 9). There was a decrease in all of the subscales scores for participant 1 except on the Clear goals subscale which went up by one point. On the other hand, participant 2 saw an increase in their total score in DFS- 2 from 138 to 153 after the intervention. The most notable increases were on the subscales of Merging action and awareness (from 14 to 19) and on the Loss of self- consciousness subscale (from 12 to 20). The only subscale that had lower scores after the intervention with participant 2 was the subscale of Unambiguous feedback, which went down from 14 to 11 points.

Table 2

Subscale scores and the total score on the Dispositional Flow Scale- 2 (DFS- 2) pre and post- intervention

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Participant		Balance	Merging	Goals	Feedback	Concen.	Control	Consc.	Time	Auto	Flow
1	pre	17	11	19	18	14	14	17	16	14	140
	post	11	7	20	16	13	12	8	12	9	108
2	pre	16	14	16	14	14	15	12	17	20	138
	post	16	19	15	11	16	16	20	20	20	153

Qualitative measures

Qualitative question 1

For the first qualitative reflection question (1): “Do you think the mindfulness sessions were useful for your racing? If so, in what ways?” Participant 2 answered: “Yes, I do! It helped me refocus on getting ready for the race. I noticed that a lot of people, even though it was with good intentions, wanted something from me. So, in that moment, I needed to refocus on myself and the race and with mindfulness that really helped me.” Participant 1 answered: “Mindfulness is the number 1 task in racing because it’s all about confidence and focus”. Both of the participants expressed the common theme of (re)focus concerning the usefulness of the intervention.

Qualitative question 2

The second qualitative question the participants answered was (2): “Did you experience any challenges during the sessions or during practice?”. Participant 1 answered: “Making time for it”, while participant 2 answered: “Yes, I’m very quickly distracted. So that is something I will always have. It really comes up when I need to focus on myself when I am alone. When I am in the car, my focus is instantly on.”

Qualitative question 3

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The third reflection question asked was (3): “On average, how many times did you practice mindfulness weekly?”. Participant 1 answered they practiced mindfulness on average twice a week, while participant 2 practiced mindfulness once a week.

Qualitative question 4

The last question concerning the qualitative reflection in this research was (4): “Do you have any recommendations to improve the quality or effectiveness of the sport psychology intervention being offered?”. Participant 2 answered: “I think the sessions themselves were very useful and helped a lot! But a tip for in the future try to keep in touch with the people you consulted. If I look at myself that is something I need because of the mental part of the sport but also life can be tough sometimes and isn't always easy to open up to especially when mental coaching is a first-timer. Besides that, I think you did great and I've learned a lot from you! (...)”. Participant 1 answered similarly: “More specific approach on a person's situation or problem to conduct this training”.

Discussion

The aim of this study was to measure the impact of a three-session mindfulness- based intervention on racing drivers' mindfulness levels and flow. The hypothesis that the mindfulness- based intervention will result in greater levels of mindfulness and flow could not be confirmed due to the assumption required by the statistical analysis not being made.

The measures on mindfulness levels had not changed notably after the intervention with both participants. However, there were some changes in the scores on the subscales of mindfulness. In both participants the Refocusing subscale increased by 2 and 4 points respectively. These results are in line with the qualitative reflections written by both participants, where they saw the usefulness of mindfulness practice in helping them refocus to their own performance.

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A noticeable difference in the measure of flow can be seen in both participants. Participant 1 scored considerably less on flow after the intervention. These results can be explained with the suggestion by Sheldon, Prentice & Halusic (2015) that mindfulness and flow are two incompatible processes. Kaufman et al. (2018) state that athletes often describe their experience of flow as effortless and automatic, such as being on autopilot. Considering that mindfulness means leaving this state of being on autopilot, this is what led to disagreement among researchers. Sheldon et al. (2015) state that mindfulness usually cultivates observing the consciousness and strives to sustain reflective moment to moment awareness. Contrasting that, Sheldon et al., (2015) argue that flow means losing this inner observer and entering a state of mind that is inherently different from mindfulness, where: "... the moment blurs into a continuous stream of activity.". On the other hand, Chavez (2008) considers this sense of automaticity as a result of complete absorption to the task or the activity and associates it to awareness being fully merged with the action as an element of flow. Sheldon et al. (2015) also found evidence in their research that increasing an individual's ability to remain mindful during an activity could actually weaken their ability to get absorbed in that activity. However, since then, there has been a burgeoning amount of empirical evidence of positive relationship between mindfulness and flow, as recently reviewed in Schutte & Malouff (2023). Another explanation for the decrease in flow is that the driver in question was in the process of moving from competing in karting, to car racing. The driver expressed some difficulties with adapting to this change during the discussions in the sessions. This can be the reason for decreased levels in some of the subscales of flow such as that of balance. This subscale represents the challenge- skill balance, and when in flow challenges and skills are matched, extending beyond personal average levels. These results can be attributed to the big difference between karting racing and car racing, as the driver possibly needs more experience to perceive her skills to be equal to the challenge. Also, a

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decrease can be seen in the subscale of the autotelic experience. This subscale represents the intrinsically rewarding experience that flow brings to the individual. It is possible that the stress of the category change resulted in the decreased scores on the intrinsic reward of the experience and that the participant had a more enjoyable experience in karting because of her mastery of it. On the other hand, participant 2 scores on the flow scale saw an increase after the intervention. Even though it is not possible to confirm the hypothesis, this score is in line with the notion that mindfulness intervention increases levels of flow and is in line with the empirical research on athletes.

The qualitative data of the current study suggested that mindfulness training could be useful and applicable for the racing environment. Participant 2 expressed that mindfulness helped them refocus on the race and their performance. During the first session, the participants were asked how important percentagewise they think focus and mental part of performance is in racing and answered 60% and 70%. From the start, the participants seemed very receptive to mindfulness and openly expressed they saw the potential behind this kind of training and its application to their performance in racing. However, the biggest challenge for the participants proved to be incorporating daily mindfulness practice to their lives. Both participants are employed and making time for this kind of dedicated practice is not as easy as it might seem. Furthermore, the participants both recommended a more personalized approach if this kind of training is to have a positive effect.

Limitations

Other than small increases on the Refocusing subscale, there were no increases in the levels of mindfulness reported by the participants and following the intervention. Several reasons might have been responsible for this incongruity with the current empirical findings

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on this topic and the scores on the Mindfulness Inventory for Sport in the current study. First, due to difficulties with scheduling and distance, only three mindfulness training sessions were held with the racing drivers, as opposed to six originally planned sessions. This intervention was based on MSPE (Kaufman et al., 2018), which is a program meant to be completed in six sessions. Inevitably, important components on how to further incorporate mindfulness into racing and performance were left out. Even though the leader discussed parts of this with the participants during the second and the third session, more meetings were needed. Plenty of other similar studies conducted on athletes, such as Moen, Abrahamsen & Furrer (2015), Vidic & Cherup (2021), Sparks & Ring (2022), Kittler, Arnold & Jekauc (2022) utilized interventions with weekly sessions ranging from 6 to 12 weeks in duration.

Secondly, it was not monitored with certainty how much the participants practiced mindfulness. Participants reported practicing mindfulness once and twice a week respectively in their qualitative reflections. Kaufman et al. (2018) accentuate the importance of developing a consistent and regular daily mindfulness practice to attain its benefits. Jon Kabat- Zinn (2009) likens the practice of mindfulness with the slow digging of trenches, working in the vineyards or with the bucketing of a pond. Furthermore, Kaufman et al. (2018) speak of practicing mindfulness as training the muscle of attention and they also compare it to physical training and add that for most of the people, this muscle of attention is weak without practice. The authors of MSPE also emphasize that people can get out of mindfulness only how much they put into it (Kaufman et al., 2018).

Thirdly, the inexperience of the mindfulness teacher can influence the results. Some authors such as Segal et al. (2002) and Kabat- Zinn (2011) emphasize the necessity and the importance of having a deep familiarity and understanding of mindfulness to teach it, which can only be achieved through regular and extensive personal practice. Meland (2020) also brings up the sensitivity of mindfulness training to poor leadership as one of the limitations of

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mindfulness training. The leader of the interventions in the current study had a personal daily mindfulness practice of three months prior to the study and attended the MBSR based course offered by the University of Groningen. Furthermore, the leader also had prior knowledge of the concept of mindfulness. However, this was the first experience in teaching mindfulness for the leader.

Lastly, another major limitation in this study is the small sample size ($N= 2$) which made the statistical analysis originally planned for the current study unjustifiable. The small sample size restricts our ability to make conclusions about the larger population of the racing drivers as the participants can have unique characteristics and experiences which may not be representative of the population. Furthermore, differences between the participants can make it difficult to conclude if the observed changes occur due to the intervention or the specific characteristics of the participants, such as the example the participant 1 in the current study. For example, personality can also have a moderating effect on the effectiveness of a mindfulness intervention. In a study done by Gan, Wang & Fan (2023) it was found that athletes with high extraversion had more improvement in mindfulness levels following the intervention. Other than that, the performance level could have an impact on the results. Bulğay, Tingaz, Bayraktar & Çetin (2022) found that athletes with high performance levels had significantly higher scores on mindfulness on average compared with athletes competing in lower performance levels. It is possible that the personality of the participants in this study also moderated the effectiveness of the intervention. All of these factors could have an effect on the results of this study. Moreover, future studies with more participants and research examining moderators are needed to explore the effects mindfulness training can have on racing drivers.

Future research and implications for practice

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The recommendation for future research is to also conduct high quality Randomized Controlled Trials (RCT) with racing drivers to more accurately describe the potential effects of mindfulness training on flow, and thus performance in racing drivers. Further recommendation based on the qualitative reflections of the participants of the current study is for the mindfulness teacher to try and involve himself more with the racing drivers with more often check- ups and reminders to practice. This is because it would possibly benefit the relationship between the mindfulness teacher and the drivers. Also, the teacher can serve as a behavioral reminder for the driver to do certain things that otherwise they would not do, such as mindfully entering a race. Another solution is to hold the mindfulness training sessions every week without big discontinuations that were present in the intervention in the current study. Kaufman et al. (2018) also suggest having an experienced mindfulness teacher co- lead the sessions together with the less experienced leader in order to increase the effectiveness of the intervention. Lastly, future research should closely monitor how much the participants practiced mindfulness in the periods between the sessions.

There have been known examples of mindfulness practice in the world of racing such as Nico Rosberg (Brolin, 2017). Based on previous research on athletes and qualitative reflections in the current study, mindfulness training seems a promising area for sport psychology practitioners involved in motorsports and with racing drivers and teams.

Conclusion

The current pilot- study explored the effects of a mindfulness intervention on mindfulness and flow in racing drivers. Two female racing drivers attended three mindfulness sessions throughout a period of 7 weeks. Descriptive data shows no notable changes in the total score on mindfulness questionnaires. Participant 1 had a notable decrease on the Dispositional Flow Scale- 2 score, while Participant 2 had a notable increase in flow. No

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further statistical analysis was justified due to a small sample size. Qualitative analysis shows that the participants perceived mindfulness training to be positive and useful for racing.

Further research is necessary to explore the effects of mindfulness training in motorsports.

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