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Unpacking the Debate: A Qualitative Investigation of First-Time Experiences with Interval Exercise

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Unpacking the Debate: A Qualitative Investigation of First-Time Experiences with Interval Exercise

Abstract

Objective: There has been compelling debate about whether interval exercise should be promoted in public health strategies as a means of eliciting the health and fitness adaptations associated with physical activity behavior, particularly among individuals who are inactive. Despite a rapidly growing body of quantitative research, there is a notable absence of qualitative research on the topic. This study used a series of interviews conducted overtime to develop a richer understanding of inactive adults' experiences and perceptions of moderate-intensity continuous training (MICT), high-intensity interval training (HIIT), and sprint interval training (SIT) overtime and factors that may influence their participation in these types of exercise. *Methods*: Thirty inactive young adults (18women, 12men) completed three lab-based trials of cycling exercise in a random order on separate days: MICT, HIIT, and SIT, and subsequently logged their free-living exercise over four weeks. Interviews were conducted at five time points and subjected to a reflexive thematic analysis. *Results*: Three overarching themes were constructed: (1) interval exercise sounds appealing, but is it for me? (2) exercise trade-offs – the value of interval vs. traditional exercise, and (3) real-world exercise adaptations to make it on your own. *Conclusions*: The findings emphasize that people respond differently to different forms of exercise and the factors that influence participation in interval or continuous exercise are far more complex than can be captured by quantitative methodologies alone. Results suggest there is indeed a place for interval exercise in exercise plans and programs for the general population and interval exercise can be used concurrently with continuous exercise.

Keywords: Interval training, public health, exercise behavior, qualitative research, physical inactivity.

Introduction

Interval exercise has been defined as exercise that involves repeated short, high-intensity efforts that are separated by periods of low-intensity rest or recovery and that typically last approximately 20-25 minutes or less (e.g., Batacan, Duncan, Dalbo, Tucker, & Fenning, 2017; Gaesser & Angadi, 2011). Specifically, high-intensity interval training (HIIT) consists of exercise efforts that generally elicit ≥80% of maximal heart rate (HRmax) and sprint interval training (SIT) refers to "all-out" efforts performed at a workload that elicits ≥100% of maximal oxygen uptake (VO_2max; Weston, Wisløff, & Coombes, 2014). Research over the past decade has shown that interval exercise training can elicit similar metabolic and cardiovascular health benefits typically associated with long-duration, moderate-intensity continuous training (MICT), but with a much shorter time commitment (e.g., Batacan et al., 2017; Gibala, Gillen, & Percival, 2014). Subsequently, this has led to a surge of interest in interval exercise among researchers, mass media, and the general public. Since 2014, interval exercise has been identified as a top three fitness trend based on the American College of Sports Medicine (ACSM)'s annual worldwide surveys (Thompson, 2019). This surge of interest has led to compelling debate and controversy about whether interval exercise should be promoted in public health strategies as a means of eliciting the health and fitness adaptations associated with physical activity behavior, particularly among individuals who are inactive. The debate has been largely driven by contrasting perspectives and theoretical viewpoints about the viability of interval exercise for the general public, how people may respond psychologically to interval exercise, and the subsequent influence this may have on exercise behavior and adherence.

The Debate

Critics of interval exercise argue that it is not a sustainable public health strategy because many people will not participate or adhere to it in the long-term (Biddle & Batterham, 2015; Hardcastle et al., 2014). This opinion is predominantly based on the notion that the intense nature of interval exercise will induce negative affective responses for most people, thus discouraging exercise participation (e.g., Biddle & Batterham, 2015; Hardcastle et al., 2014). The dual-mode model (DMM)

(Ekkekakis, 2003) has been used to support this position, with a particular focus on automatic affective responses to exercise (Type 1 processes). The DMM proposes that people's affective responses to exercise will become progressively more negative during high-intensity exercise performed above the ventilatory threshold. Importantly, there is evidence that affective responses during continuous exercise are predictive of future exercise behavior (e.g., Rhodes & Kates, 2015; Williams, Dunsiger, Jennings, & Marcus, 2012). Following this line of reasoning, it has been suggested that individuals will experience negative affect during interval exercise protocols, and this will subsequently discourage future interval exercise behavior (e.g., Biddle & Batterham, 2015; Hardcastle et al., 2014).

It has also been asserted that interval exercise is too complex and difficult for inactive people to complete and therefore may elicit perceptions of incompetence and low levels of enjoyment, self-esteem and self-efficacy; factors that could increase the potential for nonadherence (Hardcastle et al., 2014). Further, it has been suggested that interval exercise requires high levels of effort, motivation, and self-regulation, and it is unlikely that people will continue to participate outside of the laboratory environment as a result (Hardcastle et al., 2014). Finally, some have contended that many interval exercise protocols are not truly time-efficient (Hardcastle et al., 2014) and the problem is not whether people have time for exercise, but how they choose to spend their time (Biddle & Batterham, 2015).

Supporters of interval exercise have asserted that interval exercise interventions can be used to help target areas of public and population health priority such as the prevention and treatment of various cardiometabolic diseases (e.g., Biddle & Batterham, 2015). This view is based on the idea that the reduced total time commitment, the inclusion of rest periods, and the relative intensities of the high-intensity work bouts, may make interval exercise more adaptable, practical, appealing, and enjoyable than continuous exercise (e.g., Jung, Bourne, & Little, 2014; Stork, Banfield, Gibala, & Martin Ginis, 2017). It is believed that if interval exercise is time-efficient and offers more appeal than traditional exercise, people may be more likely to participate in it (e.g., Astorino & Thum, 2016b; Jung et al., 2014). This viewpoint is predominantly based on reflective social cognitions (Type 2

processes). For instance, consistent with the principles of Social Cognitive Theory (SCT; Bandura, 1997), it has been proposed that the intermittent nature of interval exercise breaks down the exercise into brief, manageable bouts, which may lead to several mastery experiences within a single interval exercise session and may consequently translate into enhanced exercise task self-efficacy (Jung et al., 2014).

Some interval exercise research has used concepts from the Theory of Planned Behavior (TPB; Ajzen, 1991) to help explain study findings and provide a better understanding of the role enjoyment may play in influencing psychological antecedents of exercise behavior (e.g., Stork & Martin Ginis, 2017). In the general context of exercise, enjoyment has been recognized as a predictor of positive exercise attitudes and behavior (Martin Ginis et al., 2006; Rhodes, Fiala, & Conner, 2009; Stork & Martin Ginis, 2017) and a moderator of the intention-behavior relationship (Rhodes & Quinlan, 2018). In the specific context of interval exercise and in line with the principles of the TPB, it has been suggested that enjoyment of interval exercise predicts attitudes towards interval exercise, with attitudes mediating future intentions to engage in interval exercise (Stork & Martin Ginis, 2017).

Much of the ongoing debate has been expressed in published commentaries and opinion articles that have lacked a strong evidence base to support various claims. Given this limitation, a scoping review of the interval exercise literature was conducted by Stork et al. (2017) to explore the viability of interval exercise from a psychological standpoint. Overall, the review showed that while in-task affect tends to be more negative during interval exercise in comparison to continuous exercise, post-exercise measures of enjoyment and preferences tend to be equal or more positive for interval exercise when compared to continuous exercise. Further, participants are able to foster positive social cognitions towards interval exercise after participating in interval exercise protocols. This review provided an important first step towards understanding the viability of interval exercise from a psychological perspective. However, the reviewers identified several important gaps and directions for future research that included examining people's participation in real-world interval exercise, understanding the relationship between in-task affect and future interval exercise behavior, and a need

for qualitative research to better understand how people experience interval exercise.

Two qualitative studies have since been published, which investigated people's experiences with HIIT (Burn & Niven, 2018; Kinnafick et al., 2018). These studies provided new knowledge of various motivational, social, and environmental factors that may influence adherence to HIIT-based exercise classes. However, both studies involved instructor-led, group-based exercise classes, conducted interviews at a single timepoint following several weeks of HIIT, and neither study compared HIIT to SIT or MICT. Further qualitative research is needed to better understand people's acute interval exercise experiences, how those experiences compare to continuous exercise, and how people's perceptions of interval and continuous exercise might change over time and with experience.

The Current Study

In order to address recommendations from the scoping review (Stork et al., 2017), we conducted an experimental study (Stork, Gibala, & Martin Ginis, 2018) which showed that while inactive participants experienced more negative in-task affect during HIIT and SIT than during MICT, enjoyment and preferences for MICT, HIIT, and SIT were similar. Additionally, the findings from participants' free-living exercise over the subsequent four weeks showed that participants tended to engage in more sessions of MICT than HIIT, and more sessions of HIIT than SIT. Finally, in-task affect during MICT was found to predict subsequent MICT behavior, but this was not the case for HIIT or SIT. This latter finding suggests there may be differences in the affect-behavior relationship for interval versus continuous exercise; however, our quantitative data could not explain *why* the relationships may differ for different types of exercise. The current study provides a qualitative analysis of interview data collected over the course of our experiment (Stork et al., 2018) in order to address key questions that remained unanswered from the quantitative data alone. A qualitative investigation of inactive people's experiences completing interval exercise in both lab-based and real-world settings provides a critical advancement to our understanding about the viability of interval exercise and its potential to improve physical activity among largely inactive populations.

Accordingly, the purpose of this study was to use interviews with inactive adults to develop a

richer understanding of their experiences and perceptions of MICT, HIIT, and SIT over time and factors that may influence their participation in these types of exercise. This study is the first to take a qualitative approach to studying people's initial lab-based experiences with interval exercise and to explore how these experiences may influence their subsequent exercise behaviors completed in naturalistic environments.

Methods

Study Design

A qualitative descriptive methodology was adopted for this study. Qualitative description draws upon a naturalistic approach to offer a rich description of experience through understanding a phenomenon and the perspectives of people involved (Bradshaw, Atkinson, & Doody, 2017). This methodological approach is appropriate when descriptions of phenomena are desired to produce practical answers regarding the who, what, and where of events (Sandelowski, 2000, 2010). As such, we adopted qualitative description to understand people's experience of interval and continuous exercise and the meanings attributed to these types of exercise over time. Researchers conducting qualitative descriptive studies tend to stay closer to their data in terms of analysing the surface of words and events (Bradshaw et al., 2017; Sandelowski, 2000). That said, qualitative description is not without interpretation (Sandelowski, 2010), a point we will return to in the analysis.

Furthermore, although qualitative descriptive studies are not committed to a particular theory, they are still influenced by theory as, "the very way researchers talk about their subject matter reflects their learnings, regardless of whether they present these inclinations as such or even recognise them" (Sandelowski, 2010, p. 79). Thus, researchers of qualitative descriptive studies should be mindful of their preconceptions and make theoretical leanings explicit. In this instance, the first and third authors had prior knowledge of several theories related to psychological responses to exercise and exercise behavior (e.g., DMM [Ekkekakis, 2003], social cognitive theories [Ajzen, 1991; Bandura, 1997] , and behavior change theory [Michie, van Stralen, & West, 2011]), while the second author had experience with qualitative research methods and methodologies (e.g., Williams et al., 2017; Williams, 2018).

We have attempted to demonstrate the application of our methodological approach and theoretical leanings by detailing methods of data collection and analysis and highlighting appropriate criteria to judge the quality of this work.

Participants

Thirty inactive men (n = 12) and women (n = 18) inexperienced with HIIT or SIT and with a mean age of 21.23 years (SD = 3.81) completed the study. The McMaster Research Ethics Board approved the study protocol and all participants provided written informed consent. Participants were considered to be "inactive" based on a self-report of ≤ 2 sessions/week of structured exercise (Rodgers & Gauvin, 1998) over the past 6 months (baseline testing confirmed participants' aerobic fitness was in the "very poor" to "fair" range (Heyward, 1998), with an average VO_2max of 31.3 ± 6.2 mL-kg^{-1}-min^{-1}). Participants were excluded from the study if they had previously participated in the same HIIT or SIT protocols as those to be administered in the study or had contraindications to exercise based on the Physical Activity Readiness Questionnaire (PAR-Q).

Overarching Study Protocol

A repeated-measures, crossover design was used for the overarching project wherein each participant completed three different exercise trials: MICT, HIIT, and SIT (see Stork et al., 2018 for full study protocol). The exercise order was randomized and counterbalanced. Following completion of the lab-based exercise trials, participants were asked to track their exercise behavior over the subsequent four weeks. In total, participants completed five visits to the laboratory over the course of approximately eight weeks and completed an interview at each visit. All interview questions were developed a priori following pilot testing of the interview questions and lasted approximately 20 to 45mins in duration across all interviews. The participant sample for the present study included all 30 participants who completed the original trial (Stork et al., 2018).

The interviews conducted at the first and final lab visits were semi-structured, with open-ended questions, to provide participants with some freedom to express their perceptions of and experiences with MICT, HIIT, and SIT (Sparkes & Smith, 2014). The interviews following the

exercise trials were more structured and briefer in order to capture participants' exercise experiences of the acute MICT, HIIT, and SIT sessions as these events happened. The five interviews were developed as a series of cohesive, interlinked interviews rather than separate one-off interviews. Thus, this longitudinal interview schedule was used to capture how participants' perceptions of MICT, HIIT, and SIT changed over time and with experience. Further details about the topics discussed at each lab visit are provided below.

Baseline testing (visit 1). The baseline interview questions explored participants' general beliefs and feelings about MICT, HIIT, and SIT prior to beginning the study. Participants were provided with a list of the specific exercise protocols to be administered for the study in order to understand the characteristic differences between MICT, HIIT, and SIT. As such, they were aware of the key differences in the nature of each form of exercise (i.e., MICT consisted of moderate-intensity continuous exercise, HIIT consisted of multiple high-intensity efforts, and SIT consisted of multiple "all-out" sprint efforts).

Exercise trials (visits 2-4). MICT consisted of 45 min of continuous cycling at 35% Wmax (50 min total), HIIT consisted of 10 x 1-min bouts of exercise at 70% Wmax, separated by 1-min rest periods (24 min total), and SIT consisted of 3 x 20-s "all-out" sprints, separated by 2-min rest periods (10 min total). The exercise trials were scheduled at least 72 hr apart. The brief, structured interviews were conducted 20 min following the cool-down of each exercise trial and were designed to capture participants' physical and psychological experiences of the acute exercise sessions. Participants were asked to elaborate on how they felt (both physically and psychologically) before, during and following the exercise protocol that they had just completed. They were also asked how they felt about completing the exact same exercise protocol during their own free time using any exercise modality.

Following their final exercise trial (visit 4), participants completed an additional set of semi-structured interview questions where they were asked to compare and contrast their experiences completing MICT, HIIT, and SIT in the lab. Additionally, they were asked to reflect upon their ranked

preferences of the three protocols they completed in the lab. Finally, participants were asked to identify which exercise type(s) they intended to do in the subsequent four weeks. They were encouraged to try variations of the three exercise protocols they completed in the laboratory using any modality (e.g., biking, running, stair climbing), but were reminded that they were not obligated to do so. Minimal instruction was provided to participants prior to the 4-week follow-up period in order to facilitate freedom in their free-living, unsupervised exercise experiences.

Follow-up visit (visit 5). Four weeks later, participants returned to the laboratory, submitted their log sheets and completed the final semi-structured interview in order to discuss and reflect upon their experiences exercising outside of the lab setting. For example, participants were asked about why they chose to engage in certain forms of exercise over others and to explain why their exercise preferences changed or remained the same over the 4-week follow-up period. Participants were also asked the same subset of interview questions as asked at visit 1 in regard to their general beliefs and feelings towards the different types of exercise in order to capture if any changes occurred in their responses. One man failed to return to the lab for his follow-up visit and therefore his visit 5 interview data was missing.

Data Analysis

The goal of qualitative description is to produce a rich account of the phenomenon of interest from those who have experienced it (Bradshaw et al., 2017). Analysis begins with a literal description of events using the participants' words as a starting point, before attempting to interpret the meaning of these events while keeping as close to the participants' meaning as possible (Sandelowski, 2000, 2010). In line with other qualitative descriptive studies (Bradshaw et al., 2017; Sandelowski, 2010), we used thematic analysis to interpret the data. Specifically, we were guided by a reflexive thematic analysis approach (Braun & Clarke, 2006, 2019). That is, we strove to be fully transparent and aware of the theoretical assumptions that informed our analysis and did not use pre-determined codes in a structured codebook or seek coding reliability. Further, we were not restricted by a prior theory or framework. Rather, we analyzed data inductively through an iterative process of repeat reading,

reviewing, and refining our codes and interpretation of themes.

Initially, the interviews were transcribed verbatim as soon as possible following the data collection period. The first author then became familiar with the data and immersed himself in the transcripts by reading and re-reading through them thoroughly and taking notes on initial patterns and meanings. Notes were taken on each participant's individual thoughts, feelings, and experiences discussed across the five interviews. These notes were continuously revisited and reconsidered throughout the analysis and writing process. Next, the first author generated codes from the data by identifying meaningful points of interest in the transcripts and important features of the data.

Following coding of the first 10 participants' data, the second author discussed the codes and initial notes with the first author as a *critical friend* to provide feedback on the data analysis and encourage exploration and reflection of alternative explanations and interpretations (Smith & McGannon, 2017; Williams, Ma, & Martin Ginis, 2017). The function of a critical friend is not to achieve consensus or coding reliability, but to promote reflexivity through critical dialogue between researchers (Braun & Clarke, 2019; Smith & McGannon, 2017). The remaining 20 participants were coded with a particular emphasis on similar and contrasting experiences to identify central patterns of meaning across the datasets.

Codes were then collapsed into potential sub-themes and themes by organizing such codes based on overarching patterns of descriptions of exercise. These themes were reviewed and combined to generate larger initial themes following continuous review of the entire data set. This was an iterative and interpretive process of defining and refining themes to ensure they reflected the participants' experiences and meanings of exercise across all five interview timepoints. For example, initially organizing data into sub-themes created some redundancy and repetition within and across themes. Therefore, upon continuous and thoughtful engagement with the data, sub-themes were collapsed into higher-order themes that were more meaningful and represented patterns of shared meaning (Braun & Clarke, 2019). The second and third authors continued to act as critical friends throughout the analysis and writing processes.

Criteria for Judging Research Quality

We used an open-ended set of appropriate criteria to guide the quality of our research in line with our methodological approach: the worthiness of the topic of research, rich rigor, meaningful coherence, sincerity, and significant contributions (Bradshaw et al., 2017; Morse, 2015; Smith & McGannon, 2017; Tracy, 2010). Thus, readers may use the suggested criteria to draw their own conclusions and judge the quality of this research.

The topic of the current study can be considered *worthy* because this is the first study to qualitatively analyze people's intricate experiences with MICT, HIIT, and SIT exercise, and is timely and relevant given the current controversy regarding interval exercise and the need for more research evidence in the area. This study demonstrated *rich rigor* through the conduct of data collection and analysis with care and thoroughness, engaging a critical friend with expertise in qualitative methods, using appropriate interviewing procedures conducted at multiple timepoints, and spending ample time familiarizing with the data and analyzing data from a large sample of 30 participants. Moreover, this study exemplified *meaningful coherence* by achieving the stated purpose, using methods that were consistent with the stated purpose and diligently interconnecting the study rationale, interpretations of the data, methods, and findings. By incorporating self-reflexivity about author values and theoretical assumptions, and being transparent about the study methodology, this study demonstrated *sincerity*. Finally, the current study provided a *significant contribution* by providing novel insight into key theoretical, methodological, and practical considerations that need to be made when investigating the physical and psychological responses to acute MICT, HIIT and SIT exercise and when individuals attempt to engage in these forms of exercise in the real world.

Results

The reflexive thematic analysis of the interview data resulted in the construction of three overarching themes: (1) interval exercise sounds appealing, but is it for me?, (2) exercise trade-offs – the value of interval vs. traditional exercise, and (3) real-world exercise adaptations to make it on your own. While the data have been organized for ease of presentation, there is some overlap between the

three themes, which will be addressed in the discussion. Anonymous participant identification codes are provided at the end of each quote (W = woman, M = man).

Theme 1: Interval exercise sounds appealing, but is it for me?

Participants' initial perceptions about various forms of exercise were framed by their previous experience (or inexperience) and knowledge gained from a variety of sources. As a result, many participants struggled to determine if interval exercise was suitable for them in comparison to traditional exercise. There was a wide range of contrasting thoughts and beliefs about MICT, HIIT and SIT relating to participants' exercise familiarity, the appeal of interval exercise, and a complexity of changes in perception over time. Firstly, there was a contrast in participants' familiarity with the various exercise protocols. Many participants felt they were most familiar with traditional, continuous forms of exercise like MICT. For example, when asked about MICT, one participant stated:

> I think [MICT] is the type of exercise that, well at least for me, that I am most familiar with. I think whether it is media or friends or family, you kind of think of an hour of fitness or exercise as the standard … I guess it's kind of ingrained in my head that more than 30 minutes is probably the standard amount of time you want to be keeping up some kind of moderate exercise. (W16)

In contrast, while many participants were generally aware of the *concept* of interval exercise, they were less familiar with *engaging* in HIIT or SIT than MICT. In particular, participants expressed a lack of understanding of exactly what HIIT or SIT were, how to do them, and questioned whether this type of exercise was for them. One participant discussed her general thoughts about HIIT: "I don't know what exactly that does to my body or what it's going to be … So I guess the unfamiliarity of it is striking me the most about [HIIT]. I guess I kind of reserve it for like people who know what they are doing in terms of exercise" (W16). When asked about SIT, another participant replied: "Sounds brutal. Sounds very hard. I've never tried it; I've never really heard of it either" (W1). Participants also expressed their uncertainty of the benefits of HIIT or SIT in comparison to MICT:

> I would say I don't know enough information to differentiate why there would be more

> benefits in doing high-intensity exercise over moderate-intensity exercise and so I think I would prefer doing moderate exercise over a greater period of time than a short period of high-intensity exercise. (W2)

In addition, unlike with MICT, participants seemed to be intimidated by the high-intensity nature of HIIT or SIT. When asked about her thoughts regarding SIT exercise, one participant stated: "[SIT] sounds very complicated and I don't think I've ever done anything like that before. Sounds a little difficult to be honest" (W15). Another participant was more blunt in his response about SIT: "I'd probably hate [SIT]. Just because it's exerting yourself all at once, which is not something I like to do" (M1). In a similar vein, many participants were unsure if interval exercise was appropriate for them as they perceived it to be more appropriate for athletes or people undergoing high-level training. As one participant stated: "A lot of athletes use [HIIT]. Body builders, stuff like that … I guess it's more known to be people who are at that level of training" (M2).

A further source of contrast was that, despite being less familiar with HIIT or SIT in comparison to MICT, many participants acknowledged the perceived appeal of interval exercise based on what they had seen or heard. One participant stated:

> It seems like it's the thing now that a lot of people are going towards, like fitness trainers and even just everyday people. You hear CrossFit and stuff like that, right. So it seems like it's become more and more popular and maybe that's because the science is catching up and realizing that it's a good benefit. (M3)

Another participant discussed what she had heard about interval exercise from her friends: "I've also heard of a lot of YouTube videos now have these minute-long exercises, 'Insanity' or whatever it's called … they do all these minute exercises and cool downs and I know a lot of friends think that that's the best way of getting fit and getting healthy and losing weight, so I hear a lot about that" (W4).

Some participants felt the time-efficiency of interval exercise was appealing and therefore was something they would be open to trying. For instance, when one participant was asked about HIIT she

said: “It’s a very short type of exercise so that’s very appealing because you could just do a quick 20-minute exercise” (W4). The same participant also expressed her interest in SIT: “I guess I think it sounds very appealing and very tempting to do because it takes less time and it’s still working out your body in the same way that low intensity exercise would be for a longer duration of time” (W4).

There were also contrasting patterns in people’s complex changes in perceptions over time. Over the course of the study, many participants changed their thoughts and beliefs towards MICT, HIIT and SIT at different time points and for different reasons. As illustrated above, many participants entered the study with a limited understanding of what HIIT or SIT were. However, most participants expressed a better understanding of the exercise after completing the study and trying HIIT and SIT for their first time. For example, when asked about his thoughts about HIIT at visit 1, one participant responded by saying: “Not the biggest fan of high intensity interval exercises” (M11). Yet at visit 5, that same participant shared his new thoughts about HIIT:

> I didn’t really know what it was going in, I sort of had an understanding that it was going to be on and off, you know doing something intensely, and then break and then you know rinse and repeat but … you know now that I've actually experienced [HIIT], it’s much more clear to me what it is now and something I would consider doing more on my own time. (M11)

Similarly, when another participant was asked about SIT at visit 1, she said: “That one I think would be the most difficult one” (W11). However, when discussing SIT at visit 5 she stated:

> I really like that one. I thought it was a good alternative, I didn’t know about the whole interval thing beforehand, so I really like that and it wasn’t too much for me. I feel like I was still working out and doing a good job even though I wasn’t really tired and didn’t feel as discouraged doing it. So I really like that one. (W11)

Another participant echoed a similar change in his opinions about SIT: “I didn’t really have an opinion going into this study, but after coming out of the study, [SIT] wasn’t that bad, it was a lot better than I thought it’d be. I thought it would be really painful and agonizing but it wasn’t that bad” (M5).

Many participants also had contrasting changes to their perceptions about exercise based on their experiences exercising on their own. Interestingly, while participants may have preferred one type of exercise in the lab, this did not always result in the completion of that type of exercise in their free time. For example, based on her experiences in the lab, one participant expressed a preference for completing SIT on her own time. However, she had a change of mind when discussing HIIT and SIT at the end of the study:

> I always thought [interval exercise] – it's like high intensity but it's over within a few minutes. So that's why I kind of thought I'd like it more, but after actually doing those things, because I never did them before, I prefer [MICT] just because [interval exercise] didn't make me feel that great, so I prefer feeling good while I'm doing the exercise and after. Like the [interval exercise] made me feel better shortly after I finished the exercise but not so much during, so I prefer just enjoying it while it's happening. (W6)

Following her HIIT trial completed in the lab, another participant stated: "I don't want to do it. I wouldn't do it again" (W15). However, she subsequently completed HIIT during her own free time and expressed a change in her belief:

> I actually didn't mind it … when I was doing [HIIT] in the lab, it was not fun – maybe it was because it was biking, and I'm not used to biking that often. I remember in the beginning I wasn't too sure what it was either, so now I know what it is and it is not that bad. So, I like it. (W15)

Theme 2: Exercise trade-offs – the value of interval vs. traditional exercise

Throughout the study, participants expressed a trade-off between a wide range of positive (e.g., energizing, motivating, invigorating) and negative (e.g., fatiguing, sore muscles, demotivating) physical and psychological experiences during MICT, HIIT, and SIT. These trade-offs ultimately contributed to the value they placed on the various forms of exercise. For example, there were trade-offs relating to the extent participants felt engaged during exercise. On one hand, some participants tended to express feelings of boredom and a lack of motivation to persist during MICT. One

participant described her experiences during the MICT trial:

> And then during it, I felt mostly bored. I'd say physically I wasn't exerting myself at the maximum compared to the other exercises. So it was a really long time to do the exercise and I was just kind of like 'oh when is this going to end', this is really not enjoyable (W2).

On the other hand, some participants expressed their appreciation for not having to devote all of their attention towards the exercise during their MICT trial: "It's less focusing on the actual exercise and I can let my mind wander … it's easier to complete in that sense" (M5).

Unlike MICT, many participants felt they were particularly focused and engaged during the HIIT trials: "I like [HIIT] the most because I felt most involved in it physically and mentally – there was no time to get distracted" (W17). This idea is consistent with a participant's suggestion that he felt he was most engaged, and got the most out of, his HIIT trial: "The high-intensity exercise I liked the best. I felt like I got the most out of it and it was the most energizing actually. I felt pretty good throughout it, I didn't feel really tired or really disengaged. I felt pretty engaged throughout it" (M6). Moreover, some participants perceived their physiological responses to HIIT (e.g., sweating) to be an indication that they were getting an increased health benefit from the exercise. For example, one participant stated about HIIT: "I feel that I'm having a good workout and I'm actually sweating and getting the benefits from it" (W1).

While many participants appraised their heightened level of engagement with HIIT positively, others associated it with fatigue. Participants tended to express feelings of exhaustion or soreness more frequently during HIIT and SIT trials than compared to MICT. For instance, when describing her experiences during SIT, one participant said: "Physically, it was exhausting … I felt like I was over-exerting myself" (W4). Another participant echoed these comments: "During [SIT] I felt exhausted, my muscles were hurting, even on my butt" (W18). Despite feelings of exhaustion during SIT, some participants believed the rest periods were very helpful:

> I found it was exhausting – the sprint intervals of course, but … I liked that we had the breaks in between and I found it was more feasible to do because there were longer breaks and it was

> a shorter period of time that you were exercising. (W4)

Similar comments related to the trade-off between exertion and rest were also made about HIIT: “I like how I could stop for a whole minute and just pace myself and then do another set again” (W18). Interestingly, several participants shared their mindset when battling fatigue during HIIT and SIT. One participant expressed her back-and-forth experience during HIIT: “During, I was physically tired and then psychologically I was going between telling myself to give up and to keep going.” (W5).

Notably, in addition to experiencing engagement in and fatigue from HIIT or SIT, participants also expressed feelings of accomplishment during or following these protocols. For example, one participant expressed feeling good about completing his SIT trial:

> I felt like after the first [sprint] I could actually, you know, go through the entire thing and psychologically I felt good too because I was physically fine … I was sort of reassured that I could complete this exercise. After the third [sprint] I felt really good. Although I was tired, I felt really good psychologically because I got through it. (M10)

Similarly, a different participant also expressed a sense of achievement after completing SIT: “Being able to give everything you have or to push yourself to do that for even short amounts of time, that’s still rewarding in itself … So I think that was probably why I found [SIT] the most interesting and enjoyable” (W14).

When participants were given the opportunity to reflect upon their experiences with engaging in MICT, HIIT and SIT in the lab or on their own, they had mixed preferences for the three protocols for a variety of reasons. Many of these reasons were related to trade-offs in physical and psychological responses to the different exercise protocols. Although quantitative reports of preferences for MICT, HIIT, and SIT were similar based on experiences in the lab, many participants expressed an overall tendency to engage in MICT rather than HIIT or SIT in the real-world (see Stork et al., 2018). This tendency seemed to be, in large part, due to participants feeling that MICT was less complicated than HIIT or SIT to complete on their own, and as pointed out in the first theme, they

were most familiar with and accustomed to MICT to begin with:

> It's familiar and it's easy – you throw on your shoes go for a run. That's part of it – so familiarity, the easiness of it. But also I find that you don't have to think about it – like if you have half an hour or 40 minutes, you don't have to think about getting your watch and structuring it exactly. Whereas with the [HIIT] or the [SIT], you got to kind of structure it, you got to plan out your workout and so there's that component. (M3)

Notwithstanding, many participants engaged in HIIT on their own and indicated a preference for HIIT over MICT or SIT. A contributing factor was that participants perceived HIIT to sit in the middle of the trade-off between exercise intensity and duration:

> I liked [HIIT] because I liked how I didn't like have to exert myself either completely for a short amount or barely exert myself throughout a long period of time. I liked having it kind of in between where I could exert myself for a decent amount of time, then have a break, and then be able to do it continuously for a certain period of time. I found it – I just found it probably the most beneficial and the most refreshing in a sense. (M6)

Others liked HIIT because it was less boring and provided them with a sense of accomplishment: "It's just enough to make me sweat so I feel like I accomplished something. And at the same time, I wasn't really bored or my mind wasn't really wandering anywhere else like [MICT]. And [MICT] kind of gets boring because it's the same consistency over and over" (W12). One participant acknowledged a trade-off between pleasure and boredom when discussing the intermittent nature of HIIT: "You can handle doing like one minute of a lot of exercise and then being like, 'okay I am going to have a break' and then do another minute. It's not very pleasurable, but it's not as boring I would say" (W2).

Participants who preferred SIT the most seemed to be very intrigued with its time-efficiency, despite the "all-out" nature of the sprint bouts. One participant spoke about this when discussing SIT:

> Time-wise it just looks less daunting than committing yourself to, I guess like, an hour if you think about getting ready for exercise, stepping out of the house – that kind of stuff. So I guess

> if you compare maximum 15 minutes to an hour plus shower time and all that, then it seems a lot more feasible in terms of schedule wise … can you fit in ten minutes per day? It seems like an obvious yes for the most part versus an hour, so I think that in my free time if I had to commit to it regularly, then time-wise [SIT] definitely looks the most appealing. (W16)

Based on these exercise trade-offs, there were a number of reasons why participants may have valued one form of exercise over another. Importantly, however, many participants reported engaging in combinations of more than one form of MICT, HIIT, or SIT on their own. One example comes from a participant who predominantly engaged in MICT and HIIT on her own time. She explained that when she felt low on time because she was busy with school or studying, she would opt for completing HIIT over MICT:

> School was a big one because if I had something to study for I'd be like, 'okay, I can't do [MICT] obviously' so I'd have to go with [HIIT]. So that was another reason why I did [HIIT] more, so I was able to go to the gym and go to school as well since it only took 20 minutes or around that time. (W8)

Theme 3: Real-world exercise adaptations to make it on your own

Building on their experiences completing exercise in a controlled, lab-based setting, participants needed to adapt when completing exercise on their own, outside of the lab. These adaptations were based on the multitude of factors to consider when attempting to exercise outside of a tightly controlled lab environment. For example, participants frequently suggested that having access to exercise equipment, a gym, or a quiet place to complete HIIT or SIT were particularly important, whereas MICT was easier to adapt and complete outside. One participant explained:

> The way that my life is structured, I enjoy [MICT] – just running because it's easiest to do. I don't have to go to a gym or find like a track or a long piece or stretch of road that I can do hard running on. (M3)

The same participant elaborated by saying: "[MICT] is versatile, you can do it outside, inside. It's easy to do, it's quick – if you have an hour, you know you can go do it. You can enjoy the weather

outside, so I enjoy doing it" (M3). On the contrary, another participant expressed her lack of motivation to participate in MICT on her own: "To be honest, it's hard to find an incentive to do it. I would like to do more of it because I do have the time for that in my schedule … but I can't say it's easy to find the motivation" (W2). However, several participants mentioned that when completing MICT outside of the lab they would have the ability to watch TV or listen to music, which they were not permitted to do in the lab. For example, when speaking about MICT, one participant mentioned: "I think in my own time I could probably listen to music or something and that would make it a little bit more bearable" (W10). Another participant explained that she would be more likely to do MICT on her own for the same reason: "If I had music or was running outside, I think it'd be better and I'd actually do it more" (W3).

Some participants expressed challenges adapting and completing HIIT or SIT on their own in less comfortable settings and without full knowledge about how to do them on their own. One participant felt SIT was the hardest protocol to complete on his own:

> It's kind of awkward if you're sprinting on the treadmill at the gym; you know if you step on the side or something you're going to go flying. And you can't really do it on the pavement when you're running, you've got to find a track or a really good place to run … you really have to want to do it because you're going to be 'that guy' at the gym who's just going as hard as he can. So you really have to want to do it and you have to know what you're doing. (M3)

Another concern when attempting to do HIIT or SIT on one's own was that it required more effort to keep track of and to time the work and rest intervals. One participant expressed this:

> I think it is easier when someone's giving you specific instructions. I am good at following instructions, so I think in a controlled setting or maybe if I was with a partner, I could do that. I think on my own I can't keep track of it, so I have a lot more difficulty. And in this case, I was with my dogs so it would have been hard for them to stop and start all of the time. (W2)

Nonetheless, several participants implemented creative strategies in order to adapt to the challenges associated with completing HIIT or SIT on their own. For example, many took it upon

themselves to try HIIT or SIT at home using different modalities than what was used in the lab. One participant discussed completing HIIT in the form of stair climbing at home: “And [HIIT], I guess I decided it was easy to do at home – I could do stair climbing for a minute at a time and that’s what I wanted to try doing to see how I'd like that” (W4). Another participant described his interest in completing HIIT in the form of body weight intervals:

> I’m going to try to do more body weight [HIIT] because I found that can be good in the mornings. Get up and try to throw in some intervals of push-ups and sit-ups, and I actually got a door for chin-ups and pull-ups which is really good, so – yeah, I got to try to do more of that and, yeah I don’t know, I like it. (M3)

Since the interval exercise protocols administered in the lab-based portion of the study consisted of a specific number and duration of work and rest periods (i.e., HIIT = 10 x 1-min at 70% Wmax, 1min rest; SIT = 3 x 20-s “all-out”, 2min rest), several participants acknowledged that it may be difficult to complete the exact same protocols on their own. As such, many participants modified, or suggested that they would modify, these protocols when completing them outside the lab. When discussing completing HIIT on her own, one participant stated:

> I think I could do it but I'd probably modify it so I might not do ten [bouts] all at once like I might start off with four or five [bouts] and maybe have two minutes of rest in between or a minute and a half. I think it would take me a while to get up to actually doing that [ten bouts] properly, but eventually I would want to reach that goal. (W11)

Discussion

In light of growing interest in interval exercise as a viable alternative to traditional endurance exercise (Stork et al., 2017), there has been debate about whether interval exercise should be promoted in public health strategies as a way of inducing the health and fitness benefits of physical activity participation (e.g., Biddle & Batterham, 2015). There has been a recent influx of quantitative research aimed at addressing this debate, but a relative dearth of qualitative research (Stork et al., 2017). The results of the present qualitative study yielded three themes which provide a unique look

into inactive people's experiences of MICT, HIIT, and SIT and how such experiences may influence their participation in these forms of exercise again in the future. Throughout the discussion, these new qualitative findings will be used to expand upon previous quantitative results and provide theoretical and practical implications.

The theme 'interval exercise sounds appealing, but is it for me?' illustrated that there is a multitude of influences that can shape people's contrasting perceptions of and intentions to participate in MICT, HIIT, and SIT. For example, while traditional MICT may be more familiar and less intimidating to participate in, interval exercise has appealing attributes (e.g., time-efficient, popular) that make it an enticing exercise option. Further, people's perceptions of MICT, HIIT, and SIT appear to be shaped by personal experiences and social influences from media, friends, or family. For instance, social media sources such as Facebook or Instagram have been shown to have an important influence on young adults' perceptions of exercise (Vaterlaus, Patten, Roche, & Young, 2015).

Findings from the theme 'exercise trade-offs – the value of interval vs. traditional exercise' showed that many participants reported experiencing greater physiological exertion (e.g., sweating, exhaustion, sore muscles) and less pleasure during the work bouts of HIIT or SIT when compared to MICT. These findings are consistent with the existing quantitative data (e.g., reports of affect, arousal, ratings of perceived exertion [RPE]; Stork et al., 2018) and the theoretical underpinnings of hedonic theory (e.g., DMM; Ekkekakis, 2003). However, many participants stated that they found HIIT or SIT preferable to MICT due to a trade-off between engagement and (dis)pleasure. Despite experiencing less pleasure in-task, they found HIIT or SIT to be less boring, and more engaging and motivating than MICT. For example, participants explained that being able to withstand heightened physiological responses during HIIT or SIT work bouts provided them with greater perceived benefits from the exercise than when completing MICT. Many participants felt that the rest periods during HIIT and SIT helped them overcome in-task experiences of exhaustion or fatigue by making the exercise more bearable and less boring. Additionally, participants expressed a sense of reassurance and accomplishment following the individual high-intensity work bouts of HIIT and SIT and after

completing the full HIIT and SIT sessions. This finding provides new empirical evidence to support the notion that individuals can experience multiple mastery experiences within a single interval exercise session (which has previously been purported in quantitative research; Jung et al., 2014). Moreover, these findings are also consistent with previous qualitative studies (Burn & Niven, 2018; Kinnafick et al., 2018) which reported that individuals experienced feelings of pride, competence, and accomplishment from pushing through and completing group-based interval exercise classes. It is possible that repeated successful interval exercise experiences may subsequently enhance exercise task self-efficacy and therefore improve the likelihood of continued participation.

Previous qualitative studies have investigated people's experiences completing several weeks of supervised, group-based HIIT classes (Burn & Niven, 2018; Kinnafick et al., 2018). The current study expanded beyond the previous literature by examining how people experienced unsupervised, free-living HIIT and by comparing experiences with HIIT to SIT and MICT. In particular, the theme 'real-world exercise adaptations to make it on your own' explored participants' ability to modify and adapt their exercise behaviors when exercising outside of a controlled environment. While participants generally found MICT to be a more versatile and readily available form of exercise to participate in when unsupervised, they also developed creative strategies to participate in HIIT or SIT. Several participants adopted interval exercise in the form of bodyweight exercise or stair climbing and some even modified the number and duration of their work and rest periods to cater to their own fitness levels and needs. However, some participants felt they lacked the knowledge of how to complete HIIT or SIT on their own and faced challenges when attempting to try these forms of exercise in less comfortable settings.

Theoretical Implications

Affect-behavior relationship. Based on the quantitative findings reported previously (see Stork et al., 2018), in-task affect during MICT predicted MICT behavior over the subsequent four weeks, but this was not the case for HIIT or SIT. Results from the present qualitative study suggest that individual differences in participants' reflections and cognitive appraisals of their exercise

experiences may explain why their in-task affect for HIIT and SIT did not predict their subsequent interval exercise behavior. Although all participants may have experienced physical demands and reduced pleasure during the HIIT and SIT trials, not all participants reflected upon these experiences the same way. As demonstrated in the theme 'exercise trade-offs – the value of interval vs. traditional exercise,' some participants expressed an appreciation for the rest periods and/or appraised their exercise sessions as an achievement, and these outcomes may have been incentives to try HIIT or SIT again. Others expressed an aversion to the high-intensity work bouts and appraised the exercise as overly strenuous, and these may have been deterrents to future participation. Future research should examine if participants' cognitive appraisals of their in-task exercise experiences moderate the affect-behavior relationship for interval exercise.

The theme 'interval exercise sounds appealing, but is it for me?' showed that many participants had contrasting and complex changes in their thoughts and beliefs towards MICT, HIIT, and SIT at various time points over the course of the 8-week study. Cognitions that underpin exercise intentions and behavior may have continued to evolve after participants left the lab setting. As such, prediction of participants' real-world exercise behavior would likely be improved by taking their evolving thoughts and beliefs into account instead of relying on acute lab-based affective responses alone. Likewise, participants reported several barriers to participation for HIIT and SIT (e.g., unfamiliarity, lack of knowledge, difficulty tracking workouts) that were not reported for MICT. Individuals who had favorable perceptions of HIIT and SIT may have been impeded by such additional barriers. Overall, it is not surprising that there was no consistent and direct affect-behavior relationship for HIIT and SIT at a group level given a) participants' contrasting reflections and opinions about interval exercise, b) potential continuous changes in participants' exercise cognitions over time, and c) additional barriers that may have hindered participants' ability to enact on their interval exercise intentions.

Dual process theory. The findings from this study serve as a reminder that we should not undervalue the importance of individuals' reflections and cognitive appraisals of their exercise

experiences. Dual-process theories, such as the DMM (Ekkekakis, 2003), are named as such because they acknowledge that behavior is influenced by both *Type 1 Processes,* which are automatic, heuristic, and reflexive, and *Type 2 Processes,* which are slow, deliberate, and reflective (Evans & Stanovich, 2013). In the interval exercise debate, there has been such a strong emphasis on the role of core affect, a Type 1 process, that the role of Type 2 processes, by comparison, have been understudied (Stork et al., 2017). Drawing from the current findings, we must not neglect the important interplay (and potential trade-off) between the dual-processes that occur when people make decisions about whether to engage in interval or continuous exercise behavior (or no exercise at all). Thus, the findings highlight the need to think beyond a direct relationship between in-task affect and behavior, perhaps by considering the role of emotions (e.g., pride) and social cognitions (e.g., self-efficacy) that result from exercisers' appraisals of their in-task experiences. This notion aligns with newer dual-process theory (e.g., Affective-Reflective Theory of physical inactivity and exercise; Brand & Ekkekakis, 2018) and supports the need for more research to examine the interaction between affect and cognition when people make decisions about participating in interval and continuous exercise.

Behavior change theory. Based on existing evidence (e.g., Kinnafick et al., 2018; Stork et al., 2017) and the current findings, Michie's COM-B system of behavior change (Michie et al., 2011) may be an important framework to consider as a basis for developing interval exercise interventions or guiding future research to examine the psychological and/or behavioral responses to interval exercise. According to COM-B (Michie et al., 2011), capability, opportunity, and motivation are fundamental components that interact to engender behavior. Unlike many of the other theories or models discussed earlier, this framework can be applied not only to the individual level, but also to the group and environmental levels. These levels have been largely overlooked in the interval exercise research, but can influence exercise behavior change (e.g., Burn & Niven, 2018; Kinnafick et al., 2018). For example, according to the COM-B, "Opportunity is defined as *factors that lie outside the individual* that make the behavior possible or prompt it" (Michie et al., 2011, p. 4). The findings from the theme

'real-world exercise adaptations to make it on your own' illustrated that individuals may require assistance with adapting exercise in the real-world (e.g., exercise resources and guidance from others) in order to engage in HIIT or SIT exercise on their own. Further, an individual's capability to engage in interval exercise can be influenced by both psychological and physical capacities. For instance, participants may require specific knowledge and skills before they can effectively try HIIT or SIT. Finally, consistent with other dual process models (e.g., DMM; Ekkekakis, 2003), the COM-B recognizes that motivation encompasses both automatic (Type 1) and reflective (Type 2) processes. Use of the COM-B framework may help to broaden our understanding of interval exercise behavior at the group and environmental levels, while still accounting for important motivational factors.

Practical Implications

The findings from this study highlight a wide range of factors (e.g., barriers, facilitators, perceptions, feasibility) that may impact inactive people's ability to participate in interval exercise in real-world settings. The findings can be used to provide practical recommendations for inactive individuals interested in trying interval exercise. For instance, people who may have difficulty tracking their workouts or who lack the knowledge of how to complete interval exercise independently could be advised to use a device (e.g., smart phone, stopwatch) to time their work and rest periods and to try interval exercise with an experienced friend who can help monitor their workout and show them how to do it. Additionally, fitness professionals could educate and advise clients on how to complete interval exercise at prescribed intensities when they are on their own and not under supervision (see [Taylor et al., 2019] for guidelines on prescribing and monitoring free-living HIIT-based exercise using RPE and heart rate as intensity parameters, and [Kilpatrick, Newsome, Foster, Robertson, & Green, 2020] for scientific rationale for using RPE in exercise prescription). Future research would benefit from determining the scalability of prescribed interval exercise intensities in non-lab settings and what tools and resources (e.g., Taylor 's (2019) guidelines for HIIT-based exercise prescription) can be provided to help individuals attempting to engage in

interval exercise on their own. For example, a recent 6-week, unsupervised SIT intervention (Metcalfe et al., 2020) was delivered using a cycle ergometer placed within a workplace setting. The cycle ergometer was equipped with a computer monitor that provided guidance on how to complete the prescribed SIT sessions and biofeedback in the form of real-time heart rate and power output data. Participants reported that the SIT intervention was acceptable and enjoyable, and found that receiving biofeedback was an important exercise motivator.

Participants in this study discussed adapting and modifying the HIIT and SIT protocols they completed on their own. This finding highlights the adaptability of interval exercise for people who are inactive and want to try interval exercise for the first time. It would be advisable for individuals to start at a manageable intensity or volume of interval exercise and then progressively increase this with time and practice. For example, people who are less active may begin by completing a 4-5 x 1-min HIIT protocol with 2 min of rest and eventually progress to a 10 x 1-min HIIT protocol with 1 min of rest. This suggestion aligns with quantitative observations of in-task affect dropping into the negative valence by bout 6 of the 10 x 1 HIIT protocol (see Figure 3, (Stork et al., 2018)) and with the current qualitative data. This approach is also consistent with the progressive HIIT protocol used by Locke et al. (2018) that was shown to increase HIIT task self-efficacy. By taking a progressive exercise approach, individuals may minimize the potential for experiencing displeasure and maximize the likelihood of mastery exercise experiences, which may subsequently promote continued behavior.

During the 4-week follow-up period of this study, participants exercised on their own using a variety of modalities including body weight exercise, stair climbing, outdoor running, biking, and swimming (Stork et al., 2018). Such findings further our knowledge on the types of exercise inactive people may prefer to participate in outside of the lab and some of the reasons why. For example, stair climbing interval exercise may be particularly effective given that stair climbing may be more accessible, less costly to do, and more practical (see also Allison et al., 2017). Although interval exercise in the form of stair climbing or body weight exercises presents a promising avenue for

promoting interval exercise in real-world settings, the psychological and behavioral responses to such protocols still need to be evaluated further.

Some participants suggested that watching TV or listening to music makes MICT less boring and more enjoyable. This is consistent with evidence of the motivational and psychological benefits of music and/or video during continuous exercise (e.g., Hutchinson et al., 2015; Karageorghis & Priest, 2012) and supports the use of music or TV. Likewise, there is emerging research evidence suggesting that music can enhance the pleasure and enjoyment of HIIT or SIT exercise and this may subsequently encourage future participation (Jones, Tiller, & Karageorghis, 2017; Stork, Karageorghis, & Martin Ginis, 2019; Stork, Kwan, Gibala, & Martin Ginis, 2015; Stork & Martin Ginis, 2017). Further, in the aforementioned workplace SIT intervention (Metcalfe et al., 2020), participants reported using strategies such as music, self-talk, and the use of social support from an exercise partner to help maintain motivation to adhere to the exercise program. Such strategies may be encouraged to promote adherence for future interval exercise interventions.

Strengths, Limitations, & Future Directions

The longitudinal interview approach used for the current study enhanced the temporal sensitivity of the data and allowed for greater insight into how participants' contrasting thoughts, feelings, and beliefs towards exercise changed over time. The use of a single "snapshot" interview would not have captured these changes or recognized factors that influenced such changes (see also Williams, 2018). Furthermore, this study exemplified analytical generalizability by providing a novel conceptual and theoretical understanding of how inactive people experienced MICT, HIIT, and SIT in the lab and in the real world, and how their perceptions of these forms of exercise changed over time and with continued experience. Analytical generalizability is said to happen when researchers develop a new understanding of a topic by generalizing a particular set of results to established theories or concepts using different methodology (Smith, 2018).

Given that quantitative measures were also taken over the course of this study, some elements of the quantitative procedures may have influenced the qualitative interviews. For example, all

interviews conducted at lab visits 2-4 were conducted approximately 20 min following the exercise sessions in order to avoid contamination of the carefully controlled quantitative methods. As a result, thoughts that were fresh in participants' minds during and immediately following the exercise trials may not have been fully captured during the interviews conducted 20 min later. However, it should be noted that the timing of interviews for each participant was standardized for consistency of the experiment. Future studies could employ ecological momentary assessments where participants are prompted to discuss their experiences during the exercise sessions (e.g., during rest periods of HIIT or SIT). Moreover, the controlled exercise procedures that participants experienced in the lab (e.g., being supervised by an experimenter) are not representative of how most people would experience HIIT and SIT for their first time in the real world. Thus, participants' reflections about their first HIIT and SIT experiences were likely different from what they would have been in real-world settings (e.g., at home, outside, at the gym) and this may influence the naturalistic generalizability of the findings (Smith & McGannon, 2017). Future research could also be enhanced by drawing upon additional qualitative methods, such as diaries, to allow participants to report on experiences as they are lived in the real world (Smith, Caddick, & Williams, 2015).

The length of the interviews in the current study were limited by resource constraints and pragmatic factors related to the experimental aspects of the study protocol. For instance, all experimental visits were scheduled at least 72 hours apart and at approximately the same time of day (to control for diurnal variation). Additionally, participants were deemed to be physically inactive and may have been reluctant to return to the lab to exercise multiple times. Thus, the scheduling availability of participants and their willingness to be interviewed after exercise and to return to the lab on five occasions had to be carefully considered when pilot testing the interviews. If interviews were longer and more burdensome, it may have negatively impacted participant retention over the course of the study. Further, although conducting interviews with a sample of 30 participants over multiple time points can be viewed as a strength of the current study in terms of the breadth of data, future studies employing similar experimental designs may benefit from interviewing a smaller sub-

sample of participants and conducting longer interviews in order to achieve greater depth in the data (assuming participant and researcher burden and resource availability are not limiting factors). For example, this study could have benefited from conducting a life history interview at visit 1 and lengthier interviews at all time points throughout the study in order to allow for a more in-depth exploration of participants' past and current exercise experiences in the context of broader socio-cultural or historical issues (Poucher, Tamminen, Caron, & Sweet, 2019; Sparkes & Smith, 2014).

The ongoing debate regarding interval exercise has predominantly centered around exercise psychology theory such as hedonic, dual-process, and social cognitive theories, which the study authors are well-versed in. Consequently, the construction of themes, interpretations of the findings, and conclusions drawn were influenced by such theoretical perspectives and research backgrounds. Thus, researchers are encouraged to examine related research questions from alternative theoretical and research perspectives. For example, future research would benefit from exploring the socio-cultural and environmental influences that may impact decisions to engage in interval or continuous exercise behavior (Jaeschke et al., 2017; Wendel-Vos, Droomers, Kremers, Brug, & van Lenthe, 2007). Factors such as socioeconomic status and gender can influence people's physical (in)activity status (e.g., Abbasi, 2014; Estabrooks, Lee, & Gyurcsik, 2003) and can be used to understand past and present exercise experiences and preferences. Additionally, it is possible that the growing interest and appeal of interval exercise among the general public (Thompson, 2019) is rooted in understudied cultural and social contexts. Indeed, the analysis and results focused on participants' experiences and perceptions without explicit reference to broader socio-cultural contexts (Poucher et al., 2019). Therefore, future research could explore the use of narratives in constructing meanings of interval exercise or examine socio-cultural discourses and power structures that frame people's experiences of interval exercise (see McGannon & Smith, 2015).

While the study participants were physically inactive, they were also young and healthy. Thus, the study results may not generalize to physically inactive individuals who are older or people with chronic conditions (e.g., obese/overweight, cardiometabolic disease, physically disabled). Although

several studies have examined the psychological responses to interval exercise protocols across a wide range of populations (e.g., post-cardiac rehabilitation, coronary artery disease, obese/overweight, spinal cord injury; Stork et al., 2017), future research is required to determine if the findings from this study can also be replicated in or generalized to such populations.

The Debate: Final Thoughts

Interestingly, the debate about interval exercise has also been framed as the "HIIT versus MICT" debate, revolving around a question of whether HIIT (or SIT) or MICT is the superior form of exercise with regard to enhancing health and promoting exercise adherence (e.g., Decker & Ekkekakis, 2017; Juneau, Hayami, Gayda, Lacroix, & Nigam, 2014). Considering the current findings and, in particular, that many inactive participants engaged in HIIT and/or SIT in addition to MICT when exercising on their own, framing the debate in terms of "HIIT *versus* MICT" may be unwarranted. Given that different forms of interval exercise can be adapted and integrated into people's lifestyles in addition to continuous exercise, it would be more meaningful for future research questions to be framed in terms of "HIIT *and/or* MICT." This approach would place less emphasis on whether interval exercise is superior to continuous exercise, and place more focus on interval exercise as an exercise *option* – one that can be used concurrently with other forms of exercise. Further, it appears that an individual's participation in interval or continuous exercise is not determined solely by the pleasure or displeasure that person experiences during the exercise. Rather, exercise choices and behaviors are influenced by a contrasting, complex, and evolving set of experiences, thoughts, and beliefs.

Collectively, the findings of this study bring us one step closer to resolving the debate about interval exercise. It appears that there is indeed a place for interval exercise in exercise plans and programs for the general population. Although interval exercise may not be preferred by all people, it can serve as a meaningful exercise option for many individuals.

Conclusion

Scarce qualitative research has empirically and theoretically addressed the growing debate

about whether interval exercise should be promoted in public health strategies as a means of eliciting the health benefits associated with physical activity behavior. This study was the first to qualitatively assess people's experiences with MICT, HIIT, and SIT and provided new insights into inactive people's perceptions of, and factors that may influence their ability to engage in, these forms of exercise in the real world. Three overarching themes were identified: (1) interval exercise sounds appealing, but is it for me?, (2) exercise trade-offs – the value of interval vs. traditional exercise, and (3) real-world exercise adaptations to make it on your own. The findings emphasize that people respond differently to different forms of exercise and the factors that influence participation in interval or continuous exercise are far more complex than can be captured by quantitative methodologies alone. The qualitative approach used in this study provides meaningful new knowledge about people's experiences with MICT, HIIT, and SIT and highlights the important interplay between affect and cognition with regard to participation in interval and continuous exercise. In conclusion, the contributions from this study provide a critical advancement to our understanding of the viability of interval exercise and its potential as an exercise option among largely inactive populations.

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