The role of anticipated affect and intention in physical activity behavior

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Summary

Regular physical activity behavior has been shown to prevent several diseases, including obesity, cancer and depression. The World Health Organization recommends at least 150 minutes of moderate aerobic physical activity or at least 75 minutes of vigorous aerobic physical activity per week for adults to reap the benefits of physical activity. However, approximately 42% of adults in Western countries do not meet these guidelines. One of the many components that influence physical activity behavior is the affective experience. In exercise psychology, a compelling body of research has focused on the relationship between affective experiences and physical activity, finding that positive affective experiences during physical activity seem to increase future physical activity participation. An affective construct that has been overlooked is anticipated affect which may play an important role in decision making. Our brain is constantly building representations of the future based on past experiences that could influence our decision to engage in a particular behavior.

For example, before deciding whether to attend an exercise class, an individual may anticipate certain emotional consequences associated with attending the class. An individual may anticipate to experience enjoyment during the exercise class, which is likely to be associated with the decision to participate in the class. Conversely, an individual may anticipate to experience, for instance, anxiety during the exercise class, which may be associated with a decision to avoid the class in the future. Several theories suggest that the anticipation of affect may play an underappreciated role in decision-making processes. In economics, for instance, Nobel laureate Daniel Kahneman found that financial outcomes have an emotional value as people seem to rely more on how certain outcomes would make them feel rather than on monetary wins or losses. This supports the idea that positive and negative anticipated affective consequences influence decision-making regarding physical activity. In light of the theories presented in this dissertation, anticipated affect can be defined as an affective state that an individual expects to experience when participating in a future event. In contrast to anticipatory affect, which describes current affective states when thinking about a future event, anticipated affect is only a simulated affective response that has not yet occurred.

Another important predictor of physical activity is having the intention or the willingness to engage in physical activity behavior. Although intention is considered the

most proximal predictor of intention and previous studies showed high correlations between intention and physical activity behavior, effect sizes of intention predicting behavior in experimental studies are small. In addition, a meta-analysis showed that approximately 46% of people who intended to exercise regularly did not follow through with their intentions. Given this gap between intention and behavior, the role of intention as the most relevant predictor of physical activity is challenged. Recent studies examining potential moderators of the intention-behavior discordance and affective constructs including anticipated affect were promising approaches to bridge this gap.

As suggested by theoretical approaches and previous research, anticipated affect and intention may be relevant predictors of physical activity behavior. However, the evidence on the relationship between anticipated affect is limited. Although there are many studies on the relationship between intention and physical activity, other psychological constructs are often not included as moderators or mediators. The intention-behavior gap can only be bridged by identifying these factors. In addition, further research on the association between anticipated affect and intention is needed to clarify the relevance of this relationship for predicting physical activity engagement. To this end, four studies were conducted to (1) identify relevant anticipatory and anticipated emotion categories related to physical activity and develop a theoretical model of how anticipated affect may be related to physical activity (**qualitative study**), (2) summarize and analyze the current state of research on anticipated affect in physical activity and provide recommendations for future research (**scoping review**), (3) update and analyze the proportions of the intention-behavior profiles and the intention-behavior gap (**meta-analysis**), and (4) examine the role of anticipated enjoyment, intention, and physical activity engagement (**prospective study**).

A **qualitative study** approach was chosen to explore different anticipatory and anticipated emotion categories that seemed relevant to the participants for future physical activity engagement. Sixteen adults were interviewed consisting of eight active and eight inactive participants. The semi-structured interviews were recorded, transcribed and analyzed using Grounded Theory principles. From the interviews, 13 categories of anticipatory and anticipated emotions were determined, such as enjoyment, anxiety and pride. Anticipatory emotions seemed to reflect the current affective valence regarding exercising meaning that active participants reported more positive anticipatory emotions and inactive participants more negative anticipatory emotions. In contrast, active and inactive participants reported both positive and negative anticipated emotions regarding

the next exercise session. In addition, a theoretical model of anticipated emotion categories derived from the interviews based on identified appraisal processes. As part of the discussion, we developed a second theoretical model that explains how anticipated affect may develop based on appraisal processes and be related to exercise behavior. The model suggests that specific expectations about future exercise sessions may be formed based on previous experiences. These specific expectations may include, for example, meeting friends or experiencing social pressure. Expectations may be evaluated through appraisal processes that develop concrete anticipated emotions. Anticipated emotions may then influence proximal determinants (e.g., intention) of exercising that impact exercise behavior. The experience of exercising may then influence future expectations regarding physical activity, completing a cyclical process. This model was further used as the theoretical basis for this dissertation. While this first study focused on the appraisal processes resulting in anticipated emotion categories, the second and fourth study examined the relationship between anticipated affect and physical activity behavior.

As suggested in the theoretical model, anticipated affect may influence psychological variables related to physical activity rather than physical activity directly. Therefore, we conducted a **scoping review** analyzing the relationship between anticipated affect and (1) psychological variables related to physical activity or (2) physical activity behavior directly. For that, five databases were searched for studies on anticipated affect in the context of physical activity. No exclusion criteria were set regarding the study design, resulting in a total of 33 studies of which two used qualitative methods. The study results were clustered into five categories. First, consistently across the studies, it was shown that positive anticipated affect was positively associated with exercise intentions and negative anticipated affect was negatively associated with exercise intentions. It is important to note that negative anticipated affect which was related to missing an exercise opportunity was positively related to exercise intentions. For example, anticipated guilt when omitting an exercise session was positively associated with increased exercise intentions. Because promoting anticipated regret to increase exercise intentions seems unethical, future research should focus on how positive anticipated affect is related to intention. Second, anticipated affect was positively related to the actual affective experience meaning that participants which anticipated positive affect regarding exercising also experienced positive affect. However, several studies showed that participants underestimated how positive their affective experience would be while exercising which results in forecasting errors. This error suggests that cognitive biases

could influence the anticipation process. Affective memories or current feelings could induce cognitive biases. For example, one impressive, negative affective experience in the past could lead to an overestimation of negative anticipated emotions regarding future exercising. Third, regarding the relationship between anticipated affect and physical activity behavior, some studies point towards a positive relationship between anticipated affect and physical activity engagement, but too few studies were found for general conclusions to be drawn. Future studies with longitudinal study designs controlling for other psychological variables are needed. Fourth, one intervention study with physical activity as dependent variable suggests that manipulating positive and negative anticipated affect has an effect on intentions but not on future physical activity. Fifth, intervention studies with physical activity as independent variable showed that manipulating the exercise session (e.g., intensity) may have an effect on anticipated affect. The exploration of interventions to manipulate anticipated affect or the exercise session are needed to examine causal relationships in future studies.

The relevance of intention as a predictor of physical activity has been discussed as previous studies found a gap between intention and physical activity engagement. One prominent meta-analysis applied a four-quadrant model, called the action-control framework, and quantified the intention-behavior gap using the ratio of intenders who were not active to intenders who were active. Because this paper was published in 2013 and many more studies using this rationale have been conducted since, an updated systematic review and **meta-analysis** was needed to clarify the role of intention for physical activity behavior. To quantify the intention-behavior profiles and the intention-behavior gap, a comprehensive literature search was conducted to identify studies using a four-quadrant model. The screening process was supported by the artificial intelligence tool ASReview yielding 25 independent samples with a total of N = 29.600 participants. A random-effects meta-analysis revealed that 26.0% of participants were non-intenders who did not exceed their intentions, 4.2% were non-intenders who exceeded their intentions, 33.0% were unsuccessful intenders, and 38.7% were successful intenders. The overall intention-behavior gap among intenders was 47.6%. The findings highlight that while intention is a necessary precursor to physical activity, it is not sufficient on its own for many individuals.

Based on the outlined recommendations for future research in the scoping review and considering the large intention-behavior gap, we conducted a **prospective study** with three measurement occasions investigating the relationship between anticipated

enjoyment, intention, and exercise class attendance. For that four research questions have been outlined: (1) Is anticipated enjoyment related to the attendance at the next exercise class? (2) Is intention a mediator between anticipated enjoyment and exercise class attendance? (3) Is anticipated enjoyment a moderator of the relation between intention and exercise class attendance? (4) Is anticipated enjoyment related to the exercise class maintenance? We hypothesized that (1) anticipated enjoyment would be positively related to exercise class attendance, (2) intention would be a mediator between anticipated enjoyment and exercise class attendance, (3) anticipated enjoyment would act as a moderator of the relation between intention and exercise class attendance, and (4) anticipated enjoyment would be positively related to exercise class maintenance. To answer the research questions, 363 participants were recruited in weekly exercise classes. After the exercise class in which the participants were recruited (t_0), the participants received questionnaires assessing their anticipated enjoyment and intention regarding the next exercise class (t_1). Participants' attendance in the next exercise class (t_2) was checked by the study staff. Moreover, the maintenance of exercise classes was assessed retrospectively over five exercise classes since recruitment (t_3). Regarding the first research question, a positive relationship was found between anticipated enjoyment and exercise class attendance. However, this effect was no longer significant when including intention as an additional predictor. This showed that intention was a significant mediator between anticipated enjoyment and exercise class attendance supporting our hypothesis regarding the second research question. The moderator analysis yielded that anticipated enjoyment was not a moderator of the relation between intention and exercise class attendance not supporting our third hypothesis. With regards to the fourth research question, anticipated enjoyment was positively related to exercise class maintenance, but this effect was not significant anymore when intention was added as an additional predictor which supports the previously found mediation effect.

In this dissertation, the role of anticipated affect and intention was examined using different methodological approaches. Applying a **qualitative study** account, the first study provided insights into categories of anticipatory and anticipated emotions regarding future exercising. Based on the interpretation of the interviews and on previously published literature, a theoretical model was derived, proposing how anticipated emotions may develop an influence physical activity behavior. In addition, a **scoping review** was conducted to provide a comprehensive overview on studies that assessed the relationship between anticipated affect and physical activity behavior. While the existing evidence on

the direct relationship between anticipated affect and physical activity was sparse, several studies showed a positive relationship between anticipated affect and intention and between anticipated affect and the actual affective experience. To examine the relevance of intention as a predictor of physical activity engagement, a systematic review and **meta-analysis** was performed using the action-control framework. The results showed that intention is needed to initiate physical activity behavior as only about 4% of non-intenders were still active. In addition, the intention-behavior gap describing the ratio of unsuccessful intenders to successful intenders was about 48% which is similar in magnitude to a previous meta-analysis from 2013. In light of the recommendations for future research made in the scoping review and considering the large intention-behavior gap, a **prospective study** was conducted focusing on the relationship between anticipated enjoyment, intention and exercise class attendance. The results support the findings of the scoping review that anticipated affect is related to intention which is a predictor of physical activity. Future studies could use ambulatory assessment methods to examine changes over time in the relationship between anticipated affect and intention and allow for within-person analyses.

Zusammenfassung

Regelmäßige körperliche Aktivität kann nachweislich das Risiko an beispielsweise Adipositas, Krebs und Depressionen zu erkranken, reduzieren. Die Weltgesundheits-organisation empfiehlt für Erwachsene mindestens 150 Minuten moderate, aerobe körperliche Aktivität oder mindestens 75 Minuten anstrengende, aerobe körperliche Aktivität pro Woche, um von den gesundheitlichen Vorteilen regelmäßiger körperlicher Aktivität zu profitieren. Etwa 42% der Erwachsenen in westlichen Ländern erfüllen diese Empfehlungen jedoch nicht. Eine von vielen Komponenten, die das Bewegungsverhalten beeinflussen, ist die affektive Erfahrung mit der körperlichen Aktivität. In der Sportpsychologie hat sich eine Vielzahl von Forschungsarbeiten auf die Beziehung zwischen affektiven Erfahrungen und körperlicher Aktivität konzentriert und festgestellt, dass positive affektive Erfahrungen während der körperlichen Aktivität die zukünftige Teilnahme an körperlicher Aktivität zu erhöhen scheinen. Ein bisher häufig übersehenes affektives Konstrukt ist der antizipierte Affekt, der eine wichtige Rolle bei der Entscheidungsfindung spielen könnte. Unser Gehirn konstruiert auf der Grundlage früherer Erfahrungen wie zukünftige Ereignisse aussehen könnten. Diese Vorhersagefunktion beeinflusst Entscheidungen für oder gegen ein bestimmtes Verhalten.

Bevor eine Person beispielsweise entscheidet, ob sie an einem Sportkurs teilnimmt, kann sie bestimmte emotionale Konsequenzen vorhersehen, die mit der Teilnahme an dem Kurs verbunden sind. So könnte eine Person zum Beispiel antizipieren, dass der Sportkurs Spaß machen wird, was wahrscheinlich mit der Entscheidung für die Teilnahme am Kurs einhergeht. Umgekehrt könnte eine Person zum Beispiel Angst während des Sportkurses antizipieren, was mit der Entscheidung verbunden sein könnte, den Sportkurs zu meiden. Theoretische Überlegungen und Forschungsergebnisse aus anderen Disziplinen sprechen dafür, dass die Antizipation von Affekt eine unterschätzte Rolle bei Entscheidungsprozessen spielen könnte. Der Nobelpreisträger Daniel Kahneman hat beispielsweise herausgefunden, dass Geldbeträge für Menschen einen emotionalen Wert haben. Finanzielle Entscheidungen scheinen von den emotionalen Konsequenzen abzuhängen, die mit der Entscheidung einhergehen werden und nicht unbedingt von dem monetären Betrag eines möglichen Gewinnes oder Verlustes. Dies untermauert die Überlegung, dass positive und negative antizipierte affektive

Konsequenzen auch Entscheidungsprozesse hinsichtlich körperlicher Aktivität beeinflussen. Bisher, haben nur wenige Theorien in der Sportwissenschaft den antizipierten Affekt als affektive Variable miteinbezogen. Dabei wurde häufig postuliert, dass antizipierter Affekt eher reflexive Prozesse, wie beispielsweise die Intention, beeinflusst. Der antizipierte (engl. anticipated) Affekt kann als einen affektiven Zustand definiert werden, den eine Person erwartet, wenn sie in einem zukünftigen Ereignis partizipiert. Im Gegensatz zum antizipatorischen (engl. anticipatory) Affekt, der aktuelle affektive Zustände beschreibt, wenn an ein zukünftiges Ereignis gedacht wird, ist der antizipierte Affekt nur eine simulierte affektive Reaktion, die noch nicht eingetreten ist.

Ein weiterer wichtiger Prädiktor für körperliche Aktivität ist die Intention oder Absicht, körperlich aktiv sein zu wollen. Obwohl bisherige Studien hohe Korrelationen zwischen der Intention und dem Bewegungsverhalten gezeigt haben, sind die Effektstärken in experimentellen Studien eher gering. Darüber hinaus ergab eine Meta-Analyse, dass etwa 46% der Personen, die sich vorgenommen hatten, regelmäßig Sport zu treiben, ihre Intention nicht in die Tat umsetzten konnten. Angesichts dieser Diskrepanz zwischen Intention und Verhalten wird davon ausgegangen, dass noch andere psychologischen Konstrukte bei der Vorhersage körperlicher Aktivität eine Rolle spielen. Jüngste Studien, in denen potenzielle Moderatoren der Beziehung zwischen Intention und körperlicher Aktivität untersucht wurden, zeigen, dass affektive Konstrukte wie beispielsweise der antizipierte Affekt vielversprechende Ansätze bieten, um diese Lücke zu schließen.

Theoretische Ansätze und der bisherige Forschungsstand legen nahe, dass der antizipierte Affekt und die Intention relevante Prädiktoren für das Bewegungsverhalten sein können. Die Evidenz für den Zusammenhang zwischen antizipiertem Affekt und körperlicher Aktivität ist jedoch begrenzt. Hinsichtlich der Beziehung zwischen Intention und körperlicher Aktivität gibt es zwar viele Studien, jedoch werden andere psychologische Konstrukte häufig nicht als Moderatoren oder Mediatoren miteinbezogen. Nur durch die Identifikation dieser Einflussfaktoren kann die Intentions-Verhaltens-Lücke überwunden werden. Darüber hinaus sind weitere Untersuchungen zum Zusammenhang zwischen antizipiertem Affekt und Intention erforderlich, um die Relevanz dieses Zusammenhangs für die Vorhersage des körperlichen Aktivitätsverhaltens zu klären. Zu diesem Zweck wurden vier Studien durchgeführt, um (1) relevante antizipatorische und antizipierte Emotionskategorien im Zusammenhang mit körperlicher Aktivität zu identifizieren und ein theoretisches Modell zu entwickeln

(**qualitative Studie**), (2) den aktuellen Forschungsstand zu antizipiertem Affekt bei körperlicher Aktivität zu analysieren und darüber hinaus Empfehlungen für zukünftige Studien auszusprechen (**Übersichtsarbeit**), (3) die Verteilung der Intentions-Verhaltens Profile sowie die Größe der Intentions-Verhaltens Lücke zu aktualisieren und zu analysieren (**Meta-Analyse**) und (4) die Beziehung zwischen der antizipierter Freude, der Intention und dem Aktivitätsverhalten zu untersuchen (**prospektive Studie**).

Zunächst wurde eine **qualitative Studie** durchgeführt, um die antizipatorische und antizipierte Emotionskategorien zu untersuchen, die den Teilnehmern für ihr zukünftiges Aktivitätsverhalten relevant erschienen. Dafür wurden 16 Erwachsene befragt, darunter acht körperlich aktive und acht körperlich inaktive Teilnehmende. Die halbstrukturierten Interviews wurden aufgezeichnet, transkribiert und nach einigen Prinzipien der Grounded Theory ausgewertet. Aus den Interviews wurden 13 Kategorien von antizipatorischen und antizipierten Emotionen ermittelt, wie beispielsweise Freude, Angst und Stolz. Antizipatorische Emotionen schienen die aktuelle affektive Valenz (positiv vs. negativ) in Bezug auf das Training widerzuspiegeln. So berichteten körperlich aktive Teilnehmende mehr positive antizipatorische Emotionen und inaktive Teilnehmende mehr negative antizipatorische Emotionen. Im Gegensatz dazu berichteten körperlich aktive und inaktive Teilnehmende sowohl positive als auch negative antizipierte Emotionen in Bezug auf die nächste Trainingseinheit. Darüber hinaus wurde aus den Interviews zum einen ein theoretisches Modell abgeleitet, das auf den antizipierten Emotionskategorien und identifizierten Bewertungsprozessen basiert. Zum anderen wurde im Rahmen der Diskussion ein zweites theoretisches Modell entwickelt, das erklärt, wie antizipierte Emotionen auf der Grundlage von Bewertungsprozessen entstehen und mit dem Aktivitätsverhalten in Zusammenhang stehen könnten. Das Modell geht davon aus, dass sich auf der Grundlage bisheriger Erfahrungen spezifische Erwartungen an zukünftiges Aktivitätsverhalten herausbilden. Zu diesen spezifischen Erwartungen gehören zum Beispiel das Treffen von Freunden oder das Erleben von sozialem Druck im Rahmen eines Sportkurses. Daraufhin finden Bewertungsprozesse statt, aus denen sich konkrete antizipierte Emotionen entwickeln können. Antizipierte Emotionen können dann die Teilnahme am Sportkurs direkt oder proximale Determinanten dieses Sportkurses beeinflussen, wie beispielsweise die Intention den Sportkurs zu besuchen. Kommt es dann zur Sportkursteilnahme, kann die dort gemachte Erfahrung zukünftige Erwartungen an die nächste Sportkursteilnahme beeinflussen, wodurch ein Kreislauf entsteht. Dieses Modell wurde weiterführend als theoretische

Grundlage für die vorliegende Dissertation herangezogen. Während sich die erste Studie auf die Bewertungsprozesse und antizipierten Emotionskategorien fokussierte, untersuchten die zweite und dritte Studie die Beziehung zwischen antizipiertem Affekt und körperlichem Aktivitätsverhalten.

Im theoretischen Modell wurde postuliert, dass antizipierter Affekt eher psychologische Determinanten des Verhaltens beeinflussen könnten, die mit körperlicher Aktivität zusammenhängen, als die körperliche Aktivität direkt. Daraufhin wurde eine **Übersichtsarbeit** angefertigt, um die Beziehung zwischen antizipiertem Affekt und (1) psychologischen Determinanten von körperlicher Aktivität oder (2) körperlicher Aktivität zu analysieren. Dafür wurden fünf Datenbanken nach Studien zu antizipiertem Affekt im Kontext körperlicher Aktivität durchsucht. Es wurden keine Studien aufgrund ihres Studiendesigns ausgeschlossen, was zu einer Anzahl von 33 inkludierten Studien führte, von denen zwei qualitative Methoden verwendeten.

Die Studienergebnisse wurden in fünf Kategorien eingeteilt. Erstens zeigten die Studienergebnisse zur Beziehung zwischen antizipiertem Affekt und der Intention, dass positiver antizipierter Affekt positiv mit Intention und negativer antizipierter Affekt negativ mit der Intention assoziiert war. Es sollte beachtet werden, dass negativer antizipierter Affekt, der mit dem Verpassen oder Auslassen einer Möglichkeit zur körperlichen Aktivität zusammenhing, positiv mit der Trainingsabsicht assoziiert wurde. So war zum Beispiel die Antizipation von Schuldgefühlen, wenn eine Möglichkeit zur körperlichen Aktivität versäumt wurde, positiv mit einer erhöhten Intention verbunden. Die positive Beziehung zwischen antizipiertem Affekt und der Intention stellte das konsistenteste Ergebnis der Übersichtsarbeit dar. Da es unethisch erscheint, antizipierte Schuldgefühle beim Verpassen einer Möglichkeit zur körperlichen Aktivität zu fördern, sollte zukünftig der Zusammenhang zwischen positivem antizipiertem Affekt und körperlicher Aktivität weiter erforscht werden. Zweitens stand der antizipierte Affekt in einem positiven Zusammenhang mit dem tatsächlichen affektiven Erleben. Das bedeutet, dass Teilnehmende, die einen positiven Affekt bezüglich der körperlichen Aktivität antizipierten, auch einen positiven Affekt erlebten. Mehrere Studien zeigten jedoch, dass die Teilnehmenden unterschätzten, wie positiv ihr affektives Erleben bei der körperlichen Aktivität tatsächlich sein würde, was zu Vorhersagefehlern führte. Diese Erkenntnisse legen nahe, dass kognitive Verzerrungen den Antizipationsprozess beeinflusst haben könnten. Affektive Erinnerungen oder aktuelle Gefühle könnten zu kognitiven Verzerrungen beitragen. So könnte beispielsweise ein eindrückliches, negatives

affektives Erlebnis in der Vergangenheit zu einer Überschätzung negativer antizipierter Emotionen in Bezug auf zukünftige körperliche Aktivität führen. Drittens deuten zwar einige wenige Studien auf einen positiven Zusammenhang zwischen antizipiertem Affekt und körperlicher Aktivität hin, jedoch war die Forschungslage zu uneindeutig, um fundierte Schlussfolgerungen ziehen zu können. Um die direkte Beziehung zwischen antizipiertem Affekt und körperlicher Aktivität zu untersuchen, sind weitere Studien mit längsschnittlichen Designs erforderlich, die psychologische Variablen, wie die Intention, kontrollieren. Viertens zeigte eine Interventionsstudie, welche die körperliche Aktivität als abhängiger Variable inkludiert, dass die Manipulation von positivem und negativem antizipiertem Affekt einen Effekt auf die Intention, nicht aber auf die zukünftige körperliche Aktivität hatte. Fünftens testeten Interventionsstudien, welche die körperliche Aktivität als unabhängige Variable inkludierten, inwiefern Veränderungen an den Rahmenbedingungen des Sportangebots (beispielsweise die Intensität oder die Reihenfolge von Übungen) einen Einfluss auf den erwarteten Affekt haben könnten und präsentierten vielversprechende Ansätze für zukünftige Interventionsstudien. Folglich werden Interventionen zur Manipulation des antizipierten Affekts oder der körperlichen Aktivität benötigt, um kausale Beziehungen herzustellen.

Bisher wurde die Intention als der unmittelbarste und wichtigste Prädiktor von Verhalten verstanden, jedoch zeigten Studien eine Diskrepanz zwischen der Intention und der körperlichen Aktivität, die häufig als Intentions-Verhaltens-Lücke bezeichnet wird. Eine prominente Meta-Analyse hat ein Vier-Quadranten-Modell angewandt, das so genannte Action-Control Framework, um die Beziehung zwischen Intention und Verhalten zu veranschaulichen. Mithilfe des Modells konnte die Diskrepanz zwischen der Intention und dem Verhalten quantifiziert werden. Hierfür wurde das Verhältnis von Personen, die zwar die Intention hatten körperlich aktiv zu sein, diese jedoch nicht umsetzen konnten, zu den Personen, die ihre Intentionen tatsächlich in die Tat umgesetzt hatten, gebildet. Da diese Arbeit im Jahr 2013 veröffentlicht wurde und seitdem viele weitere Studien mit dem Action-Control Framework durchgeführt wurden, bot sich eine Aktualisierung der Übersichtsarbeit und der Meta-Analyse an. Zur Quantifizierung der Intentions-Verhaltens-Profile und der Intentions-Verhaltens-Lücke wurde eine umfassende Literaturrecherche durchgeführt, um Studien zu finden, die ein Vier-Quadranten-Modell angewendet haben. Das Screening-Verfahren wurde durch das ASReview-Tool unterstützt und ergab 25 unabhängige Stichproben mit insgesamt N = 29.600 Probandinnen und Probanden. Eine Meta-Analyse mit random effects ergab, dass

26.0% der Stichprobe weder eine Intention hatten noch körperlich aktiv waren, 4.2% keine Intention hatten, jedoch trotzdem körperlich aktiv waren, 33.0% zwar die Intention hatten, aber diese nicht wie geplant umsetzen konnten und 38.7% ihre Intention tatsächlich in die Tat umgesetzt hatten. Insgesamt betrug die Diskrepanz zwischen Intention und Verhalten bei den Probandinnen und Probanden mit einer Intention körperliche aktiv zu sein 47.6 %. Die Ergebnisse zeigen, dass die Intention zwar eine notwendige Voraussetzung für körperliche Aktivität ist, aber für viele Menschen allein nicht ausreicht.

Auf der Grundlage der Empfehlungen für zukünftige Forschung wurde in einer **prospektiven Studie** mit drei Messzeitpunkten der Zusammenhang zwischen der antizipierten Freude, der Intention und der Teilnahme an Sportkursen untersucht. Dazu wurden vier Forschungsfragen formuliert: (1) Hängt die antizipierte Freude mit der Teilnahme an der nächsten Kurseinheit zusammen? (2) Ist die Intention ein Mediator zwischen der antizipierten Freude und der Teilnahme an der nächsten Kurseinheit? (3) Ist antizipierte Freude ein Moderator des Zusammenhangs zwischen der Intention und der Teilnahme an der nächsten Kurseinheit? (4) Steht die antizipierte Freude im Zusammenhang mit der Aufrechterhaltung der Teilnahme an Sportkursen? Es wurde vermutet, dass (1) die antizipierte Freude positiv mit der Teilnahme an der nächsten Kurseinheit zusammenhängt, (2) die Intention ein Mediator zwischen der antizipierten Freude und der Teilnahme an der nächsten Kurseinheit ist, (3) die antizipierte Freude als Moderator der Beziehung zwischen der Intention und der Teilnahme an der nächsten Kurseinheit fungiert und (4) die antizipierte Freude positiv mit der Aufrechterhaltung der Teilnahme an Kurseinheiten zusammenhängt.

In wöchentlichen Sportkursen wurden 363 Teilnehmende rekrutiert. Nach der Kurseinheit, in der die Teilnehmenden rekrutiert wurden (t_0), erhielten die Teilnehmenden Fragebögen zur antizipierten Freude und der Intention bezüglich der nächsten Kurseinheit (t_1). Die Anwesenheit der Teilnehmer in der nächsten Übungsstunde (t_2) wurde durch Studienpersonal überprüft. Zusätzlich wurde die Aufrechterhaltung der Teilnahme an fünf Kurseinheiten seit der Rekrutierung gemessen (t_3). Bezüglich der ersten Forschungsfrage wurde ein positiver Zusammenhang zwischen der antizipierten Freude und der Teilnahme an der nächsten Kurseinheit festgestellt. Dieser Effekt war jedoch nicht mehr signifikant, als die Intention als zusätzlicher Prädiktor hinzugefügt wurde. Folglich fungierte die Intention als ein Mediator zwischen der antizipierten Freude und der Teilnahme an der nächsten Kurseinheit, was die Hypothese bezüglich der zweiten

Forschungsfrage unterstützt. Die Moderatorenanalyse ergab, dass die antizipierte Freude kein Moderator der Beziehung zwischen der Intention und der Teilnahme an der nächsten Kurseinheit war, weshalb die dritte Hypothese verworfen werden muss. In Bezug auf die vierte Forschungsfrage zeigte sich ein positiver Zusammenhang zwischen der antizipierten Freude und der Aufrechterhaltung der Teilnahme an Kurseinheiten. Dieser Effekt war allerdings erneut nicht mehr signifikant, als die Intention als zusätzlicher Prädiktor hinzugefügt wurde, was den zuvor gefundenen Mediationseffekt untermauert.

In dieser Dissertation wurde die Rolle des antizipierten Affekts für körperliche Aktivität anhand verschiedener methodischer Ansätze untersucht. Eine **qualitative Studie** lieferte Einblicke in Kategorien von antizipatorischen und antizipierten Emotionen im Hinblick auf das zukünftige Aktivitätsverhalten. Auf Basis der Interviews und bereits existierender Literatur wurde ein theoretisches Modell abgeleitet, das als theoretische Basis für diese Dissertation diente. Darüber hinaus wurde eine **Übersichtsarbeit** erstellt, um einen umfassenden Überblick über die Beziehung zwischen antizipiertem Affekt und körperlicher Aktivität zu erhalten. Während die vorhandene Evidenz zum direkten Zusammenhang zwischen antizipiertem Affekt und körperlicher Aktivität gering ausfiel, zeigten mehrere Studien einen positiven Zusammenhang zwischen antizipiertem Affekt und Intention sowie zwischen antizipiertem Affekt und dem tatsächlichen affektiven Erleben. Um die Relevanz der Intention als Prädiktor für körperliche Aktivität zu untersuchen, wurde eine systematische Übersichtsarbeit und eine **Meta-Analyse** unter Anwendung des Action-Control Frameworks durchgeführt. Die Ergebnisse zeigten, dass die Intention erforderlich ist, um ein Bewegungsverhalten zu initiieren, da nur etwa 4% der Stichprobe ohne Intention körperlich aktiv waren. Darüber hinaus betrug die Intentions-Verhaltens-Lücke etwa 48%, was einer ähnlichen Verteilung wie in einer früheren Meta-Analyse aus dem Jahr 2013 entspricht. In Anbetracht der Empfehlungen für zukünftige Studien im Rahmen der Übersichtsarbeit und der großen Intentions-Verhaltens-Lücke, wurde eine **prospektive Studie** durchgeführt. Diese beschäftigte sich mit der Beziehung zwischen antizipierter Freude, der Intention und der Teilnahme an Sportkurseinheiten. Die Ergebnisse stützen die Erkenntnisse der Übersichtsarbeit, wonach der antizipierte Affekt mit der Intention in Verbindung steht, welche ein direkter Prädiktor für die Sportkursteilnahme zu sein scheint. Zukünftige Studien sollten ambulante Assessment Methoden verwenden, um Veränderungen in der Beziehung zwischen antizipiertem Affekt und der Intention über die Zeit zu untersuchen und intraindividuelle Unterschiede zu berücksichtigen.

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Preface

The following chapters have been published or are submitted in peer-reviewed journals and can be read independently of each other:

Chapter 3: Feil, K., Weyland, S., Fritsch, J., Wäsche, H., & Jekauc, D. (2022). Anticipatory and anticipated emotions in regular and non-regular exercisers – a qualitative study. *Frontiers in Psychology*, 13, 929380. https://doi.org/10.3389/fpsyg.2022.929380

Chapter 4: Feil, K., Fritsch, J., Weyland, S., Warmbrunn, U., & Jekauc, D. (2023). The role of anticipated affect in the context of physical activity: a scoping review. *International Review of Sport and Exercise Psychology*, 1-33. http://dx.doi.org/10.1080/1750984X.2023.2284473

Chapter 5: Feil, K., Fritsch, J. & Rhodes, R. E. (2023). The intention-behavior gap in physical activity: a systematic review and meta-analysis of the action control framework. *British Journal of Sports Medicine, 57*(19):1265-1271. https://doi.org/10.1136/bjsports-2022-106640

Chapter 6: Feil, K., Fritsch, J., Weyland, S., & Jekauc, D. (submitted). Examining the role of anticipated enjoyment and intention in predicting attendance in exercise classes. *BMC Psychology.*

General introduction

Have you ever found yourself deliberating about whether or not to go to an exercise class, with the class suddenly running in your mind's eye? Maybe you see pictures of the room, the teacher or other class participants. Based on past experiences, your brain is predicting what this class might be like for you. Most of the time you do not even notice this anticipation process as it is constantly running. Research has already shown that how we feel while exercising influences our future physical activity behavior (Nasuti & Rhodes, 2013; Rhodes et al., 2009). The more positive emotions we experience, the more likely we are to attend this class again (Rhodes & Kates, 2015). Before we show up in an exercise class a decision-making process takes place using the predictive function of the brain (Clark, 2013). Hereby also anticipated affective consequences (will I feel good or bad) are considered (Hoemann et al., 2017). A prominent correlate of physical activity and anticipated affect is the intention or the willingness to exercise. Intention was sought be the most important predictor of physical activity, but studies found that there is a substantial discordance between having the intention to be physically active and actually engaging in physical activity behavior (Rhodes & de Bruijn, 2013). In current research affective constructs are considered to help bridge this gap (Rhodes et al., 2022). Therefore, this dissertation aims to examine the role of anticipated affect, intention and the relation between these two constructs in physical activity behavior.

Physical activity

Health is a central good for every individual and for society. Physical activity is one of many health behaviors that is crucial for a healthy lifestyle preventing a large number of diseases such as cardiovascular diseases (Lavie et al., 2019), cancer (Minihan et al., 2022) and depression (Schuch et al., 2018). To benefit from the advantages of regular physical activity, the World Health Organization (WHO, 2010) recommends at least 150 minutes of moderate aerobic physical activity or at least 75 minutes of vigorous aerobic physical activity per week for adults (18-64 years). Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, 1985, p. 126). Thus, physical activity can be for example cycling to work, gardening or attending a fitness class. Despite the well-known health benefits of physical

activity, one-third of the people worldwide are not sufficiently active according to the WHO guidelines (Guthold et al., 2018). The highest levels of physical inactivity in 2016 were reached in western countries with 42.3%. Similarly, the WHO reported that 27.5% of adults and 81% of adolescents do not meet the recommended physical activity guidelines (World Health Organization, 2022). The promotion of physical activity is a central task of today's society which is shown in the goals of the WHO (2020) and in the Sustainable Development Goals of the United Nations (United Nations, 2017). Therefore, understanding and explaining mechanisms of physical activity behavior is an overarching goal in research to derive practical implications for stakeholders, sport facilities, trainers, and individuals (World Health Organization, 2018).

The predictive function of the brain

In neuroscience, the predictive function of the brain gained increasing attention in the past two decades (Clark, 2013). Previously, the brain was viewed as a reactive organ to stimuli which consists of billions of neurons and transmitters. Neurons were thought to wait to be stimulated by events that happen in the external world. More modern approaches suggest that the brain is an "active inference generator" (Barrett & Simmons, 2015, p. 419) or a "foretelling device" (Buzsaki, 2006, p. 1) which means that neurons do not wait in silence for external stimuli to arrive. The brain is constantly forming representations based on past experiences that serve as an internal model of how future external stimuli might affect sensations (Barrett & Simmons, 2015). These anticipations are nothing more than hypotheses about the world and can be tested against the sensory input that comes in from external stimuli. If a discrepancy between the anticipation and experience through external stimuli exist, a prediction error is present (Hoemann et al., 2017). For example, an individual anticipates to experience joy during the next workout, but during the workout the individual experienced even more joy than anticipated. The model of allostasis best describes the regulation of our system: it is an "efficient regulation (that) requires anticipating needs and preparing to satisfy them before they arise" (Sterling, 2012, p. 5). The advantage of allostasis over homeostasis, in which error-correcting feedback is highly inefficient, is that resources can be shared across systems and errors can be reduced through the use of memories (Barrett, 2017; Sterling, 2012).

This predictive function of the brain is also relevant to the experience and anticipation of emotions (Barrett, 2017; Hoemann et al., 2017). Another important step

in the predictive process of the brain is categorization. As sensory input from external stimuli is received, sensations are categorized based on previous experience. These categories are discrete concepts that help us take appropriate action (Barrett, 2017). For example, hearing strange noises in a dark forest, having goosebumps and recognizing a fast heartbeat may lead to categorizing these sensations into the category "fear" based on previous experiences or learned concepts. An appropriate action would be to run to safety as quickly as possible. The predictive function of the brain helps to understand how emotions are made and experienced, but emotions themselves can also be anticipated. Using the example of the dark forest, we can anticipate that going for a run alone in the forest at night might lead to the experience of fear, and as a result we choose another opportunity to go for a run, such as with a friend or on a different route. Several theoretical models suggest that the anticipation of emotions is relevant for decision making and subsequent behavior (e.g., Baumeister et al., 2007; Mellers & McGraw, 2001; Wilson & Gilbert, 2003).

Affective experiences and physical activity

Studies have shown that the relationship between affective experiences and physical activity is bidirectional: physical activity can have positive effect on affective processes and affective experiences can influence future physical activity engagement. Regarding the former, several reviews showed that physical activity can have a positive effect on mood, depressive symptoms and anxiety (McDowell et al., 2019; Penedo & Dahn, 2005; Schuch et al., 2018). A popular phenomenon explaining this positive relationship between affect and physical activity is called "affective rebound" as most participants showed an improvement in affect scales after physical activity (Ekkekakis & Russell, 2013). However, this effect may occur simply because physical activity is over, and not because it was so much fun. Ekkekakis (2003) proposed in the dual-mode theory that positive affective experiences during physical activity are related to the intensity of the exercise. According to this theory, affective responses depend on cognitive factors (e.g., self-efficacy) and interoceptive cues (e.g., heart rate, breath). Below the ventilatory threshold cognitive factors dominate the affective reaction. For example, having a deeper breath and sweating a little bit can be cognitively interpreted as a positive experience because it shows that the movements are effective and the body is working well. Above the ventilatory threshold interceptive cues are more intense and often exceed cognitive

abilities to reinterpret the situation. For example, an extremely high heart rate and burning muscles are often experienced as negative and reinterpreting these interoceptive cues as positive signs of growing muscles and increasing one's cardiovascular performance is more difficult.

Scientific research supporting the latter of the above postulated relationships, in which affective experiences is associated with future physical activity, increased in the past two decades. Having a positive mood before physical activity can increase the chance of actually engaging in physical activity (Niermann et al., 2016). Several systematic reviews yielded a positive relationship between affective experiences and physical activity in children and adolescents (Klos et al., 2020; Nasuti & Rhodes, 2013) and adults (Rhodes et al., 2009). Moreover, Rhodes and Kates (2015) showed that affective reactions during physical activity predicted the engagement in future physical activity significantly, while affective experiences after physical activity did not. Therefore, generating positive affective responses during exercise sessions is crucial to increase the chances of reattendance. Additionally, positive affective responses during physical activity can have a positive effect on habit formation (Weyland et al., 2020) which is relevant for physical activity maintenance (Feil et al., 2021). The convincing state of research that affective experiences are relevant for future physical activity engagement is an important basis for this dissertation, as the anticipation of affective experiences related to physical activity depends significantly on it. Without previous affective experiences it is difficult to anticipate future affective experiences in a concrete manner.

Intention and physical activity

Several prominent models in physical activity position intention as the summary motivational construct determining behavior (Rhodes et al., 2019), as for example the Theory of Planned Behavior (TPB, Ajzen, 1991). Other theories include intention but also involve other variables to explain behavior, for example the Multi-Process Action Control Framework (M-PAC, Rhodes, 2017) or the Phyiscal Activity Adoption and Maintenance model (PAAM, Strobach et al., 2020). These so-called dual-process theories do not only include reflective processes (e.g., intention), but also more automatic processes (e.g., habit). In support of the inclusion of intention within these theories, meta-analyses have shown a correlation of approximately r = .50 between intention and physical activity (McEachan et al., 2011; Rhodes & Dickau, 2012; Sheeran & Webb, 2016). While this

correlation can be considered large, there is still an intention-behavior discordance and the association between intention and behavior change is considerably smaller in experimental study designs (Rhodes & Dickau, 2012; Sheeran & Webb, 2016).

In a meta-analysis applying the action-control framework, it was shown that there is a considerably large gap between having the intention to exercise according to the WHO guidelines and actually becoming physically active of 46% (Rhodes & de Bruijn, 2013). This means that almost every second person who had the intention to exercise was not able to translate this intention into action. Moreover, it was found that 21% of participants were non-intenders who did not exceed their intentions, 2% were non-intenders who exceeded their intentions, 36% were intenders who were not successful in executing the intended behavior, and 42% were intenders who were able to translate their intentions into action. The authors concluded that (1) having the intention to exercise is deemed necessary to initiate physical activity behavior as only 2% of participants had no intention and were still active according to the WHO guidelines, and (2) having the intention to exercise is only a vague predictor of actual physical activity engagement and research on possible moderators of the intention-behavior relationship is needed.

Structure of the thesis

This thesis consists of seven chapters. After introducing the constructs affect and intention and underpinning the relevance of physical activity for health (chapter 1), a detailed overview on anticipated affect and intention in physical activity is given (chapter 2). Four journal articles investigate the relationship between anticipated affect, intention and physical activity behavior (chapter 3-6), followed by a discussion (chapter 7).

The second chapter provides an overview on the relevant theoretical background on anticipated affect and intention in physical activity. It is divided into three sections. In the first section, relevant terms such as affect, emotions and moods are defined and the emotion-as-feedback theory (Baumeister et al., 2007) focusing on the role of anticipated emotions is introduced. Further theories from other research fields including anticipated affect as a central variable to explain behavior are described in detail. In addition, theories in physical activity research including anticipated affect are depicted. Brief definitions of relevant terms in this dissertation (e.g., expectations, anticipation, mental models) are provided at the end of this section. In the second section of chapter two, relevant theories regarding the relationship between intention and physical activity behavior are delineated.

This includes a description and definition of intention and the intention-behavior gap. In last section of chapter two, the research gap and objectives of the thesis are outlined.

In chapter three, a qualitative study focusing on anticipatory and anticipated emotions regarding future exercise sessions is presented. The study aimed to identify and describe categories of anticipatory and anticipated emotions and to develop a theoretical model of anticipated emotion categories. For that, eight regular and eight non-regular exercisers were interviewed and principles of the Grounded Theory were used to analyze the statements. While anticipatory emotions seemed to reflect the momentary affective valence of exercising, anticipated emotions were more complex with regular and non-regular exercisers both reporting positive and negative anticipated emotions. Besides a theoretical model of anticipated emotion categories based on appraisal processes, a second theoretical model on how anticipated emotions may be related to physical activity behavior is derived. These theoretical considerations are discussed in light of previous research and implications for future research are provided.

Chapter four contains a scoping review aiming to systematically review the current state of research on anticipated affect in physical activity behavior and to outline recommendations for future research. Thirty-three studies were classified into five categories showing that (a) anticipated affect was related to intention and (b) to affective experiences. While results regarding (c) the prediction of physical activity through anticipated emotions were inconclusive, intervention studies with (d) physical activity as the dependent variable and (e) as the independent variable revealed promising approaches to manipulate either anticipated affect or the exercise session to increase the positive effect of positive anticipated affect on physical activity. Within these categories, empirical studies are explained in more detail followed by a thorough discussion. Based on the findings of the scoping review, concrete recommendations for future research are outlined.

Chapter five comprises a systematic review and a meta-analysis quantifying the intention-behavior profiles and the intention-behavior gap. This paper is an update of an article published by Rhodes and de Bruijn (2013) with a seven times larger sample size. Moreover, the screening procedure was conducted using an innovative, artificial intelligence tool called ASReview. The results suggest that intention-behavior profiles and the intention-behavior gap remain of similar distribution as in the meta-analysis in 2013. However, moderator analyses were conducted showing that the sample population, the physical activity measurement and the risk of bias of the studies influenced the size

of the intention-behavior gap. The impact of these findings is discussed from a theoretical and practical perspective.

In line with the recommendations drawn in the scoping review, an empirical study examining the relationship between anticipated enjoyment, intention, and exercise class attendances is presented in chapter six. In this study, 363 adults were recruited form weekly exercise classes. Participants reported their anticipated enjoyment and intention several days before exercise class attendance. Additionally, exercise class attendances over the next five exercise classes were assessed respectively. The results showed that anticipated enjoyment was related to exercise class attendance, but this effect was no longer significant when intention was added as an additional predictor. Intention was not only a significant mediator between anticipated enjoyment and the next exercise class attendance, but also a significant mediator between anticipated enjoyment and the next five exercise class attendances.

Chapter seven includes a general discussion starting with the discussion of the findings presented in chapter three, four, five and six. Additionally, theoretical and methodological considerations for future research are outlined. Strengths and limitations are discussed followed by the conclusions of this dissertation.

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Theoretical background on anticipated affect and intention

Anticipated affect

Affect, emotions and moods

Three articles presented in this dissertation focus on affect and emotions which is why a short differentiation between the constructs will be given according to the literature. Affect is frequently used as an umbrella term for all kinds of feeling states such as core affect, emotions, and moods (Ekkekakis & Russell, 2013). It can be convenient to use affect as a collective term when referring to all these phenomena (as done in this thesis), but it is important to clarify the differences between these psychological concepts. Core affect was defined by Russell (2003) as a primitive and simple feeling at any given moment that evolves on the two dimensions valence and arousal. According to Russell (2009), core affect is always there and can change quickly. Moreover, it is often understood as an automatic process that evolves without thinking (Baumeister et al., 2007). The scientific community is less in agreement about what an emotion is and how it develops. However, the consensus is that emotions are more context dependent than core affect and related to an object, situation, or event (Moors, 2009). Clore and Ortony (2000) put it another way and described emotions as affective states that have an object and therefore involve cognitive processing. Some researchers argue that emotions are consciously accessible while an affective experience is not (e.g., Baumeister et al., 2007). Baumeister et al. (2007) differentiates between a "full-fledged" emotion that is a reflective experience while automatic affect will in most cases not reach the threshold for a reflective experience. Another concept that is often meant by affect is moods. Moods typically last longer and are less intense than emotions (Beedie et al., 2005). Moreover, they are often not about a specific object, situation or event suggesting that little cognitive processing is involved (Clore & Ortony, 2013). In the following paragraphs, theories focusing on the relationship between anticipated affect or emotions and behavior are outlined.

Emotions as feedback

Emotions in the form of feedback about certain situations or behaviors can help us to make wise and effective decisions. Imagine you have a disturbing conversation with

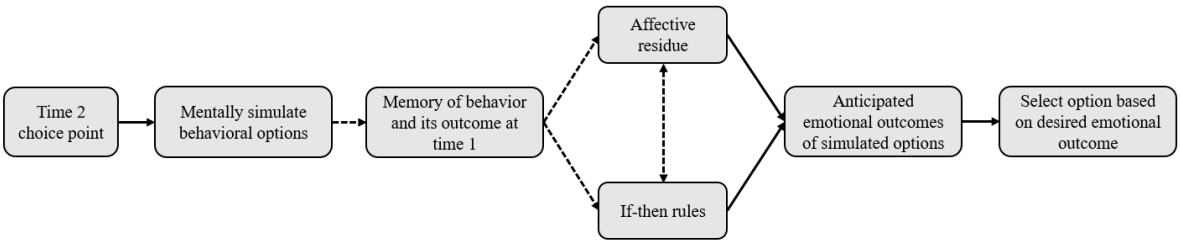
a good friend and you are angry and upset. You decide to sit on the couch eating unhealthy food and watching a movie. While doing that you realize that you regret not going to the exercise class you originally had planned for this evening because of the situation with your friend. According to Baumeister et al. (2007), the situation is stored in memory along with an affective residue that links this feeling of regret to the argument with your friend. Whenever a similar situation arises, the affective residue gets activated, warning you not to make the same bad decision. The residue is called "affective" because no deliberately thinking is involved.

In addition to affective residuals, the memory of past behavior and its outcomes also influences existing if-then rules. If-then rules are the way in which implementation intentions can be applied and operationalized in real life. Gollwitzer (1993) emphasized the relevance of implementation intentions, which can be understood as a specification of when, where, and how one wants to pursue certain thoughts, feelings, or actions to achieve a goal. There is a considerable amount of research on if-then planning in health psychology that supports its relevance for behavior change (for a review see Bieleke et al., 2021). Examples of if-then rules involving physical activity behaviors may be for example "If someone calls me on the phone, I will walk around during the call to get more steps" or "If the chance of it raining today is less than 70%, I will ride my bike to work". According to Baumeister et al. (2007), if-then rules help us navigate through a complex world by providing shortcuts that work without weighing pros and cons. The feedback theory by Baumeister et al. (2007) postulates that if-then rules are updated through the experience of emotions. Returning to the example of the argument with a friend, this means that eating unhealthy food instead of going to the gym could be an existing if-then rule ("If I have a conflict with a person close to me, I will eat unhealthy food and watch a movie to distract myself"). Experiencing a negative emotion, such as regretting not attending the exercise class, signals that the existing if-then rule needs to be revised. When an if-then rule is associated with positive emotions, it signals that the rule is effective and working well and will create a positive affective residue.

In a situation similar to the argument with the friend, the feedback theory (Baumeister et al., 2007) postulates that anticipated emotional outcomes would guide future behavior (see Figure 1). According to the feedback theory, one simulates behavioral options to respond to the situation (e.g., eat unhealthy food and stay home, join an exercise class, talk to another friend about the conflict, etc.). Memories and outcomes of previous situations trigger affective residue (e.g., association between the

argument with the friend and feeling regret) and if-then rules (e.g., staying home and eating unhealthy food when arguing with a friend). Emotional outcomes of other behavioral options (e.g., attending the exercise class) may be more attractive, resulting in the selection of that option based on the desired positive emotional outcome (e.g., having fun instead of experiencing regret).

Figure 1. *Theory of anticipated emotional outcomes guiding subsequent behavior (according to Baumeister et al. 2007)*



A meta-analytic test showed that both the "emotion-as-direct-causation theory" and the "emotion-as-feedback theory" predicted social behavior (DeWall et al., 2015). However, currently experienced emotions predicted behavior in only 22% of the included studies, whereas anticipated emotions predicted behavior in 87% of the studies. Although the number of studies on anticipated emotions is still small, the rate of successful predictions of social behavior was high, suggesting an underestimated importance of anticipated emotions in predicting behavior (DeWall et al., 2015).

Theoretical approaches in decision making

For decades, economists have studied how people make financial decisions. In this chapter, two theoretical approaches focusing on decision making and emotional outcomes are introduced: The prospect theory by Kahneman and Tversky (1979) and a theoretical idea by Mellers and McGraw (2001). Both theories underpin the relevance of anticipated emotions in decision making that may not only apply for financial decisions but also for health decisions.

Experiments in economic science typically involve a gamble where the participant is given two options to choose from (e.g., Imagine that you will win $900 for sure or $1000 with a 90% probability. Which will you choose?). For a long time, it was accepted

that the utility of the outcome was relevant to the decision as suggested by Bernoulli in the 18th century. It was assumed that utility could be estimated by comparing two states of wealth (e.g., the difference between $900 and $1000). It was not considered that losing $100 reflects a different utility than gaining the same amount. Kahneman and Tversky (1979) postulate that showing risk-averse or risk-seeking behavior depends on the psychological value of the money and not on the amount. In their experiments, they showed that responses to losses are stronger than responses to gains. Their main findings were that when both a gain and a loss are possible, loss aversion leads to risk-averse decisions, whereas a certain loss compared to a larger loss that is only probable leads to risk-seeking behavior (see also Kahneman, 2011). The expected outcome seems to have an emotional value that influences decision making.

Mellers and McGraw (2001) proposed a similar theoretical approach, suggesting that instead of wins and losses, positive and negative affective reactions resulting from the situation are relevant for decision making. According to their theory, people will weigh the feelings according to the likelihood that they will occur and choose the more pleasurable option, as suggested by the affect heuristic (Slovic et al., 2007). In addition, Mellers and McGraw (2001) argue that the emotions experienced during the decision-making process may play an underestimated role (Loewenstein et al., 2001). These "anticipatory affective responses" reflect a momentary affective reaction when thinking about a future event (for a detailed review on affect-terms see Williams et al., 2019). Both anticipatory and anticipated affect appear to be relevant for decision making and behavioral prediction.

Biases in anticipated affect

Another body of research on anticipated affect can be found in social psychology focusing on biases. Wilson and Gilbert (2003) describe the process by which people anticipate their future feelings as affective forecasting. They outline four components of affective forecasting: *valence*, *specific emotions*, *duration* and *intensity*. People are often correct in anticipating the *valence* of their emotions (positive vs. negative). Experiments with financial bets or hypothetical social games showed that winning is associated with positive affect and losing with negative affect (Kahneman, 2011; Mellers & McGraw, 2001; Wilson et al., 2004). As an example, participants of a running race anticipated their affective valence after the race correctly before the race begun (Aitken et al., 2021).

When it comes to *specific emotions*, people are less accurate in anticipating which emotion they will most likely feel. In one experiment, participants were shown pictures and asked which emotion they would feel when looking at the pictures (Robinson & Clore, 2001). Participants were quite good at naming a specific emotion for each picture. In another experiment, however, participants anticipated feeling happy and sad at the same time when imagining that they would graduate from high school (Larsen et al., 2001). Wilson and Gilbert (2003) concluded that the more mixed emotions are anticipated (positive and negative), the less specific the emotions. In addition, emotions are less specifically anticipated when the situation lies in the far future compared to the close future (e.g., in several months vs. tomorrow). In the context of physical activity, the duration of an exercise class, for example, could also be a relevant aspect for anticipating mixed emotions. Participants may enjoy some exercises more than others and anticipate both positive and negative emotions for the entire exercise class. In a study by Ruby et al. (2011), participants anticipated different intensities of enjoyment depending on the strength exercises and workout phases (warm-up, main workout, cool-down).

Research has identified several biases related to the *duration* and *intensity* of anticipated emotions. According to the duration bias, people overestimate the duration of future emotional responses to events (Wilson & Gilbert, 2003). For example, sports fans correctly estimated their happiness after a sports game, but overestimated how long that feeling would last (Wilson et al., 2000). The impact bias reflects the "tendency to overestimate the enduring impact that future events will have on our emotional reactions" (Wilson & Gilbert, 2003, p. 351) and includes both overestimation of duration and overestimation of intensity. In terms of intensity, participants in a running race overestimated their affective arousal after the race, overestimated negative affective states such as frustration and nervousness and underestimated positive affective states such as pride and confidence. The underestimation of positive emotions in the form of enjoyment in relation to physical activity has also been found in several other studies (Loehr & Baldwin, 2014; Ruby et al., 2011), underlining a forecasting error in the anticipation of emotions.

Wilson and Gilbert (2003) suggest that several effects and biases should be considered when interpreting forecasting errors. First, we cannot be sure that the emotions stored in memory are the same as the emotions actually experienced in a past situation. For example, peaks and ends are likely to be overrepresented in memory and could lead to forecasting errors. Second, if there is no previous emotional experience stored in

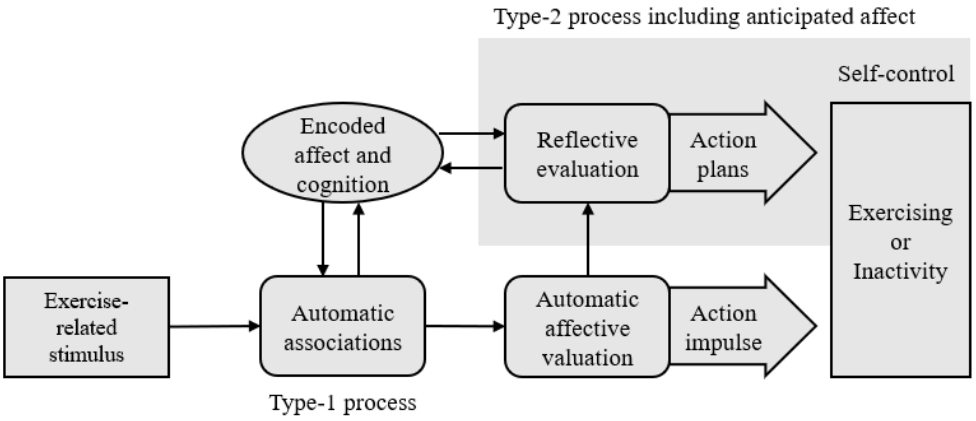
memory for a particular situation, people may have inappropriate theories about the future. Third, currently experienced emotions could influence the anticipation process, which is called projection bias. For example, when people are hungry in a supermarket, they tend to buy the food they crave at that moment, estimating that they will crave it again the following week, when in fact they will not. Fourth, according to the assimilation effect, people will like something even more if they expected to like it than if they did not have the positive expectation (also called self-fulfilling prophecy).

Research on the four components of affective forecasting shows that the process of anticipation is often biased and inaccurate. These findings must be taken into account when discussing and interpreting study results. Moreover, although these biases may lead to suboptimal decisions in the examples above, they reflect the strong influence of the anticipation process on behavior. Future research should explore how this process can be manipulated to successfully inform decision making.

Theories in physical activity including anticipated affect

So far, only very few theories in the physical activity context included anticipated affect as a variable influencing exercise behavior. One of these theories is the "Affective-Reflective Theory of physical inactivity and exercise" (ART) by Brand and Ekkekakis (2019). Based on the dual process approach (Evans & Stanovich, 2013), the authors suggest that two types of processes influence physical activity behavior (see Figure 2).

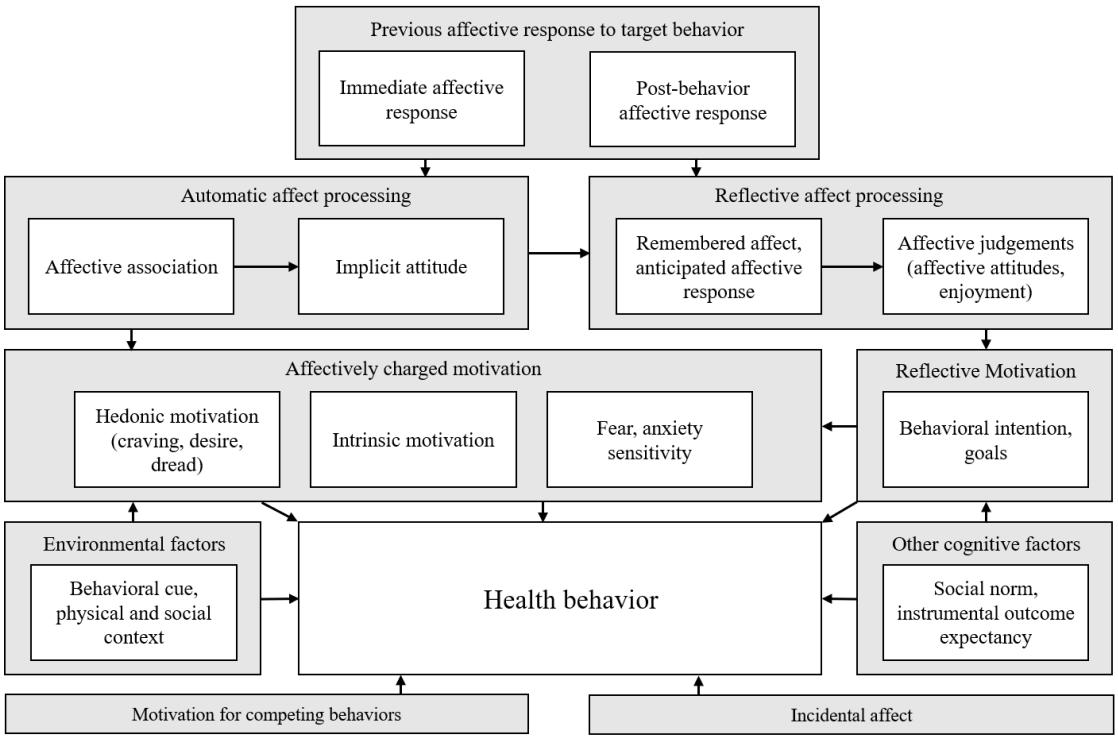
Figure 2. *Affective-Reflective Theory of physical inactivity and exercise (according to Brand & Ekkekakis, 2019)*



The type-1 process is called automatic affective valuation and reflects automatic associations between a stimulus and pleasure or displeasure. This automatic affective valuation can directly trigger an action impulse for either active or inactive behavior. Affective associations can also interact with cognitive processes resulting in an affective evaluation reflecting the type-2 process in the ART. In the type-2 process the stimulus is appraised reflectively as "good" or "bad" initiating action planning for active or inactive behavior. Typically, type-2 processes are slower, more effortful and more likely to be reflective as type-1 processes (Evans & Stanovich, 2013). Brand and Ekkekakis (2019) proposed anticipated affect as a type-2 process as anticipated affect related to exercising or inactivity derives from pervious experiences and mental simulations of the future. However, the authors do not explain in detail how this "rather reflective process" of anticipation proceeds.

Another framework in the physical activity domain that included anticipated affect is the "Affect and Health Behavior Framework" by Stevens et al. (2020). The authors suggest that previous affective responses to physical activity influence two types of processes, again consistent with the dual-process approach (see Figure 3).

Figure 3. *Affect and Health Behavior Framework (according to Stevens et al., 2020)*



Note: The paper focuses on physical activity as the target behavior, but the authors suggest the framework for health behaviors in general.

Automatic affect processing reflects the type-1 process in which affective associations result in an implicit attitude towards the target behavior. Reflective affect processing is considered the type-2 process, including remembered affect, anticipated affective responses and affective judgements. Stevens et al. (2020) emphasize that automatic and reflective affect processes likely overlap. For example, the authors suggest that in the reflective process, individuals first remember affective responses, second anticipate future affective responses and third form affective attitudes. In the automatic process, the same steps occur automatically in an aggregated form resulting in implicit attitudes. Therefore, we cannot conclude that the anticipation of affective responses is always a type-2 process. Rather, it is that whenever the anticipation process is part of type-1 processes, we simply cannot access it.

Stevens et al. (2020) suggest that both automatic affect processing and reflective affect processing do not directly influence health behavior. On the one hand, automatic affect processing triggers affectively charged motivation such as hedonic motivation (craving, desire, dread), intrinsic motivation, and sensitivity to fear or anxiety which in turn influence health behavior. On the other hand, reflective affect processing interacts with reflective motivation such as behavioral intentions and goals which in turn influence health behavior and affectively charged motivation. In addition to affective and reflective motivation, the authors propose four other factors that influence health behavior: environmental factors (e.g., context), other cognitive factors (e.g., social norms), motivation for competing behaviors (e.g., inactivity), and incidental affect (e.g., momentary feelings). In summary, it can be said that the framework by Stevens et al. (2020) suggests a more complex interaction of not only type-1 and type-2 processes, but also other factors. Furthermore, they emphasize that reflective affect processing including anticipated affect is more likely to influence behavioral intentions and goals rather than health behavior directly.

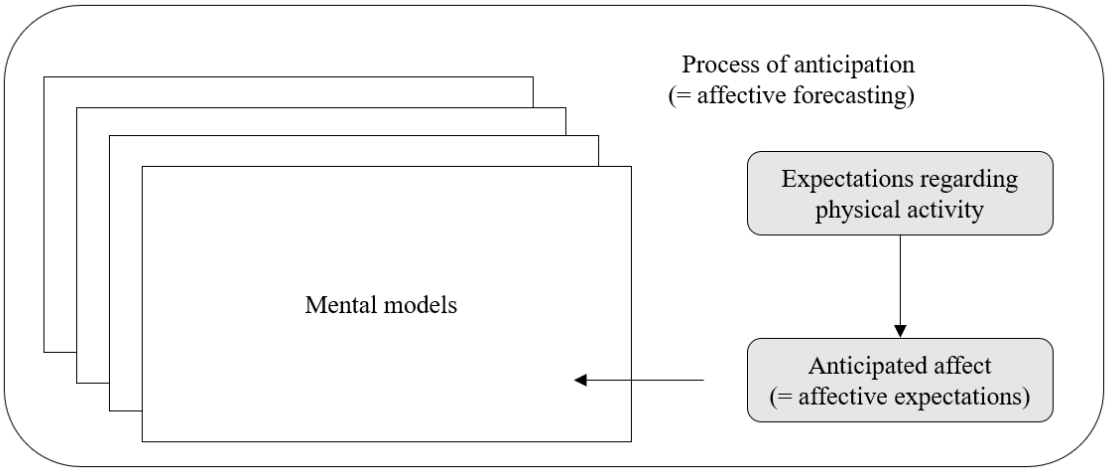
Definition of terms related to anticipated affect

In the previous sections it became evident that the anticipation of affective responses can be found in many areas of research. Various terms are used to describe this process that are not clearly defined. Therefore, this section serves to define terms relevant for the understanding of the dissertation topic and how these terms are related to each other (see Figure 4).

Expectations (or expectancies) can be defined as "beliefs about a future state of affairs" (Roese & Sherman, 2013, p. 91) based on past experiences. These expectations are typically about something (e.g., physical activity) and their function is to guide effective behavior. Expectations can be of different nature, for example of affective nature.

Affective expectations are simply more specific expectations and the same as what can be understood as anticipated affect. *Anticipated affect* is an affective state that a person expects to experience when confronted with a future event. It is a simulated affective consequence of a future situation that has not yet happened (Williams et al., 2019). These anticipated affective states can be a vague feeling of good or bad, but also specific emotions such as anger or fear (Baumeister et al., 2007).

Figure 4. *Relationship of terms relevant to anticipated affect*



Specific expectations such as anticipated affect are typically stored in *mental models* that are representations of external reality (Jones et al., 2011). Mental models are used to anticipate events and to explain one's own world. Thereby, a person's goals and knowledge influences how mental models look like as people have the tendency to seek information that fits their understanding of the world (also called confirmation bias).

This whole process of *anticipation* is what can be understood as *affective forecasting* (Wilson & Gilbert, 2003). A term that is frequently used as a synonym is prediction, which is not meant in a statistical sense, but from a neuroscience perspective.

Intention

The intention-behavior relationship

A considerable amount of research suggests that intention is a prominent determinant of physical activity behavior. Having the intention to do something represents the result of the deliberation about what to do and how hard one is willing to try to achieve certain goals (Ajzen, 1991; Webb & Sheeran, 2006). This definition comprises two components: decisional intention reflects the direction of action, while intention strength represents the commitment to enact behavior in that direction (Rhodes & Rebar, 2017). Decisional intention in particular is used to understand pragmatic real-world decisional processes such as choosing to form health behavior goals, join a recreation program, or make a new year's physical activity resolution. It is typically assessed bidirectional (yes/no) or with open choice formats ("I intend to exercise ___ times this week"). Intention strength can be measured with likert-scales ranging from strongly disagree to strongly agree (Rhodes & Rebar, 2017).

Intention has been shown to be a significant correlate of physical activity in numerous meta-analyses (McEachan et al., 2011; Rhodes & Dickau, 2012; Sheeran & Webb, 2016). However, there remains a substantial discrepancy between intention and behavior, particularly in prospective study designs. For example, experimental research suggests that even substantial increases in intention have little effect on behavior (Rhodes & Dickau, 2012; Sheeran & Webb, 2016). This discrepancy between intention and behavior is often coined the intention-behavior gap (Sheeran, 2002). The intention-behavior gap is particularly concerning to theoretical approaches where intention is considered the proximal antecedent of physical activity (e.g., Theory of Planned Behavior), because there is no explanation for this discordance.

Pragmatically, the dichotomous nature of decisional intention also allows for a four quadrant distribution of intention-behavior profiles known as the action control framework (Rhodes & de Bruijn, 2013). The four quadrants include (1) non-intenders who subsequently do not perform the behavior, (2) non-intenders who perform the behavior, (3) intenders who fail to perform the behavior, and (4) intenders who successfully perform the behavior. The discrepancy between (3) intenders who failed to perform the behavior and (4) intenders who successfully performed the behavior can be used to describe the intention-behavior gap on a between-subject level. These four quadrants are helpful to understand the nature and distribution of the intention-behavior

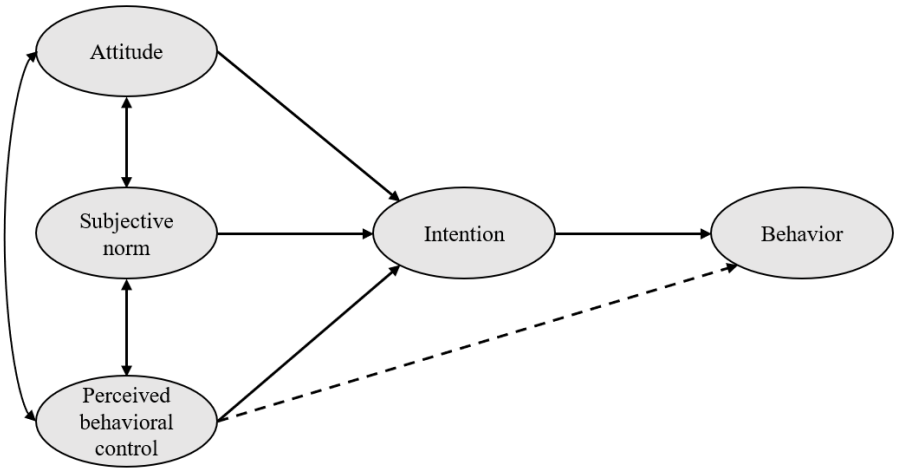
gap and to quantify the convergence and divergence of the intention-behavior relationship (Rebar et al., 2019; Sheeran, 2002). Considering the gap between intention and behavior, the development of theoretical models focusing on constructs that may bridge this gap are needed (Rhodes & Yao, 2015). A recent systematic review shows that anticipated emotions (e.g., anticipated regret) strengthened the intention-behavior relationship (Rhodes et al., 2022). These results give reason to believe that also other anticipated emotions and anticipated affect as a more comprehensive construct may influence the intention-behavior relationship.

Intention and anticipated affect in social cognitive theories

Given that anticipated affect is theoretically understood as a more reflective process, researchers suggest that anticipated affect is related to social-cognitive variables such as affective attitude, intention, or self-efficacy (Brand & Ekkekakis, 2019; Williams et al., 2019). The most prominent social cognitive model in the past decades is the "Theory of Planned Behavior" (TPB) by Ajzen (1991). Ajzen proposes that the intention is the central predictor of behavior (see Figure 5). Having the intention to do something represents the result of the deliberation about what to do and how hard one is willing to try to achieve certain goals (Ajzen, 1991; Webb & Sheeran, 2006). Perceived behavioral control is one of three predictors of intention and directly influences behavior. Ajzen emphasizes that one's perception of action control is what makes perceived behavioral control an important variable in the TPB. The second variable predicting intention is the subjective norm, which reflects the perceived social pressure of whether the behavior should be performed or not. The third variable is attitude toward the behavior and describes how favorably or unfavorably one evaluates the behavior.

According to Ajzen (2011), the anticipation of pleasure, regret or fear as a consequence of performing a behavior are simply behavioral beliefs. Behavioral beliefs can be of instrumental or affective nature. For example, one person may believe that physical activity will help with back pain (instrumental) while another person may believe that physical activity will give them pleasure (affective). Ajzen (2011) argues that anticipated affect regarding engaging in a behavior is part of attitude and therefore a predictor of intention.

Figure 5. *Theory of Planned Behavior (according to Ajzen, 1991)*



Other social cognitive models, such as the self-efficacy theory by Bandura (1997), include outcome expectancy constructs that play a similar role to affective attitudes in the TPB. In the self-efficacy theory, outcome expectancy is understood as the expectation of positive and negative outcomes as a result of one's performance (for a review on outcome expectancies, see Williams et al., 2005). Outcome expectancy was postulated as a mediating process between self-efficacy and behavior (Bandura, 1997), while in the TPB outcome expectancies in form of affective attitude influenced behavior indirectly via intentions (Ajzen, 2011). As we can see in these two social cognitive models, the relationship of anticipated affect and the target behavior is not yet fully understood. A recent meta-analysis by Bohlen et al. (2022) yielded that affective consequences in longitudinal studies were positively associated with physical activity (k = 14; r = 0.13; 95% CI [0.06, 0.19]).

Research gap and objectives

The relationship between affective experiences during exercise and future engagement in physical activity has received increasing attention in research (Klos et al., 2020; Nasuti & Rhodes, 2013; Rhodes et al., 2009). Researchers concluded that the study findings support the premise of hedonic theory, which states that people tend to decide and behave in ways that are pleasurable to them (Slovic et al., 2007). In other words, if people enjoy an exercise session, they will reattend because they want to experience that feeling again. Physical activity research has not focused as much on what happens

between the enjoyable, first exercise session and the future, second exercise session from a psychological perspective. What happens to that positive affective experience in between the two exercise sessions, and what exactly is it that influences participation in the future? According to neuroscientific research, the brain constantly uses memories to anticipate the future, including the anticipation of affective responses (Barrett, 2017; Hoemann et al., 2017). In other areas of research (e.g., in economics), it has already been recognized that anticipation processes are significantly involved in decision-making and subsequent behavior. Therefore, anticipating affective responses could help to explain exercise engagement.

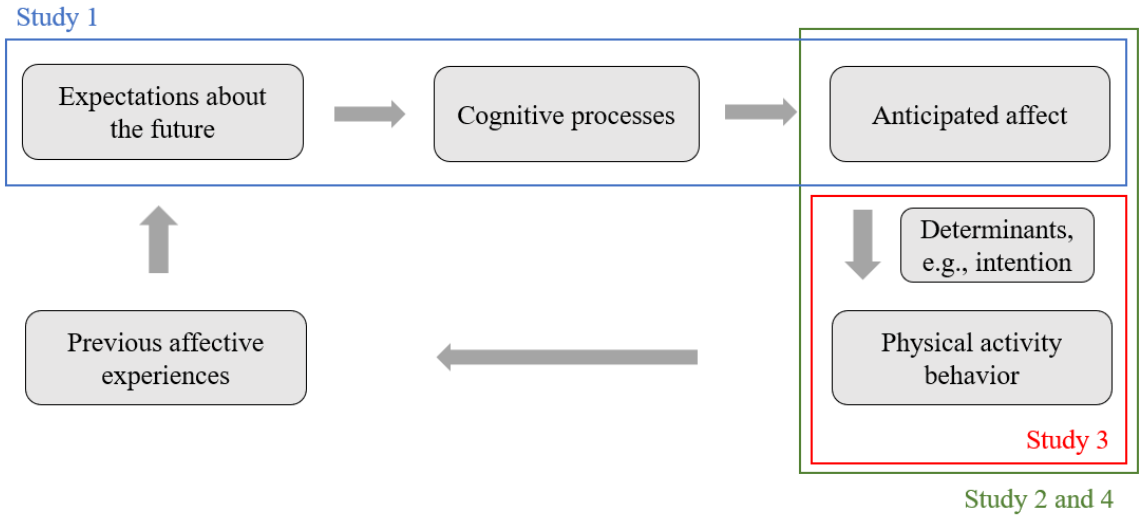
Another relevant component of physical activity behavior is the intention to exercise which has been underpinned by a large amount of research. However, the predictive power of intention on future physical activity behavior has been called into question as large changes in intentions resulted in only small changes in behavior. The meta-analysis by Rhodes and de Bruijn (2013) presented a considerably large gap between intention and physical activity, but it is unclear if this relationship has changed in recent years considering a larger number of studies focusing on this topic. Furthermore, if the intention-behavior gap is still considerably large, anticipated affect could influence this the intention-behavior relationship as a moderator. For example, anticipated regret, as one specific anticipated emotion, was a significant moderator of the intention-behavior relationship and other anticipated affective states also showed positive correlations with intention.

Given the presented research gaps, this dissertation aims to examine the role of anticipated affect and intention in physical activity behavior. Therefore, the main objectives of this thesis are:

(1) Identify relevant anticipatory and anticipated emotion categories regarding physical activity and develop a theoretical model of how anticipated emotions can be related to physical activity,
(2) summarize and analyze the current state of research on anticipated affect in physical activity and provide recommendations for future research,
(3) analyze and update the proportions of the intention-behavior profiles and the intention-behavior gap, and
(4) examine the role of anticipated enjoyment in exercise classes including intention as a widely accepted predictor of physical activity engagement.

Four studies were conducted to accomplish the objectives of this dissertation. Figure 6 shows the relationship between these studies. We assumed that in the context of physical activity, everyone has previous affective experiences that influence expectations about future events. The first study focused on how these expectations are transformed into affective expectations (anticipated affect or more concrete anticipated emotions) through cognitive processes. The second study reviewed how anticipated affect is related to physical activity and other relevant variables in the context of physical activity such as intention and affective experiences. The third study analyzed the intention-behavior relationship and presents the current state of research regarding the intention-behavior gap. Derived from the recommendations of the second study and due to the large observed size of the intention-behavior gap of the third study, the fourth study examined the relationship between anticipated enjoyment (as a specific anticipated emotion), intention (as one specific proximal determinant of physical activity), and physical activity behavior.

Figure 6. *Theoretical model to investigate the role of anticipated affect and intention in physical activity behavior*



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Anticipatory and anticipated emotions in regular and non-regular exercisers – a qualitative study

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Abstract

Future-oriented emotions could influence our decisions in everyday life and help understand why some individuals are physically active whilst others are not. Current literature distinguishes between two future-oriented emotion constructs: anticipatory and anticipated emotions. While anticipatory emotions are currently experienced emotions about a future event, anticipated emotions refer to the emotions that a person is expected to experience when confronted with a future event. The main aims of the present study were (1) to identify and describe (a) categories of anticipatory emotions experienced before exercise, and (b) categories of anticipated emotions expected to be experienced during and after exercise, and (2) to develop a theoretical model of anticipated emotion categories. Sixteen participants (M_{age} = 26.03, *SD* = 6.66) were recruited for semi-structured interviews, and their statements were analyzed using principles of the Grounded Theory. In total, 13 different anticipatory and anticipated emotion categories were identified, such as enjoyment, anxiety, pride, self-anger, and relief. Anticipatory emotions seem to reflect the current affective valence of exercising and may be influenced by daily factors. With regards to anticipated emotions, the results show that regular exercisers anticipated also negative emotions such as anxiety, disappointment, and self-anger, and non-regular exercisers also anticipated positive emotions such as enjoyment, pride, and satisfaction. Therefore, future research should not only focus on the valence of future-oriented emotions but should investigate the possible impact of specific anticipated emotions on exercise behavior. In addition, a theoretical model of anticipated emotion

categories in exercise behavior derived from the interviews. The model outlines different categories of anticipated emotions based on appraisal processes. In conclusion, we assume that this developmental process of anticipated emotions may be embedded in a broader, cyclical process within the context of exercising.

Keywords: anticipatory, anticipated, emotion, affect, physical activity, exercising

Introduction

Even though the benefits of regular exercise behavior on physical (Reiner et al., 2013) and mental health (White et al., 2017) are widely known, studies show that across countries, people are not sufficiently active (Hallal et al., 2012; Marques et al., 2015). Worldwide, 31.1% of adults are physically inactive and do not meet the physical activity guidelines (Hallal et al., 2012). In a European study, participants older than 24 were more likely to attain the recommended physical activity guidelines compared to 18–24-year-old ones (Marques et al., 2015). Therefore, young adults seem to be a vulnerable group when it comes to physical activity promotion. Considering the relevance of physical activity, it is not surprising that there is a great interest in understanding the psychological processes that can influence an individual's decision about being physically active or not. According to the pleasure principle, individuals are drawn to behaviors associated with pleasure and avoid behaviors associated with displeasure (Higgins, 1997). Behaviors are associated with a certain level of affect and these associations influence the decision whether or not to carry out a behavior (Slovic et al., 2007). Future-oriented emotions could play a crucial role in the decision-making process regarding the execution of physical activity. The theoretical approach of this article focuses on the anticipation of emotions related to future physical activity behavior rather than looking at currently experienced emotions during physical activity (Baumeister et al., 2007; DeWall et al., 2015).

In exercise psychology, the concept of affect has become the focus of recent research. Affect is an umbrella term for phenomena related to moods and emotions (Russell, 2003; Barrett, 2006). In particular, the term core affect is used to describe a "neurophysiological state consciously accessible as the simplest raw (non-reflective) feeling evident in moods and emotions" (Russell, 2003, p. 148). In the circumplex model (Russell, 2003), affective states are located on two dimensions that characterize core

affect: valence (pleasure - displeasure) and arousal (deactivated – activated). Emotions are context-dependent and more complex than core affect (Russell, 2003; Barrett, 2006; Clore and Ortony, 2013). According to Ortony et al. (1988, p. 13), emotions are "represented as a set of substantially independent groups based on the nature of their cognitive origins." In terms of future-oriented emotions, anticipatory emotions and anticipated emotions are considered two central constructs (Baumgartner et al., 2008). On the one hand, anticipatory emotions are currently experienced emotions about a future event (Bagozzi et al., 1998; Baumgartner et al., 2008). For instance, a person experiences the emotion anxiety in the moment they think about the next exercise session. On the other hand, anticipated emotions refer to the emotions that a person is expected to experience when confronted with a future event (Perugini & Bagozzi, 2001; Baumgartner et al., 2008). For example, in an imaginary prediction, a person expects to experience enjoyment during the next exercise session. Expectancies are defined as "beliefs about a future state of affairs" based on past experiences (Roese & Sherman, 2013, p. 91). Thus, the anticipated emotions can be considered a cognitive construction of a future state based on expectancies. It is assumed that they are either reflectively or automatically stored in form of mental models which can be understood as internal representations of the world constructed by the individual (Jones et al., 2011; Saban, 2019).

Focusing on anticipatory emotions, Bagozzi et al. (1998) were looking for prospective emotions that may influence motivation and goal-achievement regarding their body weight (success or failure). They showed that positive anticipatory emotions were a significant predictor of motivation and future health behaviors, such as exercising and dieting (Bagozzi et al., 1998). However, it should be mentioned that items to assess anticipatory emotions were rather formulated as a measurement of anticipated emotions ("If I succeed/do not succeed to … I will feel …"). In an attempt to distinguish more between these two constructs, Baumgartner et al. (2008) studied anticipatory and anticipated emotions independently. The study was about the millennium change and its possible negative impact on the country and on the participants' personal lives. Regarding anticipatory emotions, participants rated how worried, anxious, uncomfortable, optimistic, and confident they currently felt about the millennium change and the consequences during the first days of 2000. Anticipated emotions regarded the imagined emotions during the first week of 2000. The results indicated that both anticipatory and anticipated emotions independently influenced behavior intentions to limit possible negative consequences caused by the millennium change. Moreover, the study showed

that anticipatory emotions were mainly reflected in the prospective emotions hope and fear, while anticipated emotions, regarded rather retrospective emotions, such as relief, satisfaction, disappointment, and anger (Baumgartner et al., 2008). Importantly, however, to the best of the authors' knowledge, anticipatory emotions defined as currently experienced emotions about a future event have not yet been studied within the context of physical activity.

Compared to anticipatory emotions, there is more research on anticipated emotions. In another study, Perugini and Bagozzi (2001) focused on anticipated emotions in exercising and dieting and showed that positive anticipated emotions positively influenced decisions regarding these future behaviors. Comprising social behaviors and decisions, a meta-analysis showed that anticipated emotions can guide social behavior and judgment (DeWall et al., 2015). In exercise psychology, research rather focused on anticipated affect than on anticipated emotions. Anticipated affect is defined as "the expectation of how one will feel in response to engaging in, or failing to engage in, physical activity" (Stevens et al., 2020, p. 10). A recently published narrative review indicated a positive association between positive anticipated affect and positive affect during and after exercising and the intention toward exercising (Stevens et al., 2020). However, only one study showed that positive anticipated emotions associated with having successfully engaged in physical activity for 90 days were a stronger predictor for future exercising after this period of time than negative anticipated emotions associated with having failed to engage in physical activity for 90 days (Dunton & Vaughan, 2008). This finding is congruent with previous research on emotions experienced during exercising. As Rhodes and Kates (2015) revealed in a systematic review, positive emotions experienced during exercising are positively associated with future exercise behavior. A more recent systematic review showed that positive emotions, such as enjoyment, can be promoted through intervention studies in order to increase exercise participation (Klos et al., 2020). Included studies referred to positive affect or enjoyment or even used both terms synonymously. However, enjoyment should be understood as a specific emotion while positive affect is used as a more general term in this field of research (Chen et al., 2021). Based on the presented reviews one could conclude that regular exercisers anticipate positive emotions and that the promotion of those lead to a higher level of physical activity. So far, the valence of affect has been a central predictor of future exercise behavior in research (Rhodes et al., 2009; Rhodes & Kates, 2015). Accordingly, it is reasonable to conclude that negative emotions lead to avoidance of the

behavior (Higgins, 1997). However, given the complexity of physical activity this perspective might oversimplify the role of emotions in this particular behavior (Baumeister et al., 2007) and the influence of different emotions remains unconsidered.

While some studies focused on the valence of anticipated emotions, studies on specific anticipated emotions, such as regret, pride, and enjoyment present interesting results about how these specific emotions may influence intentions, exercise behavior, and emotions during and after exercising. Two studies focusing on anticipated regret showed that the imagination of failing to exercise predicted intentions regarding exercising and the exercise behavior itself (Abraham & Sheeran, 2003; 2004). Research on self-conscious anticipated emotions, such as pride and shame, in competitive, long-distance runners revealed that training progress was predicted by pride at the within and between-person level (Gilchrist et al., 2018a), while in another study, neither pride nor shame predicted training effort (Gilchrist et al., 2017). Moreover, expended effort was greater in participants who reported more anticipated pride than others (Gilchrist et al., 2017). In a third study on anticipated pride, more pride was anticipated in participants that were not as fit as they wanted to be compared to their imagined, ideal fitness status when they were asked to anticipate their emotions after a successful sport scenario (Gilchrist et al., 2018b). The anticipation of enjoyment was evaluated in two studies (they used enjoyment and positive affect synonymously; Ruby et al., 2011; Loehr & Baldwin, 2014). These studies showed that anticipated enjoyment was a significant predictor of experienced enjoyment, and anticipated enjoyment was significantly lower in inactive individuals while experienced enjoyment did not differ between active or inactive individuals (Loehr & Baldwin, 2014). At the same time, both studies also revealed a forecasting error, meaning that anticipated enjoyment was lower than the expected enjoyment during exercising (Ruby et al., 2011; Loehr and Baldwin, 2014). This forecasting error appeared regardless of the type of exercise (Ruby et al., 2011). The presented state of research shows that the number of studies on specific anticipated emotions in exercise behavior is limited, but it gives intriguing insights into how specific emotions can influence exercise behavior.

There are various theoretical positions on how to distinguish between emotions. One model to differentiate emotions was proposed by Ortony et al. (1988; commonly referred to as the OCC-model in Clore & Ortony, 2013). Interestingly, this theoretical approach has also been used by Bagozzi et al. (1998) to assess anticipatory and anticipated emotions (Perugini and Bagozzi, 2001; Baumgartner et al., 2008). According to Ortony

et al. (1988), so called emotion types can be differentiated based on the appraisal of conditions. Whether or not an emotion develops depends on the goals (appraisal of desirability), interests (appraisal of praiseworthiness), and beliefs (appraisal of appealingness) of each individual. Additionally, the model acknowledges that emotions are individually constructed and an emotion with the same label (e.g., anxiety) can be experienced differently by individuals (Clore & Ortony, 2013). The authors assume a cognitive structure of emotion types that depend on three major aspects of the world, namely events, agents, and objects. With regards to the first aspect, "events," emotions can be differentiated depending on whether the outcome of an event concerns the own person (e.g., joy) or someone else (e.g., pity). Furthermore, outcomes can already have happened (e.g., grief) or they can be prospective (e.g., anxiety). In this case, expectations about an outcome can be realized (e.g., satisfaction, fears confirmed) or not (e.g., disappointment, relief). Concerning the second aspect, "agents," outcomes can be viewed as one's own praiseworthy (e.g., pride) or blameworthy (e.g., shame) action or as someone else's praiseworthy (e.g., admiration) or blameworthy (e.g., reproach) action. The third aspect, "objects," can elicit emotions when objects are appraised as appealing (e.g., love) or unappealing (e.g., hate) (for a more detailed description of the OCC-model see Ortony et al., 1988; Clore & Ortony, 2013).

In summary, both anticipatory emotions and anticipated emotions seem to be two constructs that can contribute to a better understanding of whether an individual engages in exercise or not. Because these two constructs have so far received little attention in exercise psychology, we conducted an exploratory study with two main aims. The first aim was to identify and describe (a) categories of anticipatory emotions experienced before exercise, and (b) categories of anticipated emotions expected to be experienced during and after exercise in regular and non-regular exercisers. Because the experience of emotions has been shown to depend on their measurement either "during" or "after" exercise (Ekkekakis et al., 2011), we referred to both time points for anticipated emotions. The second aim was to develop a theoretical model of anticipated emotions that are particularly related to exercising. For that purpose, the interviews intended to reveal the appraisal processes related with emotions as these appraisal processes seem crucial for the development of the theoretical model. In contrast to the OCC-model as a rather general emotion model, the postulations of the theoretical model target the appraisal processes that are particularly relevant for the context of exercising.

Materials and methods

A qualitative study using semi-structured interviews was conducted to explore the role of anticipatory and anticipated emotions regarding future exercise behavior.

Participants

A purposive sampling strategy was used, considering three different factors to generate a high heterogeneity of the sample: gender (male vs. female), regularity of exercising (regular vs. non-regular), and the type of exercise (individual vs. group). The combination of these three factors built the inclusion criteria to participate in the study. Individuals that could not identify themselves as either regular or nonregular exercisers or participated in individual and group exercises equally were excluded. The participants needed to be between 18 and 65 years old as this study focused on adults. In line with the transtheoretical model (Prochaska & DiClemente, 1983), someone was considered a regular exerciser when their current type of exercise had been carried out at least once a week for at least 6 months. Even though tennis, squash, and climbing can also be regarded as individual sports, the selected participants attended group trainings and were therefore counted as exercises in a group. Participants allocated to "individual" exercising trained on their own, with an online coach, or used a mobile application.

Personal contacts of the interviewer were asked to reach out to people who met the criteria for participating in the study. The interviewer did not know the participants personally prior to the study. Two strategies were applied to recruit participants. A purposive sampling strategy allowed to create a high heterogeneity in the study sample, because differences in future-oriented emotions were assumed to be dependent on the predetermined characteristics. Additionally, theoretical sampling (Bryman, 2016) was applied until no more new categories of future-oriented emotions were reported. Through this procedure, a total of 16 participants (8 female) aged between 20 and 48 years (M = 26.63, SD = 6.66) were recruited (Table 1). Because we could not find many nonregular exercisers participating in groups, only two non-regular participants exercised in a group. General information about the purpose of the study, study procedure and data protection were sent via e-mail to the participants after ethical approval was obtained by the Ethics Committee of the university. Additionally, participants signed written consent forms prior to the interviews.

Table 1. *Description of study sample*

Gender	Regular active, individual	Regular active, group	Non-regular active, individual	Non-regular active, group
Female	2 running, horse riding	2 volleyball, climbing	3 home workouts	1 home workouts
Male	2 weight training, running	2 tennis, running	3 home workouts, weight training	1 Squash

Data collection

Semi-structured interviews were conducted with the participants. Interviews were conducted via Skype due to social distancing orders during the COVID-19 Corona virus pandemic. Participants verbally agreed to having the interview recorded. A semi-structured interview manual was created according to a 32-item checklist (Tong et al., 2007). The interviewer outlined the definition of anticipatory and anticipated emotions before the interview started. The interviews started with general questions followed by more specific questions. The first four questions addressed the participants' current exercise behavior such as the kind of exercising, how the exercise program was structured and for how long this exercise program has already been carried out by the participant. In three more questions, the participants were asked about their reasons for exercising and how important exercising is for them to estimate the role of exercising the participants' life. The term exercise is a subcategory of physical activity defined as "physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective" (Caspersen et al., 1985, p. 128).

Further, the interview was divided into two sections to question the participants about (a) their anticipatory emotions, and (b) about their anticipated emotions during and after exercising. For both sections, the interviewer referred to the type of exercising, which the participants had performed in the last 6 months the most. The interview manual for both sections was structured similarly. After one central question several additional questions followed to gather more information about each specific emotion. Thus, three question catalogs involving a central question and some additional questions were conceived, one question catalog for (a) anticipatory emotions and two for (b) anticipated emotions. The central question in the first section on anticipatory emotions was "What

do you feel right now when you think about your next sport or exercise session?" In the second section, the central question was about the participants' anticipated emotions during exercising: "What feelings are you expecting during the next sport or exercise session?" In a third central question, the participants were asked about their anticipated emotions after exercising: "What feelings are you expecting immediately after the next sport or exercise session?" After each of the three central questions, participants were asked to describe their feelings and related thoughts. They were also asked if a physical sensation was related to this feeling and if they can find a name for this specific emotion. These additional questions were part of all question catalogs. Regarding (a) anticipatory emotions, participants were also asked how this anticipatory emotion is related to similar situations experienced in the past and to the present situation. Regarding (b) anticipated emotions, participants were also asked if they know why they anticipate these specific emotions. This makes a total of seven questions regarding one anticipatory emotion and a total of five questions regarding one anticipated emotion. All questions of the interview manual were asked if they were not already obviously answered beforehand. This was only the case regarding the name of specific emotions (e.g., "I would call this feeling …"). After the interview catalog regarding a specific anticipatory or anticipated emotion was completed, participants were asked if they feel or anticipate any other feelings that are different from the feeling described before. Then the same question catalog was applied again. The full interview manual can be found in the supporting information. Interviews were transcribed verbatim using the f4 transcription software (Dresing & Pehl, 2018).

Data analysis

For the organization of the data the f4 analysis software was used (Dresing & Pehl, 2018). Transcripts were analyzed according to the principles of the Grounded Theory (Strauss and Corbin, 1996). This analysis included three steps. Open encoding as the first step in the analysis process started after the first interviews were transcribed. Full texts were coded by building different concepts inductively and classified into categories in order to group similar concepts. In the second step, axial coding was used to find connections between categories. Relationships between categories and subcategories were analyzed within the third step of selective coding. The final categories reflect the anticipatory and anticipated emotions of exercisers. For anticipated emotions, a

theoretical model was proposed based on relationships between emotion categories. Additionally, anticipated emotions were embedded in a broader context resulting in a process model. The statements were interpreted with regards to existing emotion theories. For example, when participants reported only the valence (feeling good or bad) or the arousal (feeling relaxed or tensed) of an emotion, these statements were not interpreted as distinct emotion categories. Direct quotations in the section "Results" serve as examples and were analogously translated into English by the first author of the study.

Trustworthiness

We applied several steps to increase the trustworthiness of the present study. The interviewer was a graduate in sports and health sciences with personal experiences in competitive sports. Her experience in various team and individual sports helped her understand the different perspective of the participants. Social desirability bias (Bergen & Labonte, 2020) can occur in interviews about sensitive topics such as emotions. Therefore, interviews were conducted with only one researcher and participants were informed about the study topic and aim prior to the interview. Furthermore, the interviewer did not know the participants personally before the interviews, allowing for a neutral relationship between the interviewer and the participant. With this procedure we aimed to reduce the risk of social desirability bias and increase the trustworthiness of the participants' statements.

Interviews were transcribed by the first author, and the transcripts were then checked by the participants. During the inductive coding process, some of the participants' statements remained unclear for interpretation. Therefore, member reflection conversations were conducted with six participants in total. Member reflection conversations were undertaken to gain additional data and to clarify ambiguous descriptions of emotions in the interviews (Smith & McGannon, 2017). Semi-structured interview manuals were individually created for each member reflection conversation based on the first interviews. When participants had difficulties describing an emotion or were unsure how to differentiate emotions from each other, the interviewer supported the participant with examples of emotion types in accordance with the OCC-model (Ortony et al., 1988). In the interpretation process of the participants' statements, other researchers in the area of sport and exercise psychology served as critical friends. The results drafted

by the first author were critically discussed to reflect on alternative interpretations of the interview statements and to improve the comprehensibility of the results.

Results

Anticipatory emotions

Seven different emotion categories emerged through the interpretation of the participants' reported anticipatory emotions. All participants stated at least one and up to three different anticipatory emotions.

Enjoyment. Ten participants, of which five exercised in a group or with a partner, and seven were males, reported joy, enjoyment, and happiness when thinking about the next exercise session. Statements about having fun were also summarized under the term enjoyment. Seven out of ten participants were regular exercisers who looked forward to exercising because the execution of the sport itself was perceived as enjoyable. Participants described this emotion with excitement in the stomach, beaming with joy and smiling when thinking about their sport. Enjoyment was attributed to meeting teammates and friends with whom exercising is more fun. Participants stated that a short period of abandonment due to injuries or closures of sport facilities resulted in enjoyment, because they were looking forward to executing their sport again. Other reasons were that exercising was perceived as a change to the daily working routine, as an experience of nature, or as a possibility to increase the performance level.

> *"In that regard, I'm happy that I can be active again and do something good for myself"* (No. 7, male, non-regular exerciser, individual).
>
> *"Yeah, it plays an extremely big role for me when I've had a stressful week at work, and that's very common. The training is on Friday, it's this compensation really, this coming down and this shaking the stress off. That's actually the greatest joy"* (No. 4, female, regular, group).

Anxiety. Five exercisers, of which two were regular exercisers and three were non-regular exercisers, recognized being anxious when thinking about their next exercise session. All of them exercised on their own and four out of five participants were female. They reported being afraid of disappointing themselves with a bad performance and harming their body physically. Furthermore, they experienced themselves as not being good enough compared to their former fitness level or the fitness level of others. Some

statements also indicate that anxiety may be an emotion that precedes the development of disappointment or shame. Additionally, participants showed physical symptoms of anxiety such as a queasy feeling in the stomach and an uncontainable feeling of nervousness.

> *"Also, a little bit of anxiety, because right now or a few weeks ago I had a little bit of trouble with running"* (No. 3, male, regular exerciser, individual).
>
> *"(...) that's why it's also a bit of fear of seeing that what I achieved was all for nothing. And that's just demotivating"* (No. 5, female, non-regular exerciser, individual).
>
> *"Yes, it goes in the direction of fear. I can't describe the queasy feeling in my stomach very well, it just comes, and I can't control it. But it's just so uncomfortable what's going on in my stomach. Then, I also get nervous and just don't want to go outside or move at all"* (No. 12, female, non-regular exerciser, individual).

Relief. One female regular exerciser reported being relieved when thinking about her next exercise session. Her perceived relief was due to a full recovery after a long period of injuries and being able to train again. This participant was part of a volleyball team as a player and a coach.

> *"The fact that it's working again now, that I have fought my way back [to playing volleyball], is just such a relieving feeling, which I still have when I think about it."* (No. 2, female, regular exerciser, group)

Pride. One male non-regular exerciser was glad that he had been physically active in the past, so that he had a fitness level to build on. He was not grateful for something that was given to him but rather proud that he exercised in the past which is a benefit for him now.

> *"To some extent maybe, when I look back on past exercise trainings, then some of it is gratitude towards myself for exercising back then."* (No. 16, male, non-regular exerciser, individual)

Remorse. One male non-regular exerciser had feelings of remorse, such as feeling guilty about not having exercised regularly in the past. Exercising regularly may be something that others expect from him because as a healthy student without a stressful job he had no

excuse not to exercise. This participant used to go on his own to the gym for weight training.

> *"Yes, I feel a bit bad about it [not exercising]. I have a guilty conscience. (…) Yes, I should go to the gym more often, and that it's good for me, when I go to the gym. I don't know why I don't go more often; even though I have time."* (No. 7, male, non-regular exerciser, individual)

Shame. One female non-regular exerciser reported feeling shame when thinking about the next exercise session. She reported societal pressure as the reason why she thinks her performance is embarrassing. According to her description, the image of a young woman nowadays involves being athletic. Because she cannot fulfil these expectations, she prefers to exercise alone using online videos.

> *"Maybe a little bit of shame. Exactly, because I think socially it's regarded that it's a good thing to be athletic."* (No. 6, female, non-regular exerciser, group)

Regret. Three regular exercisers stated that they would miss the exercise experience when they imagine not being able to participate in the next exercise session. One female exerciser had strong feelings of regret, because she may leave the team when she is pregnant.

> *"If I didn't do it, I would absolutely miss it."* (No. 2, female, regular exerciser, group) *"Because I know what it's like when training is cancelled or when you don't have that equalizer on Fridays. That really drags on into half the weekend until you really come down."* (No. 4, male, regular exerciser, group)
>
> *"(…) it's because I would miss something when I wouldn't do it."* (No. 14, male, regular exerciser, group)

Anticipated emotions during exercising

Emotions that were anticipated to be felt during the next exercise sessions were transformed into ten different emotion categories. All participants reported at least one and up to four different anticipated emotions during their next exercise session.

Enjoyment. Enjoyment was described by eleven participants, of which six were regular and five non-regular exercisers. Four out of eleven participants exercised in groups, and

six exercisers were male. Enjoyment was the most frequently reported anticipated emotion during the exercise session. Five participants explained that they anticipated to enjoy the next exercise session because they like executing the sport and experience it as fun. Enjoyment was also described as an exhilaration or as an exuberant feeling of joy. This emotion was accompanied by laughing, joking, feelings of ease and strength during the training.

> *"Enjoyment, enjoying the sport. I go into the climbing hall and I'm just insanely happy to be able to do the sport."* (No. 9, female, regular exerciser, group)
>
> *"I laugh and have fun, because I'm joking with others."* (No. 2, female, regular exerciser, group)
>
> *"So, it's a very, very positive feeling I must say, at this moment. I'm really looking forward to it. (...) At first, it's pure joy."* (No. 1, female, regular exerciser, individual)
>
> *"At the beginning, in any case, very happy and glad about doing it (...)."* (No. 8, male, non-regular exerciser, group)

Displeasure. One female and two male non-regular active participants anticipated to feel displeasure during their next exercise session which is why they would try to avoid the participation. They were demotivated to engage in future exercise sessions.

> *"It's this displeasure, the avoidance of uncomfortable situations."* (No. 6, female, non-regular exerciser, group)
>
> *"When I realize that I have gotten weaker and I don't feel strong during the exercises, I become demotivated."* (No. 10, male, non-regular exerciser, individual)

Hope. One male non-regular exerciser who trained on his own stated he anticipated to feel hope during his next exercise session. He anticipated to hopefully reach the end of the exercise session and to accomplish a valuable task.

> *"(...) or maybe also hope in the sense that soon I will have made it and will have done something good."* (No. 16, male, non-regular exerciser, individual)

Anxiety. The emotion anxiety was reported by seven participants, two non-regular and four regular exercisers. Four participants were female and three participants exercised on their own. Anxiety or nervousness was anticipated to be felt during their next exercise

session, because they expected some undifferentiated negative consequences, such as failing certain tasks. One participant stated that the change of environmental conditions could compromise her safety.

> *"(…) sometimes you have thoughts of fear or what would you do when you can't control your horse. (…) You don't know what could happen or you are afraid that something could happen that you can't anticipate."* (No. 11, female, regular exerciser, individual)
>
> *"So, at the beginning, I would say that the first five to ten minutes are pretty exciting."* (No. 4, male, regular exerciser, group)

Satisfaction. Three non-regular and four regular active participants anticipated to feel satisfaction during their next exercise session. Five out of seven exercisers who anticipated satisfaction participated in groups and four of the seven participants were male. The satisfaction was related to the participants' own ability to participate in the training or the positive outcome of a match. Participants used the terms calmness and detachedness to describe their feelings. Some participants closely linked the experience of satisfaction to the emotions enjoyment and pride.

> *"I'm satisfied that I decided to do it again (…)"* (No. 13, female, non-regular exerciser, individual)
>
> *"A certain satisfaction and great joy when you have won and rewarded yourself for the work during the session."* (No. 8, male, non-regular exerciser, group)
>
> *"I would say this interaction gives you, somehow, satisfaction."* (No. 4, male, regular exerciser, group)

Disappointment. Two non-regular active participants reported to expect disappointment during the next exercise session. The emotion was directed to themselves because they anticipated consequences, which they tried to avoid. Both participants also said that the emotion self-anger accompanied the emotion disappointment.

> *"Yes, a certain sense of disappointment is already there if it doesn't get better or doesn't work out, even though you tried with all your strength to change something (…)."* (No. 8, male, non-regular exerciser, group)
>
> *"(…) when I don't achieve the things that I've set out to reach or when I don't have the power that I would have had for that exercise, then I'm really*

disappointed with myself and maybe a bit angry, too." (Nr. 12, female, non-regular exerciser, individual)

Anxiety confirmation or despair. One non-regular exercising female participant anticipated that her fears would come true which would result in despair. She expected to fail in some exercise tasks and she did not know how to cope with this situation. Despair was related to frustration and self-anger.

"(…) the fear that I'm no longer able to accomplish certain tasks and of being desperate. (…) I will probably be desperate in that moment, because I'm not able to execute the task." (No. 13, female, non-regular exerciser, individual)

Pride. Three female and two male non-regular exercisers who trained individually anticipated to feel pride during the next exercise session. On the one hand, they were proud of themselves because of their decision to participate in the exercise session and on the other hand, they linked pride to the experience of success. In the view of some participants, the experience of pride was closely linked to enjoyment.

"A little bit proud, because I managed to overcome my weaker self, again, (…) as I said, pride, because I did it again (…)." (No. 5, female, non-regular exerciser, individual)

"Actually, joy and pride that I made it." (No. 7, male, non-regular exerciser, individual)

"Depending on how much you've done, you're prouder than you would be if you'd only done one fitness video." (No. 6, female, non-regular exerciser, group)

"I think it feels a bit like success when I exercise, because I notice that it really feels good and it feels like happiness (…)." (No. 13, female, non-regular exerciser, individual)

Self-anger. Five participants, of which two were regular and three were non-regular exercisers, anticipated to feel self-anger during their next exercise session. Two of them exercised in groups, and three out of five participants were females. Self-anger was anticipated due to experiences of failure and the self-evaluation of being unable to fulfill the tasks. Two participants linked their self-anger to the feeling of frustration.

> *"If I stop, I have to be really angry or frustrated, then, I stop and that's the point where I say okay, I'm not running any further now."* (No. 1, female, regular exerciser, individual)
>
> *"I also have phases where I'm concentrated, where I get angry, because something doesn't work out the way I would like it to (...)."* (No. 2, female, regular exerciser, group)
>
> *"Yes, depending on how stupid the loss of a point or the final result was or how unfortunate it was, I would like to smash the racket on the ground from time to time. But of course, you can't do that."* (No. 8, male, non-regular exerciser, group)
>
> *"It has happened that I've been angry at myself and that lead to the fact that I just give up and I don't continue the exercise session."* (No. 12, female, non-regular exerciser, individual)

Shame. One female non-regular exerciser described the fear of getting exposed in front of others while exercising. In a member reflection conversation, she described this feeling with the emotion shame. To reduce this negative emotion, she predominantly exercises at home and avoids the attention of others.

> *"I just feel extremely uncomfortable in a gym, and these feelings of worry and fear would be even bigger than they already are at home."* (No. 12, member reflection, female, non-regular exerciser, individual)

Anticipated emotions after exercising

Based on the anticipated emotions after exercising reported by the participants, eight different emotion categories were conceptualized. All participants stated to feel at least one and up to five different anticipated emotions after the next exercise session.

Enjoyment. Eight participants, of which four were regular and four were non-regular exercisers, anticipated to feel enjoyment after their next exercise session. Two of them participated in a group and six were males. The exercisers who anticipated enjoyment expected to enjoy the physical and mental state after exercising. Participants described the anticipation of enjoyment as a consequence of the fun they would be experiencing during the exercise sessions. They anticipated that enjoyment would influence their

general mood and attitude positively. This effect was supported by evaluating the exercise session as successful.

> *"I expect, and it occurs like that almost every time, that I feel great. I'm happy and directly after I stopped running in the forest, I experience joy after work is done."* (No. 1, female, regular exerciser, individual)
>
> *"It is in any case then simply the enjoyment to have played again, to have exercised again, to have moved again and simply to have had fun."* (No. 8, male, non-regular exerciser, group)
>
> *"Predominantly I'm glad; joyous that I did it."* (No. 16, male, non-regular exerciser, individual)
>
> *"Being happy and having joy in having achieved that."* (No. 12, female, non-regular exerciser, individual)

Displeasure. One non-regular male exerciser expected to quit early from exercising because he anticipated to experience displeasure during the exercise session.

> *"When it [the exercise session] didn't go that well, it wasn't fun and exhausting, then I quit. I say to myself, it just doesn't make sense today, and I don't feel pleasure."* (No. 10, male, non-regular exerciser, individual)

Hope. One male non-regular active participant anticipated to feel hope besides enjoyment, after his next exercise session. Based on the assumption that the next exercise session may be a positive experience, he anticipated having hope for becoming a regular exerciser.

> *"Maybe also a little bit of hope that this overcoming which I had to put up with before, was perhaps not so great and this should get me to exercise more regularly in the future. (…) besides the joy that I did it, I think that I should do it more often and that it mainly was a positive experience."* (No. 16, male, non-regular exerciser, individual)

Satisfaction. Nine participants, of which four were non-regular exercisers stated that they anticipated to feel satisfaction after their next exercise session. Five out of nine exercisers participated in a group, and four exercisers were females. Satisfaction was the most frequently anticipated emotion after exercising. Participants anticipated to be satisfied with their physical effort during the exercise session and with benefits associated with the

exercise session (e.g., meeting friends). Three participants closely linked the emotion satisfaction to the emotions enjoyment and pride.

> *"Well, satisfaction, just to have burned off energy, to have given everything, to have met friends, just to have had a great evening and then you go home satisfied."* (No. 9, female, regular exerciser, group)
>
> *"Yeah so, satisfaction and joy. I'm actually happy afterwards. Happy and satisfied. (...) Exactly, so as I've said, the satisfaction with myself is quite big."* (No. 7, male, non-regular exerciser, individual)
>
> *"(...) I would feel satisfied again, maybe a little exhausted depending on how I exerted myself, but in general I would feel satisfied, I assume."* (No. 13, female, non-regular exerciser, individual)
>
> *"You are simply satisfied that you've done something. That you have moved, and that you already know, from the past, that what you have just done is good for you."* (No. 14, male, regular exerciser, group)

In a member reflection conversation, one participant explained that anticipated satisfaction depends on the success of his own performance. He then referred to the emotion pride. Two other participants specified their emotions as anticipated satisfaction in member reflection conversations.

Disappointment. One male regular exerciser and one male non-regular exerciser anticipated to be disappointed after their next exercise session. They anticipated this emotion for when the performance outcome is evaluated as poor or not good enough resulting in a feeling of dissatisfaction.

> *"Probably also sometimes disappointment, if it didn't go so well."* (No. 3, male, regular exerciser, individual)
>
> *"Yes, dissatisfaction. (...) I have not shown the performance I would have expected."* (No. 10, male, non-regular exerciser, individual)

Relief. Four participants, of which two were non-regular and two were regular active exercisers anticipated relief after their next exercise session. Three out of the four participants exercised on their own and three participants were males. The exercisers anticipated to be relieved because eventual negative consequences of their performance may not occur. Doubts which they had prior to the exercise session have would not be

confirmed. A non-regular active participant anticipated to be relieved, because he would not have to exercise again, as he already did a training session this week.

> *"Just like you can check something off from a to-do list. Relieved, just like relief. The relief of doing a task that you don't like so much, but have the feeling that you have to do it."* (No. 6, female, non-regular exerciser, group)
>
> *"Well, I mean, to some extent you're always glad when training is over. I like it very much, but I'm also happy when it's over because it's a really big effort for the body. I'm happy when I'm coming home relieved."* (No. 15, male, regular exerciser, individual)
>
> *"Relief comes up when I can estimate or foresee the end of the training and I'm convinced that this initial nervousness or fear of failure will not occur."* (No. 14, member reflection, male, regular exerciser, group)

Pride. Five participants, of which four were non-regular active exercisers, anticipated to feel the emotion pride after the next exercise session. Three out of five exercisers were females, and four participants exercised individually. The exercisers explained that they anticipated to be proud of themselves for taking the step to participate in the exercise session or for accomplishing more during the training than they had expected. In one of the exerciser's descriptions, the anticipation of pride was related to the achievement of personal goals.

> *"So, the positive feelings after exercising are that I'm happy that I did it again. I'm actually proud of myself and feel real joy, and think to myself, wow, good!"* (No. 5, female, non-regular exerciser, individual)
>
> *"Depending on how much you've achieved, you're prouder than you would be, if you had only done one exercise video."* (No. 6, female, non-regular exerciser, group)
>
> "I'm very proud of myself that I managed to go to the gym and pull it off." (No. 7, male, non-regular exerciser, individual)
>
> *"It's less pride towards others, so it's not like that you've accomplished some work, but pride in the sense that even though it is very limited running, you're setting personal goals."* (No. 14, male, regular exerciser, group)

Another female non-regular exerciser described feelings of hubris as a sense of superiority over others and a heightened form of pride. She anticipated becoming more

athletic over the next exercise sessions while others remain inactive even though she was a non-regular exerciser herself.

> *"Maybe you can call it a bit of arrogance, that I think yes, I've made it (...), I feel really good now, because I've achieved more than someone else."* (No. 12, female, non-regular exerciser, individual)

Self-anger. Two participants reported that they anticipated becoming angry with themselves after their next exercise session. One female non-regular exerciser anticipated the emotion of self-anger, because she expected herself to perform poorly during the exercise session and explained this with non-regular training, although she is aware of the benefits of physical activity. Another female but regular exerciser would only anticipate this emotion if she were to have performed poorly that day. This indicates that self-anger depends on the performance outcome of the exercise session. The emotion was reported to be expressed through nervous movements and harsh self-talk.

> *"(...) I know that it is important that you are physically active, and then I get angry at myself that I'm so exhausted from jumping around for 20 minutes. (...) Yes, anger and rage at myself for being such a loser (...)"* (No. 5, female, non-regular exerciser, individual)
>
> *"Well, should it not go well, maybe also anger. So rather a negative emotion, when I realize oh, well, the bouldering session today did not work out at all (...)."* (No. 9, female, regular exerciser, group)

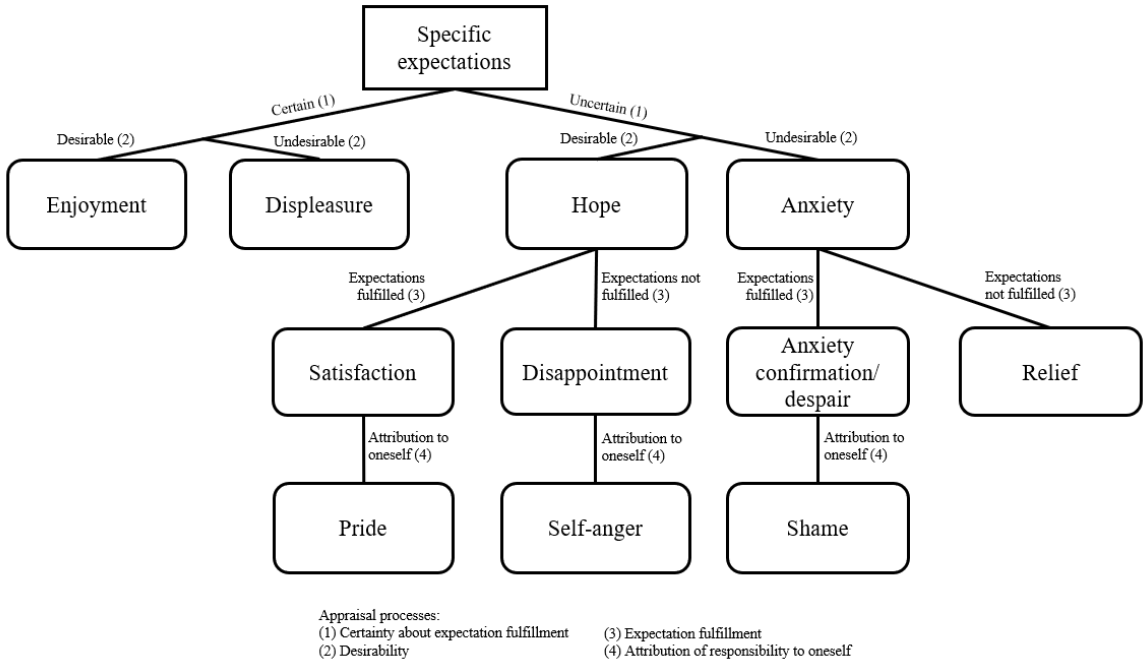
Theoretical model of anticipated emotion categories

Based on the identified emotion categories, a theoretical model of anticipated emotion categories was derived, including anticipated emotions during and after exercising (Figure 7). This theoretical model postulates that different emotion categories are anticipated depending on specific appraisal processes.

Four appraisal processes that guide the anticipation of emotions have been identified from the interviews: (1) certainty about expectation fulfillment, (2) desirability, (3) expectation fulfillment, and (4) attribution of responsibility to oneself. The occurrence of emotion-provoking events during exercise can be appraised as either relatively certain or relatively uncertain. If an individual is convinced that the expectation will come true, they anticipate enjoyment when the outcome is desirable or displeasure when the outcome

is undesirable. For example, one exerciser anticipated enjoyment because she was convinced that it would be fun to meet friends and to play as a team (No. 2). Another participant anticipated feelings of displeasure while exercising because she had multiple negative experiences and so, expected negative consequences for sure (No. 6). In the case of uncertain outcomes, one anticipates hope if the consequences are expected to be rather desirable or anxiety if the consequences are expected to be rather undesirable. One participant anticipated to feel hope during exercising because he was unsure if he would persevere until the end of the session (No. 16), while another participant anticipated to feel anxiety because she was unsure about possible negative consequences that would come up during the exercise session, such as being judged by others (No. 6).

Figure 7. *Theoretical model of anticipated emotion categories in exercise behavior*



Hope and anxiety are emotions with a prospective character and depend on the valence of the expected consequences. Depending on the actual consequences, emotions with a responsive character can develop. The development of emotions with a responsive character is driven by the anticipation of the fulfillment of expectations. In the case of hope, when the individual expects desirable consequences during or after the exercise session, the anticipation that these consequences actually come true can be associated with the anticipation of satisfaction. In contrast, if the individual anticipates that the desirable consequences will not occur, they would rather anticipate disappointment. For

example, one participant anticipated to be disappointed because she hoped for positive performance outcomes even though she did not exercise regularly and it was likely that her desirable consequences would not occur (No. 12). Likewise, in the case of anxiety, when the individual expects undesirable consequences during or after the exercise session, the anticipation that these consequences actually come true can be associated with the anticipation of despair. For example, one exerciser anticipated anxiety, resulting in despair because the upcoming exercise tasks would be too hard (No. 13). In contrast, if the individual anticipates that the undesirable outcomes will not occur, they would rather anticipate relief. One participant explained that relief occurs after the training because the expected fear of failure during the running session did not arise (No. 14).

Finally, the outcomes are appraised in terms of their causes. In the interviews, individuals frequently attributed the causes of outcomes to themselves and this attribution process was related to the formation of three emotions: pride, self-anger, and shame. First, if one attributes anticipated desirable consequences to the competence of oneself, anticipated satisfaction can develop into anticipated pride. For example, one participant anticipated to be proud after training because he decided to participate until the end and take care of his physical health (No. 7). Second, if an individual blames oneself for the unexpected undesirable consequences, anticipated self-anger can emerge from anticipated disappointment. One participant anticipated to feel anger and rage after exercising because she attributed the physical exertion to her insufficient performance level (No. 5). Third, if an individual blames oneself for the expected undesirable consequences, anticipated shame can arise from anticipated despair. For example, one participant anticipated to feel shame because she feels embarrassed when exercising in front of others (No. 12). It should be mentioned that the emotion categories anxiety confirmation/despair and shame were only anticipated by one participant respectively.

Discussion

The main aim of this study was to identify categories of anticipatory emotions and categories of anticipated emotions during and after exercising. Categories of anticipatory emotions were enjoyment, anxiety, relief, pride, remorse, shame, and regret. Categories of anticipated emotions during and after exercising were enjoyment, displeasure, hope, anxiety, satisfaction, disappointment, anxiety confirmation/despair, relief, pride, self-anger, and shame. The valence of anticipatory and anticipated emotion categories was

positive as well as negative within both regular and non-regular exercisers. However, tendencies show that regular exercisers anticipated more positive emotions, while non-regular exercisers anticipated more negative emotions. This tendency was more apparent for anticipatory emotions. The results revealed not only a detailed description of emotion categories, but also allowed to conceive a theoretical model of anticipated emotion categories which may help to explain how different emotion categories emerge based on expectancies and appraisal processes.

Anticipatory emotions

The results of this study demonstrate that anticipatory emotions can be clustered into three groups. First, anticipatory emotions, such as pride, relief, shame, and remorse were based on past experiences with exercising, but were still viewed as relevant for future exercising. Participants felt proud or guilty because they had or had not been exercising for a while, they felt ashamed the last time they exercised, and they felt relieved after long period of injuries. Second, the emotion regret is different from the other emotions because it involves the imagination of missing the next exercise session. All participants that reported regret were regular exercisers, which fits with the results published by Abraham and Sheeran (2003; 2004) who showed a positive association between regret to miss an exercise session and exercise behavior.

Third, the anticipatory emotions enjoyment and anxiety were directly related to events during the next exercise session. Compared to pride, relief, shame, and remorse, these two emotions were not only based on past experiences but also on expected events such as meeting friends or experiencing social pressure specifically during the next exercise session. According to the OCC-model (Ortony et al., 1988), enjoyment can be experienced when one is pleased about a desirable event. Participants stated that they execute their sport primarily because they enjoy it. Therefore, enjoyment was viewed as an emotion that "leads to performing an activity primarily for its own sake" (Kimiecik & Harris, 1996, p. 258) which is closely linked to intrinsic motivation (Ryan & Deci, 2000; Wienke & Jekauc, 2016). According to the Self-Determination Theory, enjoyment is postulated as a relevant regulatory process that determines intrinsic motivation "which refers to doing an activity for the inherent satisfaction of the activity itself" (Ryan & Deci, 2000, p. 71). We identified the need of autonomy, competence, and relatedness as important factors whose satisfaction could have enhanced enjoyment and subsequently

the intrinsic motivation of the participants in the present study. Several participants reported that meeting friends, increasing performance, and reducing stress are important aspects for experiencing enjoyment. Anxiety has a prospective character because the undesirable consequences are anticipated and have not yet happened (Ortony et al., 1988; Baumgartner et al., 2008). As outlined in previous studies, depending on the outcome of the event, anxiety can be an antecedent of emotions with a responsive character (Baumgartner et al., 2008; Ortony et al., 1988). With regards to the definition of anticipatory emotions (Baumgartner et al., 2008), these emotions were experienced in the moment of the interview but refer to a future event. Thus, it is important to consider that a current emotional experience can also be influenced by other factors, like one's current mood.

Anticipated emotions

During the analysis process of anticipated emotion categories, it was notable that both regular and non-regular exercisers anticipated positive as well as negative emotions. However, it must be mentioned that regular exercisers described more positive anticipated emotions and non-regular exercisers described more negative anticipated emotions. Additionally, participants reported a greater variety of anticipated emotions compared to anticipatory emotions. In a previous study examining anticipatory and anticipated emotions related to the historic event of the millennium change, it was postulated that anticipatory emotions typically have a prospective character (hope, anxiety), while anticipated emotions typically have a responsive character (e.g., disappointment, satisfaction, Baumgartner et al., 2008). However, in our study, we found that anticipated emotions can have both a prospective and responsive character. The event of an exercise session must be distinguished from historic events, such as the millennium. The results of the present study underline the uniqueness of an exercise session that extends over a limited period of time and that contains several small events which can elicit different emotions compared to the imagined consequences of one historic moment. Moreover, anticipated emotions involve a greater cognitive component (Williams et al., 2019). While anticipatory emotions follow automatic pathways, anticipated emotions are part of a more reflective process (Stevens et al., 2020).

The guiding role of anticipated pleasure or displeasure in decision making has already been investigated years ago. Mellers and McGraw (2001) suggest that individuals

choose their behavior with the highest likelihood of it being pleasurable compared to other options. Furthermore, they acknowledge that anticipated pleasure can increase when individuals anticipate their performance to be high and satisfying. In the present study, especially non-regular exercisers were unsure of what to expect from the next exercise session because they could not estimate their own abilities and tended to overstrain themselves. The level of effort of the exercises should match the current abilities and needs of the participants in order to promote outcome expectancies appraised as desirable. As shown in various studies, exercising with moderate intensity is perceived as more pleasurable than high intensity exercise (Ekkekakis et al., 2011; Ekkekakis, 2003; Ekkekakis et al., 2004), suggesting that matching skills to training demands promote positive affect and desirable outcome expectations. In particular, female, non-regular exercisers expected negative outcomes because their physical abilities were estimated as low compared to the demands of the workout, and they anticipated rather negative emotions, such as displeasure, anxiety, disappointment, shame, and self-anger. Literature suggests that higher levels of social media use can predict increased body shame (Salomon & Brown, 2018) and reduce motivation to exercise (Robinson et al., 2017). These findings underline the importance of exercise environments in which participants feel secure, respected and encouraged, regardless of their exercise level. It should be pointed out here that the sample of this study consists mainly of young adults (M = 26.63, SD = 6.66) and that self-conscious emotions were less reported by participants older than 35 years. In addition, a coach could help to motivate exercisers complete their workout, correct wrong movements and set an appropriate exercise load (Strauch et al., 2019).

Parallels to the OCC-model (Ortony et al., 1988) can be found regarding the appraisal processes and emotion categories. As we outlined in the theoretical model of anticipated emotion categories, the development of emotions underlies some sorts of appraisal processes, which are part of many emotion theories (Ortony et al., 1988; Scherer, 2010; Moors, 2009). In the present study, these were (1) certainty about expectation fulfillment, (2) desirability, (3) expectation fulfillment, and (4) attribution of responsibility to oneself. The past three appraisals were part of the OCC-model, resulting in similar emotion categories. In terms of the desirability and expectation fulfillment, Ortony and colleagues (1988) outlined that satisfaction emerges when the desired consequences occur, while disappointment emerges when they do not occur. In contrast, when expected undesirable consequences come true, anxiety is confirmed whereas relief emerges when they do not come true. Although we did not separate event-based from

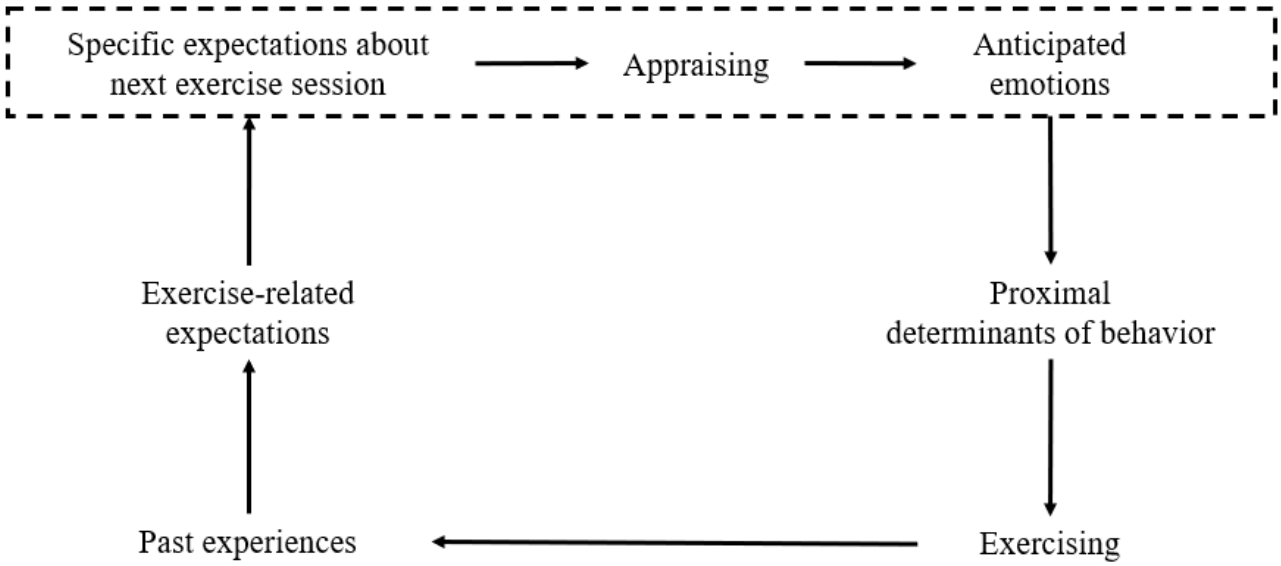
agent-based emotions, as postulated in the OCC-model (Ortony et al., 1988), the attribution of responsibility was an important condition for the anticipation of pride, self-anger, and shame. Participants reported anticipated pride along with anticipated satisfaction, with the difference that for pride, the outcome was attributed to their personal competence. The same principle applies for self-anger and shame, where participants blamed themselves for failing to prevent undesired consequences. According to the OCC-model (Ortony et al., 1988), the development of self-conscious emotions, such as pride and shame depends on the fulfillment of certain standards in form of values. One's standards might involve a certain fitness status, and if the value is not achieved, deficits are attributed to oneself. We can find a similar approach in Carver and Scheier's Control-Process View (Carver & Scheier, 1990) in which they argue that the comparison between the reference value and the current state results in affective reactions and behavior consequences, aiming to reduce the discrepancies. Pride, for example, was anticipated especially by female non-regular exercisers. They were proud of their decision to exercise and to not give up. In addition, they anticipated more pride when more exercises or workout clips were done. A previous study found that anticipated pride may be associated with an increasing training effort (Gilchrist et al., 2017), but this may not apply to inactive individuals. In the present study, participants indicated that anticipated pride was related to social acceptance. Participants reported assessing their current fitness level as far away from the ideal fitness level given by the society or peer-group. When they succeed in overcoming the discrepancies between the current and the social standards, this then would result in the experience of pride (Tracy & Robins, 2004). The anticipation of pride reflects a more external motivation to gain attention and praise. Considering the maladaptive effects of such a rather extrinsic motivation (Ryan & Deci, 2000), the promotion of anticipated pride as an incentive for behavior change is only advisable when goals are based on more autonomous behavior regulations.

The outlined theoretical model of anticipated emotion categories focuses on the development and definition of emotion categories based on the relevant appraisal processes revealed in the interviews. Our data give us reason to assume that the development of anticipated emotions could be part of cyclical processes in the context of exercise behavior (Figure 8).

As we pointed out in the introduction, expectations can be understood as beliefs about future states based on past experiences (Roese & Sherman, 2013). In the context of the present study, expectations would be exercise-related. We assume that individuals

construct specific expectations about their next exercise session based on more general exercise-related expectations. In the present study, specific expectations about the next exercise session mainly referred to one's own performance level, meeting friends, experiencing social pressure, or being physically challenged. These specific expectations were evaluated by appraisal processes (see Figure 8: certainty about expectation fulfillment, desirability, expectation fulfillment, attribution of responsibility to oneself), resulting in concrete anticipated emotions. Previous research gives reasons to believe that anticipated emotions may not directly influence the decision for or against exercise behavior (Perugini & Bagozzi, 2001; Helfer et al., 2015; Loehr & Baldwin, 2014). Proximal determinants could mediate the influence of anticipated emotions on exercising. For example, studies about anticipated affect in the context of physical activity suggest that anticipated affect influences exercise behavior through intention (Loehr & Baldwin, 2014; Helfer et al., 2015; Perugini & Bagozzi, 2001). However, dual-process approaches show that besides a deliberative and reflective system (e.g., intention, self-efficacy) an automatic and non-reflective system (e.g., habits, affective responses) can influence exercise behavior as well (Strobach et al., 2020; Brand & Ekkekakis, 2018). Finally, as shown in Figure 9, we assume that the actual behavior (i.e., exercising or not) may then influence our experience and future exercise-related expectations.

Figure 8. *Role of anticipated emotions in exercise behavior*



Strengths and limitations

The present study has several strengths and limitations. The study focused on affective constructs that are increasingly gaining attention in exercise psychology and may contribute to a better understanding of why individuals are active or not (Stevens et al., 2020). Additionally, a theoretical model of anticipated emotion categories in exercise behavior derived from the interviews which helps to understand how anticipated emotions develop based on appraisal processes. The purposeful sampling strategy made it possible to find meaningful differences in the responses regarding the regularity of exercising. Member reflection conversations were conducted to reduce misinterpretations. Additionally, critical friends contributed to the quality of the interpretation. However, it is possible that not all relevant future-oriented emotions were identified in the present study. One reason could be that participants did not report all emotions they experienced or anticipated because they could not find the words to do so. Moreover, anticipatory emotions could have been influenced by other factors so that these emotions may have not only regarded the next exercise session but rather exercising in general at the moment of the interview. Another reason could be that participants described their emotions about exercising more positively than they actually were due to a social desirability bias (Bergen & Labonte, 2020). The sample size turned out rather small because a theoretical sampling strategy was applied. This means that participants were recruited according to the set inclusion criteria until no more new categories of future-oriented emotions were reported. It is also important to mention that that sample consisted mainly of young adults restricting the results to this age group. Therefore, caution is advised when interpreting the results beyond the described sample.

Future research

The results of the present study and the current state of research point to several intriguing future research directions. First, previous studies in exercise psychology focused on the valence of anticipated affect (Wang, 2011; Dunton & Vaughan, 2008), but our results suggest that distinct emotions may explain important differences in exercise behavior. As an example, further studies on self-conscious emotions, such as pride and shame related to future exercise behavior, especially in non-regular exercisers, would add to the current state of research. In particular, a sample of adolescents and young adults would be appropriate in the context of self-conscious emotions as the relevance of

different emotions could change in older age through experiences and a shift of values. Second, the derived theoretical model of anticipated emotions can help to understand relevant appraisal processes related to specific emotions. The appraisal processes outlined in this theoretical model may help understand the emotional processes that are responsible for an individual to exercise or not. Moreover, the theoretical model could be useful for coaches and sport psychologists working with athletes on emotional processes. Third, based on the appraisal processes identified in this study, questionnaires could be developed that may test the postulation of the theoretical model in a larger sample. In the same vein, longitudinal studies seem promising to understand the actual impact of anticipated emotions on exercise behavior. So far, only one study evaluated the association between anticipated affect and the likelihood of physical activity adoption and maintenance (Dunton & Vaughan, 2008), and only a few studies focused on the mediating role of intention between anticipated affect and physical activity (Perugini & Bagozzi, 2001; Helfer et al., 2015; Loehr & Baldwin, 2014). Finally, ecological momentary assessment (EMA) methods offer the opportunity to measure exercise behavior in real-time and allow researchers to assess multiple variables on different time occasions in order to identify antecedents and consequences of exercising (Dunton, 2017). Changes over time in anticipated emotions could be assessed with EMA methods to analyze if decisions for or against participation rely on anticipated emotions. This method could be particularly useful for assessing anticipated emotions occurring one or more days prior to actual physical activity behavior and relating them to actual physical activity behavior. Another interesting methodical aspect would be to assess participants' facial expressions to take them into account when analyzing participants' statements about emotions. Previous research suggests that negative affective exercise valuations were related to negative facial expressions on exercise-related stimuli especially in less active people (Brand & Ulrich, 2019). Thus, the application of facial expression recognition (e.g., in form of a software) could increase the rigor and quality in qualitative emotion research.

Conclusions

This qualitative study provided insights into anticipatory and anticipated emotions as two future-oriented affective constructs related to exercising. The results indicate that looking at specific emotions may help to understand why some individuals are exercising regularly and others are not. As non-regular exercisers also anticipated to feel positive

emotions and regular exercisers also anticipated to feel negative emotions in their next exercise session, future research should not only focus on the valence of future-oriented affect. Therefore, we encourage researchers to involve relevant emotion categories when examining the impact of future-oriented emotions on exercise behavior. In addition, the derived theoretical model of anticipated emotion categories may help to understand how specific anticipated emotions develop based on appraisal processes. This approach could be applied to practice during which coaches, teachers, and sport psychologists try to comprehend the exercise-related emotions of athletes, students, and exercisers. The role of anticipated emotions within the context of exercising should be investigated in future research considering the postulated cyclical process.

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The role of anticipated affect in the context of physical activity: a scoping review

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Abstract

Individuals often anticipate how they will feel during a potential future behaviour. Assuming that this anticipation may influence actual behaviour, the aim of this scoping review was to provide a comprehensive overview of the literature on the role of anticipated affect in the context of physical activity. Thus, relationships between anticipated affect and (1) other psychological variables related to physical activity or (2) physical activity behaviour were analysed. Five data bases were searched for studies involving anticipated affect in physical activity, resulting in 33 relevant studies. The results were clustered into five categories. (1a) Anticipated affect was related to intention and (1b) to affective experiences. However, a forecasting error appeared in several studies showing that participants underestimated how positive their emotions during or after physical activity actually were. (2a) Due to a low number of studies, it remains unclear whether anticipated affect can predict future physical activity behaviour directly. (2b) Intervention studies with physical activity as the dependent variable and (2c) as the independent variable revealed promising approaches to facilitate positive anticipated affect regarding future physical activity. Future research should consider cognitive biases in affective forecasting studies and develop validated questionnaires for studying anticipated affect in physical activity.

Keywords: anticipation, affect, emotions, mood, physical activity, exercise

Introduction

Every day the human brain constantly predicts future events and their possible consequences before we actually carry out a behaviour (Hohwy, 2013). While doing that, the human brain analyses individual aspects of our body and mind to evaluate what we really need and which behaviour is best for us (Hoemann et al., 2017). These predictions can also include emotional reactions to a future event. For example, the future event of attending a fitness class may be associated with predictions of negative emotional reactions such as feeling ashamed while exercising or being angry about one's own performance (Feil et al., 2022). That positive affective experiences have a positive effect on future physical activity has been shown in several studies (Rhodes & Kates, 2015). Therefore, also the predictions of emotional reactions may have an impact on physical activity. The relevance of regular physical activity is underpinned by research revealing that physical inactivity is associated with various physical and mental diseases such as cardiovascular diseases (Lavie et al., 2019), the metabolic syndrome (Amirfaiz & Shahril, 2019), cancer (Minihan et al., 2022), depression (Schuch et al., 2018), or dementia (Floud et al., 2020), and even increases all-cause mortality (Ekelund et al., 2016).

In this review, we use "anticipated affect" as an umbrella term to include the anticipation of core affect, affective states, emotions, and moods. According to Williams et al. (2019) anticipated affective responses are expected to arise in the future as a consequence of an event. The term core affect was defined by Russell (2003) who described core affect as a primitive and simple feeling in a given moment based on the two dimensions valence and arousal. Affective states (e.g., pleasure, tension, calmness) arise from these dimensions building the circumplex model (Russell, 2003). In contrast to core affect, emotions are more context-dependent and directed at something (e.g., angry with someone, afraid of something; Russell, 2009). Baumeister et al. (2007) pointed out that a "full-fledged" emotion is a slower, reflected experience compared to core affect defined by Russell (2003). Further, emotions are to be distinguished from moods which are typically not directed at an object, less intense, but longer lasting (Beedie et al., 2005).

So far, anticipated affect is mentioned in very few theoretical models. One of the more prominent theories is the emotions-as-feedback theory (Baumeister et al., 2007). This theory posits that emotions serve as feedback about behaviour, while anticipated

emotions guide future behaviour as a result of this feedback. For example, one might enjoy an exercise session and anticipate that the next exercise session will also be enjoyable. As a consequence, the anticipation of the emotion enjoyment may tempt one to participate in the next exercise session. The same principle could apply to negative emotions. For example, the anticipation of shame may drive one away from attending the exercise session. A similar concept can be found in the "theory of anticipated pleasure" proposed by Mellers and McGraw (2001), which suggests that people base their decisions on the anticipation of pleasurable or painful outcomes associated with their choices. That anticipated pleasure was related to peoples' decisions was shown in studies in social psychology (Mellers et al., 1999; Mellers & McGraw, 2001; Mellers et al., 1997). In the "affective-reflective theory of physical inactivity and exercise" (ART, Brand & Ekkekakis, 2018), the authors suggest that beliefs about anticipated affective experiences are a relevant part of reflective evaluation and action planning. Finally, in line with these theories, a recently published qualitative study suggested a theoretical approach based on interviews with regular and non-regular active participants (Feil et al., 2022). This theoretical approach focused specifically on the role of anticipated affect in the context of physical activity. The authors concluded that the appraisal of specific exercise expectations can lead to anticipated emotions, which may influence proximal determinants (e.g., intention) of physical activity.

The role of anticipated affect in physical activity has gained increasing attention in research. For example, a narrative review on affective determinants of physical activity published by Stevens et al. (2020) also entailed several studies on anticipated affective responses. The findings of these studies showed that anticipated affective responses were positively related to affective responses during or after exercising and that (especially inactive) participants seemed to underestimate the pleasantness of the exercise session. This phenomenon is called affective forecasting error (Wilson & Gilbert, 2003). A meta-analysis including different behaviours such as failing a driving test, showed that people are both accurate in a relative sense (i.e., those who think they will be most upset will be the most upset), but inaccurate in an absolute sense (i.e., all think they will be more upset than they will be) in predicting their affective response (Mathieu & Gosling, 2012). Moreover, Pilin (2020) concluded in a review that having a small forecasting error is most likely normal and rather a sign for good mental health as an extreme under- and overestimation of positive and negative affective reactions have been shown to occur in certain psychological disorders.

Dunton and Vaughan (2008) identified positive anticipated affective responses as a predictor of future physical activity on a long-term basis. Further, there are two meta-analyses that focused on anticipated regret (Brewer et al., 2016; Ellis et al., 2018). The first meta-analysis showed that anticipated regret was associated with intentions (r = .50) and health behaviour (r = .29; Brewer et al., 2016). The second meta-analysis on anticipated regret yielded that affective forecasting interventions had a positive effect on anticipated regret (d = .24), intentions (d = .19), and behaviour (d = .29, Ellis et al., 2018).

Previous research gives us reasons to believe that anticipated affect might directly be associated with physical activity behaviour as well as with psychological variables such as intention or affective experiences during physical activity (Brewer et al., 2016; Dunton & Vaughan, 2008; Ellis et al., 2018; Kwan, 2010). The relevance of anticipated affect in physical activity is also emphasized in the narrative review by Stevens et al. (2020). However, the purpose of this narrative review was to provide a broad overview on different affective constructs in physical activity, rather than to discuss the findings on each construct in detail. In addition, there was no systematic literature search provided, implying, for example, that studies on specific anticipated emotions were not identified. In contrast, a procedure of a scoping review allows for a systematic literature overview on both anticipated affect and anticipated emotions. In doing so, gaps in previous research can be identified and an agenda for future research can be derived (Sabiston et al., 2022). Because anticipated affect may contribute to a better understanding of why some individuals are physically active and others are not, the purpose of the present article was to provide a comprehensive overview on anticipated affect in the context of physical activity. A scoping review approach was selected to identify patterns in the literature and generate new research questions (Tricco et al., 2018). In particular, the purposes were to identify the relationship between anticipated affect and (1) other psychological variables related to physical activity (e.g., intention, affective experiences) or (2) physical activity. Furthermore, based on the identified results, this scoping review aimed to give recommendations for future research regarding anticipated affect in the context of physical activity.

Methods

This review was conducted according to the PRISMA Extension for Scoping Reviews (PRISMA-ScR, Tricco et al., 2018). Furthermore, a protocol was registered at the Open Science Framework on February 4, 2022 (osf.io/yw67d/).

Inclusion and exclusion criteria

Several inclusion criteria were set for study selection. First, articles needed to contain empirical research that was published in English or German language as the researchers screening the articles were only fluent in these languages. Peer-reviewed journal papers and dissertations were eligible for this review. No exclusion criteria were set regarding the study design. However, the study had to be conducted in the context of physical activity, which was defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, 1985, p. 126). If physical activity was part of a broader health behaviour (i.e., body-weight management), which included also other behaviours (i.e., dietary behaviour), the study was excluded. The reason for this was that anticipated affect may have a different relationship to physical activity than to dietary behaviour, making it difficult to isolate the role of physical activity. Moreover, in studies with quantitative methods, a measurement of relevant psychological variables related to physical activity (e.g., intention, affective experiences) or physical activity related variables (e.g., attendance, workout characteristics) was needed. Finally, an analysis of the relationship between anticipated affect (i.e., anticipated affective states, emotions, moods) and the outlined variables had to be part of the study (qualitative or quantitative).

Search strategy

The search was conducted on February 2, 2022 in the databases PubMed, Web of Science (Core collection), PsycINFO, Scopus, and SPORTDiscus. There was no time limit set regarding the starting date of the search. Our search term consisted of two parts, which were linked. One part consisted of concepts related to anticipated affect (e.g. anticipated affect, anticipated emotion) and the other part reflected the context of physical activity (e.g. physical activity, exercising). The full search term can be found in Appendix A. In addition, we checked the reference lists of all selected articles for further relevant

studies. If full-texts of dissertations were not available online, we contacted the authors and asked for a digital full-text version. Moreover, we contacted the corresponding authors of all selected studies and asked whether they were aware of any additional relevant studies within this area of research.

Study selection

Using the software EndNote X9, the study selection process was executed by two authors (KF and UW). After duplicates were removed, both authors independently screened the titles for eligibility. Only titles that were excluded by both authors were not eligible for the subsequent independent abstract screening. Abstracts that were not excluded by both authors were eligible for full-text reading. Both authors independently read the full-texts and examined if the articles met the inclusion criteria. In case of disagreement, one of the co-authors (JF) was consulted to clarify if a study should be included.

Data extraction

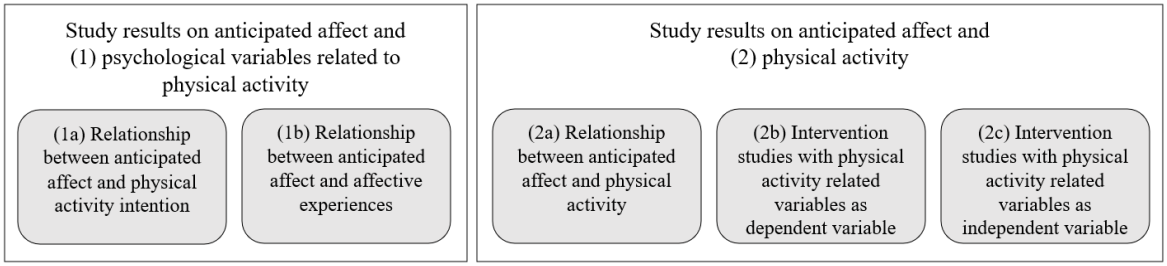
We used a Microsoft Word document to extract the data from eligible articles, including publication details, a definition of the anticipated affect under research, the general purpose of the study, information about the study sample, study design and methods, and relevant results for the research question. Additional results that were not relevant to the research question were not extracted. The extraction of data was conducted by one researcher (KF) and validated by another researcher (UW).

Synthesis of results

Study characteristics of all studies were extracted and analysed to provide a comprehensive overview of the included studies. We did not synthesize the results by method (quantitative and qualitative methods), but chose a more integrated approach instead, as suggested by Sandelowski et al. (2006). The study results were deductively classified according to the research question into (1) study results about psychological variables related to physical activity and (2) study results on physical activity. Within these two predetermined groups, studies were clustered inductively meaning that the

creation of new categories was not based on a pre-existing scheme but rather depended on the content of the included studies. This procedure led to five categories in total. In (1a), the research results were about the relationship between anticipated affect and intention, and (1b) about the relationship between anticipated affect and the affective experiences during or after physical activity. In (2a), the study results focused on the relationship between anticipated affect and physical activity. The study results of intervention studies were divided into (2b) using physical activity as the dependent variable and (2c) using physical activity as the independent variable (see Figure 9).

Figure 9. *Synthesis of results*



Several studies were part of more than one of the outlined categories. For example, intervention studies allocated to 2b or 2c also yielded results regarding the relationship between anticipated affect and other psychological variables (e.g., intention or affective experiences). The deductive and inductive classification procedures were done by the first author, who was in frequent exchange with the second author.

Quality Assessment

The quality of the included studies was assessed with the Mixed Methods Appraisal Tool (MMAT, Hong et al., 2018) which provides different tools for different study types. We used tools specifically adapted for qualitative research, randomized controlled trials and non-randomized studies (including prospective and cross-sectional studies) and each tool consists of five questions (see Appendix D). The quality assessment was done independently by two researchers (KF and JF) for each study. The agreement between the two researchers was .89. The researchers resolved disagreements through discussion.

Results

The search yielded a total of 5400 records that were exported into EndNote X9. After duplicates were removed, 4997 records remained for title screening, which was conducted by two reviewers. KF and UW screened all titles independently and found 143 titles to be eligible for abstract screening. Both reviewers screened all abstracts from which 48 records were eligible for full-text screening. Of these, 20 were included in the review (see reasons for exclusion at this stage in Figure 11). Seven additional articles were found through cross-referencing of bibliographies and contacting corresponding authors of included studies. This resulted in a total of 27 articles that were included in the review. Three of these articles (Abraham & Sheeran, 2003, 2004; Ruby et al., 2011) comprised more than one study with independent samples and research questions, which is why we counted them as separate studies (Abraham & Sheeran, 2003, study 1, study 2, study 3; 2004, study 1, study 2; Ruby et al., 2011, study 1, study 2, study 3, study 4). The dissertation of Kwan (2010) also included two studies, however, the second study of this article included the same sample and research question as the article of Kwan et al. (2017). For this reason, we only included the first study of this dissertation. This makes a total of 33 studies. The flow chart with all steps of the screening process can be found in Figure 10.

Study characteristics

Two of the included studies used qualitative methods while 31 studies applied quantitative methods. From the 31 studies with quantitative methods, 19 studies were observational studies, of which, four studies had a cross-sectional design and 15 studies had a longitudinal design (Dunton & Vaughan, 2008 yielded both cross-sectional and longitudinal study results). One study with a longitudinal design was a secondary analysis from a weight-loss intervention, but treatment groups were collapsed as there were no differences in affective experiences or physical activity level (Crane et al., 2021). Similarly, Janssen and Waters (2019) conducted a secondary analysis from a risk communication intervention applying a cross-sectional study design. Additional 12 studies were experimental studies in form of randomized controlled trials (RCT). Only two studies (Aitken et al., 2021; Feil et al., 2022) based their research on the emotion-as-feedback perspective (Baumeister et al., 2007), which is the only theoretical model with the main focus on anticipated affect in this review. Moreover, based on qualitative interviews, Feil et al. (2022) developed a theoretical model focusing on the role of

anticipated emotions in exercise behaviour. For a detailed overview on the study characteristics see Appendix B and C. Relevant extracted data regarding the research questions are in Table 2.

Figure 10. *Flow diagram*

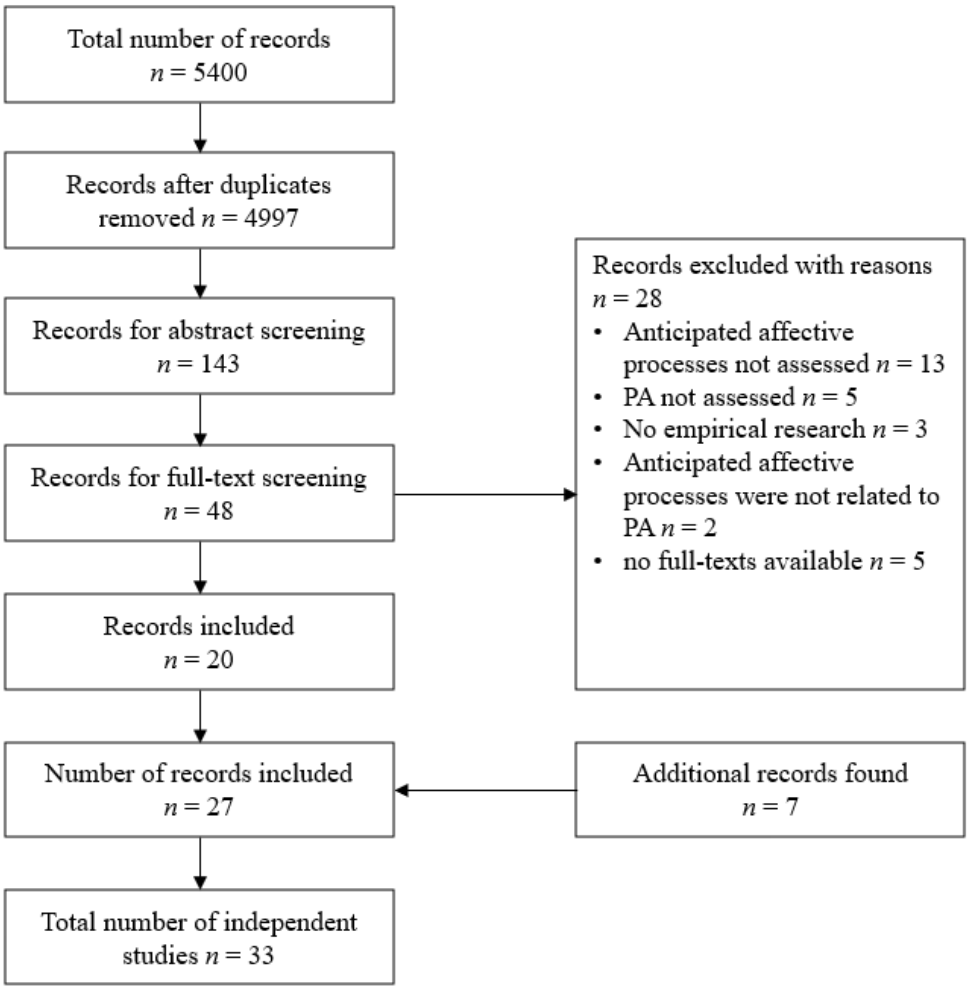


Table 2. *Characteristics of studies included in the scoping review*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Abraham & Sheeran (2003), study 1, UK	Anticipated regret regarding not exercising	Testing anticipated regret as moderator between intentions and exercising	Students n = 254, M_{age} = 20.89 ± 5.07	Longitudinal design, 2-item-questionnaires regarding intention and anticipated regret, PA behaviour was measured 2 weeks later	Anticipated regret moderated the intention-PA relationship when controlling for TPB variables (β = .14, p < .01)
Abraham & Sheeran (2003), study 2, UK	Anticipated regret regarding not exercising	Examining the influence of anticipated regret on PA intentions	Students n = 166, intervention group n = 86, control group n = 80	RCT, 1 item regarding intention and 1 item regarding anticipated regret, PA behaviour was measured 2 weeks later, intervention group: anticipated regret item was asked before intention item, control group: anticipated regret item was asked after intention item	Asking anticipated regret first strengthened the intention-behaviour relationship (interaction between intention and condition $ß$ = .24, p < .001)
Abraham & Sheeran (2003), study 3, UK	Anticipated regret regarding not exercising	Testing anticipated regret as moderator between intentions and exercising	Students n = 97	Longitudinal design, 2-item questionnaire regarding anticipated regret and 5-item questionnaire regarding intention at baseline and after 2 weeks, PA behaviour was measured 2 weeks later	Anticipated regret moderated the intention-PA relationship ($ß$ = .22, p < .01)
Abraham & Sheeran (2004), study 1, UK	Anticipated regret regarding not exercising	Exploring the impact of anticipated regret on exercise intention formation when controlling for past behaviour	Students n = 384, M_{age} = 20.89 ± 5.07	Cross-sectional design, 2-item-questionnaires for intention and anticipated regret, single item for past exercise behaviour	Anticipated regret predicted exercise intentions when controlling for past behaviour (β = .27, p < .001)

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Abraham & Sheeran (2004), study 2, UK	Anticipated regret regarding not exercising	Exploring whether rendering anticipated regret would affect exercise intention formation	Students n = 70 (50% female), intervention group n = 34, control group n = 36	RCT, 1 item regarding anticipated regret and 1 item regarding intention, intervention group: anticipated regret item was asked before intention item, control group: anticipated regret item was asked after intention item	Participants in the intervention group intended to exercise more often than participants in the control group ($t(68) = 2.38$, $p < .02$)
Aitken et al. (2021), USA	Affective forecasting regarding exercising (excitement, confidence, pride, frustration, nervousness)	Examining the accuracy of affective forecasting (running vs. finishing a race) with regards to dimensions of affect and discrete emotions	Professional trail runners n = 74 (52% female), 80.7% 31-55 years old	Longitudinal design, affective forecast regarding excitement, confidence, pride, frustration, and nervousness were assessed before competitive race, emoji grid was measured after the race regarding affective dimensions when running and finishing the race	Participants felt more confident (t = - 2.46, d = - .58, $p < .01$) and less nervous (t = 3.73, d = .88, $p < .01$) while running than predicted, runners felt more confident (t = - 3.3, d = - .78, $p < .01$), prouder (t = - 2.16, d = - .51, $p < .01$), less frustrated (t = 2.21, d = .52, $p < .01$) than expected while crossing the finish line, participants were accurate in predicting valence at finish line (t = - 1.77, p = .08, d = - .42) but overestimated arousal (t = 3.20, p = .002, d = .77)
Bagozzi et al. (1998), Netherlands	Anticipatory emotions related to success or failure of body-weight management (e.g., excited, delighted, happy, glad, satisfied, proud, self-assured, angry, frustrated, guilty, ashamed, sad, disappointed, depressed)	Exploring the role of (anticipatory) emotions in goal-directed behaviour	Adults n = 406, M_{age} = 46 ± 17.4 for women, M_{age} = 43 ± 15.3 for men	Longitudinal study, anticipatory emotions and volitions were measured at baseline, PA and goal-outcome emotions were assessed 4 weeks later	Positive anticipatory emotions were related to positive goal-outcome emotions (ES = .31, t = 7.36) and negative anticipatory emotions were related to negative goal-outcome emotions (ES = .11, t = 3.41)

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Crane et al. (2021), USA	Forecasted feelings regarding exercising (exhausted -energetic, weak - strong, bored - enthusiastic, irritable - content, in great pain - no pain)	Examining subjective experiences associated with PA, comparison of anticipated to experienced feelings	Patients for weight loss n = 320 (78.1 % female), M_{age} = 52.6 ± 10.7	Longitudinal design, adapted version of FALTAQ before (anticipated feelings), during, and after a walking test, which was carried out at baseline, after 6 and after 18 months, secondary analysis from a weight-loss-intervention	Anticipated feelings and experienced feelings did not differ ($p > .05$)
Davis & Stenling (2020), Sweden	Anticipated affective responses to exercising (pleasantness)	Exploring patterns, fluctuations, and associations of athletes' affective states and physiological responses across temporal aspects of sport competition	Competitive athletes (national/ international level) n = 25 (24% female), M_{age} = 25.44 ± 4.42	Longitudinal design; 3 cycling trials measuring anticipated affective states before trials, affective valence during trials, and recall of affective experience after trials	Anticipated affective states predicted linear slope of feeling states during all trials positively (b_{t1} = .048, $p < .05$; b_{t2} = .073, $p < .05$; b_{t3} = .096, $p < .05$), anticipated affective states predicted general affective evaluation 90s (b_{t1} = 0.46, p = .005; b_{t2} = 0.60, $p < .001$; b_{t3} = 0.87, $p < .001$) and 180s (b_{t1} = 0.55, $p < .001$; b_{t2} = 0.60, $p < .001$; b_{t3} = 0.85, $p < .001$) after each trial

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Dunton & Vaughan (2008), USA	Anticipated positive (delighted, happy, fulfilled, calm, relaxed, at ease) and negative emotions (sad, dissatisfied, distressed, nervous, tense, anxious) regarding exercising regularly within the next 90 days (success) or not (failure)	Determination of conceptual model for differences in anticipated affective consequences of success and failure across stages of PA change	Adults n = 332 (60.24% female), M_{age} = 46.95 ± 5.56, n = 229 included in analyses	Cross-sectional and longitudinal design, anticipated affective consequences, stage of change and PA behaviour was assessed, PA was measured again after 90 days determining behaviour change pattern groups	Participants anticipated different positive and negative affective consequences at different stages of behaviour change (F(8, 606) = 5.79, p < .001, η^2 = .071), at follow-up anticipated positive (F(4, 304) = 5.48, p < .001, η^2 = .067) and negative (F(4, 304) = 10.99, p < .001, η^2 = .126) consequences differed by stage: anticipated positive and negative emotions were higher for individuals in the action and maintenance stage compared to the precontemplation, contemplation and preparation stages, anticipated positive but not negative affective consequences were associated with higher likelihood of PA adoption (OR = 1.83, 95% CI 95% [1.04, 3.30] and maintenance (OR = 1.40, 95% CI 95% [1.02, 1.92]
Esposito et al. (2016), Bulgaria, Croatia, and Romania	Anticipated positive and negative emotions when someone did or did not exercise regularly (happy – unhappy, proud – not proud, excited – not excited)	Testing the TPB and extended TPB (with and without injunctive norms and descriptive norms)	Young adults n = 400; M_{age} = 20.3 ± 2.5	Cross-sectional design, testing the extended TPB involving anticipated positive and negative emotions as predictors of desire to do PA	Anticipated positive and negative emotions were no significant predictor of desire to do PA which highly correlated to PA intention (r = .83-.85, p < .01), in the model including descriptive norms anticipated positive emotions predicted desire to do PA marginally significant (r = .089, p < .1)

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Feil et al. (2022), Germany	Anticipated emotion categories during and after exercising	Identification of anticipatory and anticipated emotion categories during and after exercising and developing a theoretical model of anticipated emotions related to exercising	Adults n = 16 (50% female), M_{age} = 26.63 ± 6.66	Qualitative design, principles of grounded theory	Identified anticipated emotions during/after exercising: enjoyment, displeasure, hope, anxiety, satisfaction, disappointment, anxiety confirmation/despair (only during exercising), pride, self-anger, shame (only during exercising), relief (only after exercising)
Gilchrist et al. (2017), Canada	Anticipated pride about successfully achieving a goal set for the race and anticipated shame about not meeting the goal	Examining relation between anticipated and experienced pride and shame and the quantity and quality of training behaviour 1 week later	Long-distance runners n = 158 (76% female), M_{age} = 34.84 ± 10.44	Longitudinal design, anticipated and experienced pride and shame as well as quantity and quality of training were assessed weekly for 5 consecutive weeks leading up to a race	Anticipated pride and shame were not associated with training quantity and did not predict next week's training effort
Gilchrist & Sabiston (2018), Canada	Anticipated authentic and hubristic pride about successfully enacting one's intentions	Examining the relationship between anticipated pride and PA with intention as a moderator	Students n = 148 (63.51% female), M_{age} = 19.39	Longitudinal design, intentions and anticipated pride were assessed at baseline and were related to PA behaviour measured 2 weeks later	Anticipated hubristic pride was positively associated with MVPA (r = .15, p = .03), anticipated authentic pride (point estimate = .38, *CI* [.23, .53]) and hubristic pride (point estimate = .46, *CI* [.31, .60]) predicted intentions to engage in PA, anticipated authentic (point estimate = .12, *CI* [.05, .22]) and hubristic pride (point estimate = .15, *CI* [.08, .26]) indirectly predicted MVPA via intentions

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Helfer et al. (2015), USA	Manipulation of affective expectation in that participants were told that exercise often results in good moods, happiness, contentedness, feelings of personal satisfaction, and increases in self-esteem	Examining the effect of an affective expectation manipulation on post-exercise affect, exercise intentions, and exercise behaviour	Students n = 140 (63.57% female), 18-30 years, follow-up n = 98	RCT, PA and mood were assessed, then 2 (no expectation vs. affective expectation) x 2 (no elaboration vs. elaboration) conditioning, 10min cycling on light-intensity, then mood and intentions for future PA were assessed, after 2 weeks follow-up exercise survey	After cycling: participants in the affective expectation conditions scored higher in mood post-exercise than participants in the no-expectation conditions ($F(1, 136) = 9.31$, $p = .003$, $\eta^2 = .06$), participants in the affective expectation condition reported greater intentions to exercise in the future compared to participants in the no expectation condition ($F(1,136) = 6.87$, $p = .01$, $\eta^2 = .05$), follow-up: participants in the affective expectation x elaboration condition reported more positive mood post-exercise than participants given no expectation ($t(57) = 2.47$, $p = .02$, $d = .65$)
Jackson et al. (2003), UK	Anticipated feelings through PA within the next days (pleasure - displeasure, satisfied - dissatisfied)	Determining if the extension of the TPB to additional variables (including anticipated affective reaction) would account for more variance in PA intention and PA behaviour	College employees n = 200 (64% female), M_{age} = 42.9 ± 9.4, follow-up n = 146 (64% female), M_{age} = 42.3 ± 8.9	Longitudinal design, anticipated affective reaction, intention, and PA was measured at baseline and after 8 weeks	Anticipated affective reaction correlated positive with intention (r = .256, $p < .01$), attitude (r = .575, $p < .001$), and subjective norm (r = .342, $p < .001$), anticipated affective reaction was no significant predictor of intention

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Janssen et al. (2018), USA	Anticipated regret/madness regarding not exercising regularly	Analysing changes in key cognitive and affective precursors of health behaviour change through different risk communication strategies regarding colon cancer, stroke, diabetes, heart disease	Adults n = 844 (57.4% female), M_{age} = 48.34 ± 10.22, n = 835 included in analyses	RCT, PA and anticipated regret were measured before and after a hypothetical risk of getting pre-defined diseases was shown to participants, intervention: 12 different strategies to communicate the risk	No significant effect of communication strategy (related to PA) on anticipated regret/madness
Janssen & Waters (2019), USA	Anticipated regret/madness regarding not exercising	Examining cognitive and affective beliefs about health risks resulting from insufficient PA behaviour	Adults n = 835 (57% female), M_{age} = 48 ± 10.22	Cross-sectional design, PA behaviour, intention to PA, and anticipated regret/madness was assessed,	Intentions were higher among participants with higher anticipated regret/madness (β = .33, p < .001)* regarding the risk beliefs about any disease, negative association between anticipated regret and PA behaviour (β = - .08, p < .05)* regarding the risk beliefs about colon cancer only for those rating their perceived absolute likelihood to get colon cancer without regular PA with ‘‘do not know’’ (*hierarchical regression models involving also other variables)

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Kwan (2010), study 1, USA	Anticipated positive affect (enthusiastic, energetic, upbeat), anticipated negative affect (miserable, discouraged, crummy), anticipated tranquillity (relaxed, peaceful, calm) and anticipated fatigue (tired, fatigued, worn-out), anticipated feelings (good – bad) and anticipated arousal (high – low), anticipated self-conscious emotions when exercising as planned (proud, satisfied, self-confident, self-assured) and when not exercising as planned (regretful, guilty, ashamed, embarrassed)	Examining correlations between anticipated affect and volitional control of exercise and predicting PA intention through anticipated affect	Students n = 155 (72.9% female), M_{age} = 18.79	Longitudinal design, anticipated affective measures and intention at baseline and volitional variables and actual exercise behaviour 4 weeks later	Anticipated positive and negative self-conscious emotions and anticipated positive affective responses during and after exercising were positively correlated with intentions (r = .25-.43, p < .001-.01), anticipated negative affective responses and fatigue during and after exercising were negatively correlated with intentions (r = - .24 to - .33, p < .001-.01), anticipated tranquillity was not associated with intentions or PA behaviour, anticipated positive self-conscious emotions were positively correlated with PA behaviour (r = .18, p < .05), anticipated positive affect during exercise was positively correlated with days of moderate PA (r = .17, p < .05) and anticipated positive affect after exercise was positively correlated with days of vigorous PA (r = .20, p < .05), anticipated positive affective responses predicted commitment (β = .17, p < .05) which predicted exercise frequency positively, anticipated fatigue predicted conflict within during (β = .17, p < .05) and after exercise affect models (β = .19, p < .05) which predicted exercise frequency negatively

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Kwan et al. (2017), USA	Manipulation of anticipated affect in the positive condition regarded feeling good, energized, more positive, and relaxed during/after exercising and in the negative condition, it regarded feeling not very good, tired, not so positive, and not very relaxed during/after exercising	Examining the effects of an expectation-based manipulation on anticipated and experienced core affective responses to aerobic exercise (laboratory) and on adherence to an exercise prescription (7 days)	Adults n = 101 (59.41% female), M_{age} = 24.91, n = 98 included in analyses	RCT, cycling lab exercise plus non-lab exercise prescription for 7 days, anticipated affect measures were related to volitional variables after the 7 days, intervention: positive and negative anticipated affect interventions and control group	Affective valence was higher in the positive anticipated affect condition compared to negative anticipated affect condition ($F(1, 95) = 4.28$, $p = .04$) at t_1 (10 min cycling), positive activated affect was greater in positive anticipated affect condition compared to the negative anticipated affect condition ($F(1, 95) = 6.87$, $p = .01$) and greater in the control condition compared to negative anticipated affect condition ($F(1, 95) = 8.43$, $p = .005$) at t_1, participants expected to feel less positive affect during exercise than they actually experienced (anticipated in-task vs. t_2 PA: Wilks' $\Lambda = .92$; $F(1, 97) = 7.86$, $p < .001$), no effect of condition on non-lab exercise behaviour, anticipated affective valence (OR = 1.67, CI 95% [1.14, 2.45]) was associated with increased odds of "very strong intentions to follow the exercise prescription"

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Loehr & Baldwin (2014), USA	Anticipated enjoyment during a workout	Examining whether inactive individuals show the same forecasting error as active individuals and whether experienced enjoyment is a mediator between expected enjoyment and intentions	Students n = 42 (79.6% female), M_{age} = 20.4 ± 3.0	Longitudinal design, expected enjoyment was assessed 30 min prior to workout, experienced enjoyment and intentions for future regular PA were measured after completing workout	Participants reported greater enjoyment after completing the workout compared to expected enjoyment (F(1, 40) = 45.07, p = .001, d = 1.06, *CI* 95% for d [.60, 1.51]), size of affective forecasting error was larger among the inactive than the active participants (F(1, 40) = 3.42, p = .07, partial η^2 = .08, *CI* 95% [.00, .23]), expected enjoyment predicted intentions marginally (β = .229, p = .08) and experienced enjoyment (β = .589, p < .001), experienced enjoyment mediated the effect of expected enjoyment on intentions for inactive participants (ab = .367, *CI* 95% [.075, .742]) but not for active participants (ab = -.079, *CI* 95% [- .269, .089])
Perugini & Bagozzi (2001), Italy	Anticipated emotions regarding the achievement (excited, delighted, happy, glad, satisfied, proud, self-assured) and failure (angry, frustrated, guilty, ashamed, sad, disappointed, depressed, worried, uncomfortable, fearful) of a body weight related goal	Testing the model of goal-directed behaviour (dieting and exercising) regarding losing or maintaining body weight	Students n = 108 (58.3% female), M_{age} = 22.0 ± 6.6	Longitudinal design, anticipated emotions at baseline and PA after 4 weeks	Positive anticipated emotions influenced desires to exercise (γ = .28, p < .05) which influenced intention (γ = .77, p < .05) while negative anticipated emotions did not

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Rhodes & Mistry (2016), Canada	Anticipated regret when not engaging in PA	Theming reasons for why people respond to PA with anticipated regret	Students n = 120 (55% female), M_{age} = 20.64 ± 2.88	qualitative design, thematic analysis	Three over-arching reasons why people respond with anticipated regret when missing PA: missed opportunity to achieve PA benefits, personal shame, external pressures
Ruby et al. (2011), study 1, Canada	Anticipated enjoyment during a PA class	Examining the affective forecasting error in gym members	Gym members n = 40 (78% female), M_{age} = 23 ± 6.44	RCT, anticipated enjoyment was measured before PA class and experienced enjoyment after PA class, intervention: forecasters group that reported forecasted and experienced enjoyment, while the experiencers group reported only experienced enjoyment	Participants in the forecasters group reported greater enjoyment after completing the workout than they had predicted (F(1, 17) = 10.35, p = .005, d = .63), participants in the experiencers group reported higher experienced enjoyment that the forecasters group (F(1, 36) = .09, p = .03, d = .80)
Ruby et al. (2011), study 2, Canada	Anticipated enjoyment during a self-designed workout	Examining the affective forecasting error in gym members when considering PA intensity	Gym members n = 32 (41% female), M_{age} = 21 ± 5.63, moderate intensity group n = 17, challenging intensity group n = 15	RCT, anticipated enjoyment was measured before work-out and experienced enjoyment after work-out, intervention: completing a self-designed moderate or challenging workout	Participants enjoyed their workout significantly more than they had forecasted (F(1, 30) = 9.28, p = .005, d = .53), no effect of intensity on affective forecasting error

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Ruby et al. (2011), study 3, Canada	Anticipated enjoyment during a self-designed workout	Examining if the order of exercise sequences influences the anticipated enjoyment	Gym members n = 53 (34% female), M_{age} = 23 ± 4.92, favourite-exercise-first group n = 27, favourite-exercise-last group n = 26	RCT, anticipated enjoyment was measured before workout and experienced enjoyment after workout, intervention: participants listed favourite and least favourite exercises of self-designed workout, one group did favourite exercise first and one group did it last	Participants doing their favourite exercise first forecasted higher enjoyment than participants that did their favourite exercise last (F(1, 51) = 4.92, p = .031, d = .61)
Ruby et al. (2011), study 4, Canada	Anticipated enjoyment during a workout (enjoyment, liking, pleasure)	Examining whether spreading attention increases expected enjoyment	People on university campus n = 154 (44% female), M_{age} = 24 ± 6.22, attention spreading condition n = 75, control condition n = 79	RCT, anticipated enjoyment and intention were assessed before workout, intervention: reflect on and forecast expected enjoyment for each phase of workout (warm-up, main workout, cool-down) and for overall routine (control condition)	Expected enjoyment for the warm-up phase was lower than for the main workout and cool-down phase (F(2, 72) = 11.79, p < .001), participants in the attention condition expected to enjoy the overall workout routine more than participants in the control condition (F(1, 147) = 9.61, p = .002, d = .51), participants in the attention condition reported greater intention to engage in exercise than participants in the control condition (F(1, 147) = 5.17, p = .024, d = .36), condition predicted forecasted enjoyment (β = .20, p = .005) which predicted exercise intention (β = .40, p < .001)

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Sala et al. (2016), USA	Anticipated regret when not exercising regularly and anticipated pride when exercising regularly	Examining whether anticipatory and anticipated affect predict unique or overlapping variance in affective response	Adults n = 69 (78% female), M_{age} = 20.4 ± 2.4	Longitudinal design, anticipated affect was measured before treadmill lab exercise, affective response was assessed during exercise at various time-points	Anticipated regret (β = .28, p = .01) and anticipated pride (β = .22, p = .04) predicted affective response during the exercise
Sandberg & Conner (2011), UK	Anticipated regret regarding not exercising in the future	Examining if PA intentions are stronger when measuring anticipated regret before TPB variables	Students (gym members) n = 576 (61.98% female), M_{age} = 19.7 ± 1.16	RCT, anticipated regret and TPB variables were measured, sports centre use was assessed for 2 weeks after 4-5 weeks after questionnaire, intervention: order of anticipated regret item and TPB items (TPB only, TPB + regret mixed, TPB + regret first)	Asking anticipated regret first explained additional variance in sports centre use (R^2 change = .008, F change (1, 573) = 4.59, p < .05), this effect remained after adding TPB variables which explained together an increased amount of variance in sports centre use (R^2 change = .098, F change (5, 568) = 11.9, p < .001), order of asked items had an effect on sports centre use when intentions were at mean (B = .386, p < .05) or high (B = .656, p < .001), but not when they were low

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Vallerand et al. (2019), Canada	Anticipated regret regarding not increasing weekly aerobic exercise	Examining a telephone counselling program on motivational, regulatory, and reflexive (including anticipated regret) processes and the mediation of these processes on aerobic exercise behaviour	Hematologic cancer survivors n = 51, 18-80 years old, telephone counselling group n = 26, self-directed exercise group n = 25	RCT, anticipated regret, PA and several other variables were assessed at baseline and after 13 weeks, intervention: both groups were advised to increase PA according to Canada's PA guidelines, telephone counselling group received 12-weekly sessions based on M-PAC-based topics including booster sessions	No significant effect of the intervention on anticipated regret, anticipated regret was no significant mediator for aerobic exercise behaviour
Wang (2011), USA	Anticipated emotions how not exercising regularly would make someone feel (relaxed – tense, not guilty – guilty, not regret – regret, not angry – angry, displeased – pleased)	Examining if past behaviour moderates the relationship between anticipated emotions and intention especially in participants with low levels of PA	Students n = 517 (70.6% female), M_{age} = 20.3 ± 1.49	Longitudinal design, anticipated emotions, intention and PA were measured at baseline and 4 weeks later	Anticipated negative emotions predicted PA intentions (β = .26, p < .001) when controlling for TPB variables, but the relationship was moderated by individuals' past behaviour (β = -.22, p < .001), anticipated emotions were a more important predictor for those who did not participate in PA ($\beta_{ISD\ below}$ = .48, p < .001) than for those who did (β_{mean} = .26, p < .001; $\beta_{ISD\ above}$ = .04, not significant)

Table 2. *Characteristics of studies included in the scoping review (continued)*

Study, country	Definition of anticipated affect	General purpose of study	Participants	Research design and methods	Relevant results for the research question
Waters et al. (2021), USA	Anticipated regret/madness regarding not exercising	Examining whether risk communication strategies have an impact on comprehension of risk information and intentions to engage in PA in the next 90 days	Adults n = 372 (84.7% female), 43.8% between 50-64 years	RCT, anticipated regret was measured before and after a hypothetical risk of getting pre-defined diseases was shown, intervention: 3 different communication strategies	Anticipated regret was no significant mediator of the effect of risk communication strategy on intentions to engage in PA
Zenko et al. (2016), USA	Anticipated feelings regarding the repetition of a previous exercise session	Exploring forecasted, experienced, and remembered pleasure ratings related to an intensity-increasing and intensity-decreasing exercise bout	Members of university community n = 46 (32.6% female), intensity-increasing group n = 22, intensity-decreasing group n = 24	RCT, experienced pleasure was assessed during experimental cycling session, forecasted and remembered pleasure were measured 15 min after cycling session, 24 hours later, and 7 days later	Decreasing-intensity group reported higher levels of forecasted pleasure ($t(44) = 2.82$, $p = .007$, $d = .83$) compared to the increasing-intensity group, level of experienced pleasure predicted all forecasted pleasure ratings (15 min: $r = .63$, $r^2 = .40$, $b = 72.89$, $t = 5.43$, $p < .001$; 24 hours: $r = .61$, $r^2 = .37$, $b = 61.84$, $t = 4.94$, $p < .001$; 7 days: $r = .61$, $r^2 = .37$, $b = 62.01$, $t = 5.04$, $p < .001$), remembered pleasure and forecasted pleasure at each time-point were strongly interrelated (15 min: $r = .84$, $p < .001$; 24 hours: $r = .85$, $p < .001$; 7 days: $r = .88$, $p < .001$)

Study results on anticipated affect and other psychological variables related to physical activity

A total of 25 studies focused on the relationship between anticipated affect and other psychological variables related to physical activity. The study results of these studies were categorised into two subgroups: (a) the relationship between anticipated affect and intention and (b) the relationship between anticipated affect and affective experiences.

Relationship between anticipated affect and intention. Seventeen studies conducted research on the relationship between anticipated affect and intention. Focusing on the valence of anticipated affective reactions, positive affective reactions to physical activity were shown to be positively associated with intentions (Jackson et al., 2003; Kwan, 2010; Kwan et al., 2017), while negative anticipated affective reactions were negatively associated with intentions (Kwan, 2010). Furthermore, negative anticipated emotions referring to non-participation in physical activity ("not regularly participating in physical activity would make me feel tensed, guilty, angry, etc.") predicted intentions moderated by past behaviour (Wang, 2011). According to this, the impact of anticipated emotions on intentions was stronger for non-participants in physical activity than for regular exercisers. In addition, two studies revealed that anticipated affect was related to the desire to engage in physical activity, which had a strong positive correlation with intentions. While one study indicated that positive anticipated emotions influenced desires to exercise positively (Perugini & Bagozzi, 2001), the other study only found this effect to be marginally significant (Esposito et al., 2016).

Other study results focused on more specific emotions. For example, Kwan (2010) assessed positive anticipated self-conscious emotions referring to self-regulatory success (exercising as planned) and negative anticipated self-conscious emotions referring to self-regulatory failure (not exercising as planned). The results showed that both positive and negative anticipated self-conscious emotions were positively related to intentions. These findings are in line with two other studies which found that anticipated pride (Gilchrist & Sabiston, 2018) and, to a lesser extent, anticipated enjoyment (Loehr & Baldwin, 2014) were predictors of intentions. These results are in line with studies focusing only on anticipated regret. To measure anticipated regret, participants in these studies had to indicate how they would feel if they did not participate in physical activity. Anticipated

regret was a significant predictor of intentions (Abraham & Sheeran, 2004, study 1; Janssen & Waters, 2019), a moderator of the intention-physical activity relationship (even when controlling for TPB-variables, Abraham & Sheeran, 2003, study 1, study 3), but not a significant mediator between the effect of a risk communication strategy and intentions (Waters et al., 2021). In addition, two studies revealed that asking participants about their anticipated regret before asking them about their intention had a positive effect on their intention (Abraham & Sheeran, 2003, study 2; 2004, study 2).

Allowing more causal conclusions, there were also two studies using an RCT including a manipulation of anticipated affect and assessing its effect on intentions (Helfer et al., 2015; Ruby et al., 2011, study 4). In the study by Helfer et al. (2015), a 2 x 2 conditioning design was applied in a bicycle test. For that, two independent, dichotomous variables were used: affective expectation (yes/no) and reflection (on affective expectation/on bicycle). Participants were assigned to four groups: (1) participants receiving information that exercising often results in good moods, happiness, contentedness, feelings of satisfaction, and increases self-esteem; (2) participants receiving information about the bicycle; (3) participants reflecting on the given information (affective expectation or bicycle); and (4) participants not reflecting on the given information. Participants receiving information about the positive effects of exercising (group 1) reported higher intentions than participants receiving information about the bicycle (group 2), implying that affective expectation is an effective means of influencing intention. Additional reflection on the given information (group 3) had no impact on intention. In the study by Ruby et al. (2011, study 4), participants in the intervention group reflected on their anticipated enjoyment first and then reported their anticipated enjoyment regarding different phases of a workout (warm-up, main part, cool-down, and overall-routine). Participants in the control group read the workout routine and then reported their anticipated enjoyment for the overall-routine. It was shown that participants in the intervention group had greater intentions compared to participants in the control group. In particular, the condition predicted anticipated enjoyment which, in turn, predicted intention (Ruby et al., 2011, study 4).

Relationship between anticipated affect and affective experiences. A total of eleven studies have investigated the association between anticipated affect and actual affective

experiences during or after physical activity. Bagozzi et al. (1998)* found a positive relationship between positive anticipatory emotions and positive goal-outcome emotions related to body-weight four weeks later as well as a negative relationship between negative anticipatory emotions and negative goal-outcome emotions. Moreover, in another study, anticipated affective responses before cycling trials predicted the linear slope of feeling states during the trials as well as the general affective evaluation after trials (Davis & Stenling, 2020). These results are supported by the study by Aitken et al. (2021), in which affective valence after finishing a race was predicted accurately by anticipated affective valence assessed before the race. In another study, anticipated regret (when not exercising) and anticipated pride (when exercising) both predicted positive affective responses during physical activity (Sala et al., 2016). Several studies have examined the difference between anticipated affect and actual affective experiences, which is commonly referred to as the forecasting error. For example, Aitken et al. (2021) showed that arousal after the race as overestimated in a competitive setting. Moreover, participants felt more confident and less nervous than expected during the running competition and more confident, prouder, and less frustrated when crossing the finish line. Other studies have focused on anticipated enjoyment and have found that participants typically underestimated their experienced enjoyment (Loehr & Baldwin, 2014; Ruby et al., 2011, study 1, study 2). In particular, Loehr and Baldwin (2014) revealed that the anticipated forecasting error was even greater among inactive participants than among active participants. However, Crane et al. (2021) found no differences between the reported anticipated feelings before a walking test and experienced feelings after a walking test of weight loss patients at three different measurement occasions.

This section also includes two RCTs examining the impact of anticipated affect on subsequent affective experiences during exercise (Helfer et al., 2015; Kwan et al., 2017). In the study by Kwan et al. (2017), participants were randomly assigned to either one of two intervention groups (positive and negative affect manipulation) or to a no-manipulation control group. Both intervention groups were informed that their exercise prescription would lead to either positive or negative affective responses. The results showed that the positive anticipated affect manipulation had a positive effect on affective valence and arousal assessed during exercise compared to the negative anticipated affect

*The description of ‘anticipatory emotions’ in the paper matched our understanding of anticipated emotions, even though today, these two terms are defined differently (for a more detailed distinction see Feil et al. 2022 or Williams et al. 2019).

condition but not compared to the control condition (Kwan et al., 2017). In the study by Helfer et al. (2015), participants in the affective expectation condition scored higher in positive moods after a cycling test than participants in the no-expectation condition (study design is explained in more detail in the section on intentions). However, when asked again two weeks after the cycling test, only those participants who additionally had reflected on the possible effects of physical activity on mood still reported a higher positive mood (Helfer et al., 2015).

While all studies mentioned above were about the prediction of affective experiences through anticipated affect, Zenko et al. (2016) chose a reverse-order design. In this design, experienced pleasure was measured during a cycling test, while remembered pleasure of this experience and anticipated pleasure regarding future exercising were assessed 15 minutes and, again, 24 hours after the test (Zenko et al., 2016). The level of experienced pleasure predicted the anticipated pleasure ratings for future physical activity (r = .61-.63), and a correlation was observed between remembered and anticipated pleasure (r = .84-.88).

Study results on anticipated affect and physical activity

This section comprises 16 studies that investigated the relationship between anticipated affect and physical activity. Study results are classified into three categories: (a) the relationship between anticipated affect and physical activity, (b) intervention studies with physical activity as dependent variable, and (c) intervention studies with physical activity as independent variable.

Relationship between anticipated affect and physical activity. This sub-section comprises six quantitative and two qualitative studies that examined the relationship between anticipated affect and physical activity. One study investigated positive and negative anticipated emotions at different stages of behaviour change in the Transtheoretical Model (Prochaska & Velicer, 1997) yielding both cross-sectional and longitudinal study results (Dunton & Vaughan, 2008). The assessment of positive emotions was related to successfully participating in physical activity over the course of 90 days, and the assessment of negative anticipated emotions referred to failing regular physical activity participation over 90 days. In the cross-sectional design, the results indicated that positive and negative anticipated emotions were stronger for individuals in

the action and maintenance stage compared to the precontemplation, contemplation, and preparation stage. In the longitudinal design, the results showed that positive but not negative anticipated emotions predicted both the adoption of physical activity for those individuals who had been insufficiently active as well as the maintenance of physical activity for those individuals who had been sufficiently active at the initial assessment. Additionally, Wang (2011) found that negative anticipated emotions that refer to not exercising regularly for several weeks were a more important predictor of physical activity four weeks later for inactive individuals than for active individuals.

In another longitudinal study, Kwan (2010) first assessed anticipated affect and then, four weeks later, the days of aerobic activity measured in the last week. The results showed that positive anticipated affect during exercise positively correlated with days of moderate physical activity, while positive anticipated affect after exercise positively correlated with days of vigorous physical activity. In addition, anticipated positive affective responses predicted commitment to exercise, which, in turn, predicted exercise frequency positively. In contrast, anticipated feelings of fatigue predicted conflict with other tasks, which, in turn, predicted exercise frequency negatively.

Moreover, positive anticipated self-conscious emotions (when exercising as planned) also positively correlated with days of aerobic activity (Kwan, 2010). When looking at more specific anticipated emotions, Gilchrist et al. (2017) found that anticipated pride (when meeting the goal) and shame (when failing the goal) were not directly associated with training quantity or effort one week later. However, another study by Gilchrist and Sabiston (2018) showed that anticipated pride indirectly predicted physical activity two weeks later via intentions. Hubristic pride, which is a specific form of pride and associated with superiority and arrogance (Tracy & Robins, 2004), was directly associated with physical activity two weeks later (Gilchrist & Sabiston, 2018). Another study with a cross-sectional design analysed the association between anticipated regret and physical activity behaviour (Janssen & Waters, 2019)*. In the final hierarchical regression model, anticipated regret did not predict physical activity behaviour. Only for those participants rating their perceived absolute likelihood to get colon cancer without regular physical activity as “do not know”, a negative association between anticipated regret and physical activity was found.

The qualitative study by Feil et al. (2022) tried to identify the role of anticipated emotions in relation to the participation in exercise sessions. Even though non-regular

*The sample of this study was a subsample of Janssen et al. 2018.

active participants stated more negative anticipated emotions, they also reported positive anticipated emotions. Differences between non-regular and regular active participants became more apparent through specific anticipated emotions. For example, while those who were not regularly active were more likely to describe anticipated self-conscious emotions such as pride, those who were regularly active rather referred to anticipated enjoyment. Both emotions are positive, but appraisal processes behind the development of these anticipated emotions are different. An example for gathering deeper knowledge about a specific anticipated emotion is the qualitative study by Rhodes and Mistry (2016) that focused on the reasons why people respond with anticipated regret when missing a physical activity session. The three main reasons were a missed opportunity to achieve physical activity benefits, personal shame, and external pressures.

Intervention studies with physical activity as dependent variable. Three studies tested whether interventions would have an effect on physical activity. In one of these studies, anticipated regret was assessed, but not as a part of the intervention itself. The intervention promoted physical activity in cancer patients and yielded that anticipated regret was not a significant mediator between the phone counselling intervention lasting for 12 weeks and aerobic exercise behaviour by the end of the intervention (Vallerand et al., 2019). In the other two studies, anticipated affect was part of the intervention itself. In one of the two studies, Sandberg and Conner (2011) used the order of asked items as an intervention to test whether the measurement of anticipated regret itself influenced behaviour change. While one group was asked about anticipated regret before intentions were measured, another group was asked about intentions before assessing anticipated regret. The results showed that asking anticipated regret first resulted in an increased sports centre use, which was assessed for two weeks (up to five weeks after the intervention). However, these effects were only found when intentions were at mean or high, but not when they were low. Kwan et al. (2017) conducted a study manipulating positive and negative anticipated affect to examine its impact on subsequent exercise behaviour (the detailed study design has already been presented in the section on affective experiences). Results showed that the condition (positive/negative/no anticipated affect intervention) had no effect on subsequent exercise behaviour the following seven days after lab testing.

Intervention studies with physical activity as independent variable. Five studies examined whether interventions would have an effect on anticipated affect. In these studies, physical activity was part of the intervention and builds the independent variable. While two studies used information about physical activity (relevance for health, spreading attention on particular exercise phases) as the intervention content, participants in the other three studies engaged in physical activity interventions.

In a study by Janssen et al. (2018), risk communication strategies for chronic diseases were tested, whereby participants were presented with information about the risk of developing these diseases with and without regular exercise. The risk communication strategies had no effect on participants' anticipated regret which was assessed after the risk was shown. In the study by Ruby et al. (2011, study 4), two groups were compared with each other. The first group was asked to reflect and separately report their anticipated enjoyment for the warm-up, the main workout, the cool-down and the overall workout. The second group was asked to reflect and report their anticipated enjoyment only for the overall workout. The results revealed that participants in the first group reported higher anticipated enjoyment regarding the overall workout routine compared to those in the second group. In addition, for the first group, it was shown that anticipated enjoyment for the warm-up phase was lower than for the main workout and cool-down phase.

In the following three studies, characteristics of physical activity were manipulated to test the effect of this manipulation on subsequent anticipated affect. In one intervention, it was examined whether the order of exercise sequences may influence anticipated enjoyment (Ruby et al., 2011, study 3). Results yielded that participants doing their favourite exercise first anticipated higher enjoyment regarding the next workout than participants doing their favourite exercise last. In another intervention, it was tested whether the workout intensity (moderate vs. challenging) influences participants' forecasting error, showing non-significant effects (Ruby et al., 2011, study 2). Zenko et al. (2016) also focused on the influence of intensity on anticipated affect. In their study design, they compared participants who did exercises in a decreasing intensity group with participants who did exercises with an increasing intensity. The results showed that, after the exercise, the decreasing-intensity group reported higher levels of anticipated pleasure than the increasing-intensity group.

Results of quality assessment

The results of the quality assessment for the individual studies are shown in Appendix D. The two qualitative studies showed satisfying quality ratings. Regarding quantitative non-randomized studies, in many cases measurements for anticipated affect were not validated and information about drop-outs were not provided resulting in incomplete outcome data. In addition, several studies did not account for confounders such as age or gender. Regarding randomized controlled trials, randomization and blinding were not appropriately performed or described in many studies. Furthermore, a large amount of studies did not compare groups at baseline and showed incomplete data at follow-up measurements.

Discussion

The purpose of this scoping review was to examine the relationship between anticipated affect and other psychological variables related to physical activity as well as physical activity. For the literature review, the PRISMA Extension for Scoping Reviews (Tricco et al., 2018) was applied and 33 independent studies were identified according to the inclusion criteria. We found several results focusing on the relationship between anticipated affect and intention and between anticipated affect and the affective experience. Few studies investigated the direct relationship between anticipated affect and physical activity. In intervention studies, researchers used physical activity either as a dependent variable that was supposed to be influenced by anticipated affect interventions or included physical activity as an independent variable to increase positive anticipated affective responses through training modifications.

Anticipated affect and intention

Overall, the majority of studies found significant associations between anticipated affect and intention (Gilchrist & Sabiston, 2018; Jackson et al., 2003; Kwan, 2010; Kwan et al., 2017; Wang, 2011). Specifically, anticipated regret has been consistently identified as a predictor of intentions in 13 studies using the Theory of Planned Behaviour (TPB) as a framework (e.g., Abraham & Sheeran, 2003, 2004). This is in line with a meta-analysis by Sandberg and Conner (2008), yielding a strong correlation between anticipated regret and intention related to several behaviours ($r = .47$). In this regard, Ajzen (2011) argues

that anticipated affect of an alternative behaviour (e.g., not attending the exercise class) would be a better predictor for intention than anticipated affect that is related to the behaviour itself (e.g., to attend the exercise class). However, positive correlations between positive anticipated affect related to engaging in physical activity and the intention to exercise were also found in this review (Gilchrist & Sabiston, 2018; Jackson et al., 2003; Kwan, 2010). Even if the prediction of intentions through positive anticipated affect was only marginally significant (Jackson et al., 2003; Loehr & Baldwin, 2014), the relationship between positive anticipated affect and intentions should be further investigated in the future.

Most studies on a specific anticipated emotion were about anticipated regret in relation to intention. For example, it was shown that simply asking individuals to report their anticipated regret before asking them about their intentions increased their intentions (e.g., Sandberg & Conner, 2011). However, it remains unclear whether inducing anticipated regret is an appropriate means to promote long-term physical activity. Regret is characterized by missing an opportunity, making one feel guilty and embarrassed (Rhodes & Mistry, 2016), which is consistent with the definition of introjected regulation of motivation in the self-determination theory (Ryan & Deci, 2000). This form of extrinsic motivation is mainly regulated through internal rewards (e.g., feeling satisfied) and punishments (e.g., avoiding guilt). However, promoting extrinsic motivation to avoid negative emotions, such as regret, guilt, and shame, may not be effective for long-term physical activity promotion (Teixeira et al., 2012).

The results of the scoping review indicate that anticipated affect influences intentions, but it is not clear to what extent anticipated affect may also influence the fulfilment of intentions. Research suggests that there is a considerably large discrepancy between having the intention to show a specific behaviour and executing the behaviour (Sheeran & Webb, 2016). In the present scoping review, anticipated regret was shown to be a significant moderator of the intention-behaviour relationship (e.g., Abraham & Sheeran, 2003, 2004) which was also concluded in a systematic review by Rhodes et al. (2022). However, there were no studies focusing on other anticipated emotions as moderators of the intention-behaviour relationship, pointing to the need for future research on how anticipated affect may influence the translation of intentions into behaviour.

Affective experiences and affective forecasting in physical activity

The majority of studies found a positive relationship between anticipated affect and affective experiences. Previous research provided strong evidence for the relevance of affective experiences for future physical activity (for systematic reviews see Klos et al., 2020; Rhodes et al., 2009; Rhodes & Kates, 2015). Intervention studies by Helfer et al. (2015) and Kwan et al. (2017) have shown that the promotion of positive anticipated affective experiences can have a positive impact on individuals' actual affective experiences during and after physical activity. The tendency to look for and interpret information that confirms prior expectations can enhance this positive relationship (Morewedge & Kahneman, 2010). Individuals who anticipate positive emotions regarding future physical activity are more likely to focus on aspects relevant to those emotions, such as being with friends, and perceive negative aspects, such as physical exertion, less strongly.

However, the results of several studies in this review showed that individuals tended to underestimate their experience of positive emotions during physical activity. We suggest three explanations for the forecasting error in anticipated and experienced positive emotions such as enjoyment. First, anticipated enjoyment may be underestimated due to previous negative affective experiences. As Baumeister et al. (2007) suggested, previous affective experiences are highly relevant for the anticipation of future affective experiences. This assumption is consistent with the finding that negative forecasting error is even greater for inactive participants (Loehr & Baldwin, 2014). Second, from a methodological perspective, ratings of the affective experience measured after physical activity may be higher simply because the physical activity is over. Participants feel more positive after finishing their exercise, which may have an effect on their overall rating of the physical activity session (Box et al., 2020). This may be the case in studies where affective experiences were measured retrospectively, but items referred to the experience during physical activity (e.g., Gilchrist et al., 2017; Helfer et al., 2015). Thus, the occurrence of the forecasting error could be due to a measurement bias in the affective experience. Third, cognitive biases through cognitive appraisals could play a crucial role in affective forecasting. Researchers propose that current feelings, beliefs, and memories influence the prediction of the future (Jones & Zenko, 2021; Karnaze et al., 2017; Levine et al., 2018). For example, considering the combination of the availability bias (Tversky & Kahneman, 1973) and the negativity bias (Baumeister et al., 2001), individuals may

tend to use readily available information on negative affective experiences in the past leading to an overestimation of negative affective experiences in the future. Relatedly, consistent with the impact bias (Morewedge et al., 2005; Wilson & Gilbert, 2003), individuals seem to overestimate the intensity and/or duration of these affective experiences. Thus, negative affective experiences in a past fitness class could lead individuals to anticipate more intense and longer-lasting negative affective experiences in relation to re-attending a fitness class than they would actually experience.

Notably, the evidence regarding the forecasting error of negative emotions has been underrepresented in this review. Only Aitken et al. (2021) showed that participants overestimated their nervousness during a trail run as well as their frustration after the run. Previous studies showed that the experience of negative self-conscious emotions, such as shame and guilt is positively associated with extrinsic forms of exercise motivation (Castonguay et al., 2015; Sabiston et al., 2010). Also, Feil et al. (2022) suggested that negative anticipated emotions could play a crucial role in non-regular exercisers. Interestingly, non-regular exercisers described various positive anticipated emotions about their future exercise session even though they did not participate on a regular basis. The authors concluded that negative anticipated emotions based on negative experiences (e.g., being bullied in childhood) seem to be more relevant for these participants than potential positive affective experiences (Feil et al., 2022). More research on non-regular exercisers and their negative anticipated emotions may be just as important as studies on positive anticipated emotions.

Anticipated affect in physical activity behaviour

Empirical evidence regarding the relationship between anticipated affect and physical activity is still unclear, with mixed findings reported in the literature (Dunton & Vaughan, 2008; Gilchrist et al., 2017; Gilchrist & Sabiston, 2018; Kwan, 2010; Kwan et al., 2017). In this regard, the meta-analysis on affective forecasting interventions in health-related decision making showed that interventions had a significant effect on both health-related behaviour and intentions (Ellis et al., 2018). Nevertheless, only very few studies focused on physical activity, suggesting a need for future research to clarify the relationship between anticipated affect and physical activity. From the included studies, it is not possible to conclude which anticipated emotions may be more relevant to physical

activity behaviour than others as only very few studies analysed the direct effect of anticipated emotions on physical activity.

Furthermore, research has shown that characteristics of physical activity sessions, such as the intensity, can influence affective experiences (Ekkekakis et al., 2011) and anticipated affect (Zenko et al., 2016). Specifically, in an experimental study, it was shown that a group with decreasing intensity had higher pleasure rates assessed after the exercise regarding the next cycling test compared to a group with increasing intensity (Zenko et al., 2016). In same vein, in a more recent study it was shown that remembered pleasure and positive affect during the training sessions were significantly higher for participants who performed exercises of decreasing intensity than for participants who performed exercises of increasing intensity. The remembered pleasure in turn positively predicted anticipated pleasure regarding the next resistance training (Hutchinson et al., 2023).

In addition to intensity, perceived competence, social interaction, and novelty were identified as factors that support positive emotions during physical activity (Wienke & Jekauc, 2016) and may also be relevant for positive anticipated emotions. Moreover, considering the affective forecasting bias, personalized physical activity settings addressing these factors may be useful to reduce the bias between anticipated and actual affective response (especially negative memories are overrepresented, Morewedge et al., 2005). For example, people that are rather inactive in general tend to anticipate more negative emotions such as shame or disappointment due to one extreme negative experience with physical activity in the past (for more details see Feil et al., 2022). Physical activity settings meeting their specific needs (e.g., beginner fitness class instead of a competitive sports group) could support them to anticipate more positive emotions in physical activity.

Limitations

Some limitations of this scoping review need to be acknowledged. First, the high heterogeneity of study designs and study results did not allow for a clear answer of the research questions. For example, as discussed above, the exact relationship between anticipated affect and physical activity behaviour is still rather unclear. Second, only studies written in English or German were eligible for this review. Third, whilst this review's classification procedure into different categories helped identify patterns in the

literature, it has the risk of oversimplification. Several study designs tested both the relationships between anticipated affect and psychological variables as well as relationships between anticipated affect and physical activity in interrelated statistical models (e.g., Janssen & Waters, 2019) or with interventions affecting both aspects (e.g., increasing positive affective experience and future physical activity, Kwan et al., 2017).

Implications for future research

The results of this scoping review have important implications for future research in four areas: (1) theoretical models, (2) measures of anticipated affect, (3) study designs, and (4) cognitive biases. First, there is a need for theoretical models that focus on the role of anticipated affect in physical activity. Existing comprehensive theories such as the ART (Brand & Ekkekakis, 2018) suggest that anticipated affective experience is a type-2 process that is influenced by type-1 processes (e.g., automatic affective appraisals) and can lead to behavioural intentions and action planning. However, it remains unclear what the relevant antecedents of anticipated affect might be (other than prior affective experience in general).

Second, the results of the quality assessment showed that a validated measurement for anticipated affect is still missing. Thus, validated questionnaires are needed to assess anticipated affect in studies looking at positive vs. negative anticipated affect as well as for studies focusing on specific anticipated emotions. Researchers should choose a reference point for anticipated affect based on theoretical considerations. For example, the included studies showed that anticipated affect related to physical activity participation is associated differently with intention compared to anticipated affect related to the absence of physical activity (Sala et al., 2016).

Third, a central task for future quantitative studies is to investigate the predictive power of anticipated affect regarding physical activity in longitudinal study designs. Moreover, intervention studies aiming to increase positive anticipated emotions during physical activity should modify workout characteristics (see studies by Ruby et al., 2011) and consider facilitators of positive emotions (e.g., Wienke & Jekauc, 2016), because affective experiences during physical activity build an important basis for anticipated affective experiences in the future (Baumeister et al., 2007).

Fourth, more research is needed regarding the role of cognitive biases in affective forecasting. It was suggested that affective forecasting errors could be different between

individuals due to their cognitive appraisals (Jones & Zenko, 2021; Levine et al., 2018). In this regard, it seems also interesting to compare types of anticipated affect. So far, most studies have focused on specific emotions (e.g., anticipated enjoyment) that involve more cognitive appraisals. In contrast, the anticipation of more basic affective states involves less cognitive appraisals, which, in turn, may be less susceptible to forecasting errors.

Conclusions

The aim of the present scoping review was to provide a comprehensive overview on the growing literature on anticipated affect in the context of physical activity. The findings suggest that the way individuals anticipate how they feel during a specific behaviour influences their motivation towards the behaviour as well as the emotions they experience during the behaviour. However, the results of several studies also point to a forecasting error, with individuals tending to anticipate a less positive experience of emotions than they actually experience. Although some studies have investigated the relationship between anticipated affect and actual physical activity behaviour, the results are limited and inconclusive. Intervention studies showed that the anticipation of more positive affective experiences can be promoted through interventions that change workout characteristics (e.g., intensity, order of exercises) or include self-reflections regarding positive emotions.

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The intention-behavior gap in physical activity: a systematic review and meta-analysis of the action control framework

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Abstract

Objective: Intention is the proximal antecedent of physical activity in many popular psychological models. Despite the utility of these models, the discrepancy between intention and actual behaviour, known as the intention-behaviour gap, is a central topic of current basic and applied research. The purpose of this meta-analysis was to quantify intention-behaviour profiles and the intention-behaviour gap.

Design: Systematic review and meta-analysis.

Data sources: Literature search was conducted in June 2022 and updated in February 2023 in five databases.

Eligibility criteria for selecting studies: Eligible studies included a measure of physical activity, an assessment of physical activity intention, and the employment of the intention–behaviour relationship into profile quadrants. Only papers published in the English language and in peer-reviewed journals were considered. Screening was assisted by the artificial intelligence tool ASReview.

Results: Twenty-five independent samples were selected from 22 articles including a total of $N = 29\,600$. Random-effects meta-analysis revealed that 26.0% of all participants were non-intenders not exceeding their intentions, 4.2% were non-intenders who exceeded their intentions, 33.0% were unsuccessful intenders and 38.7% were successful

intenders. Based on the proportion of unsuccessful intenders to all intenders, the overall intention-behaviour gap among intenders was 47.6%.

Conclusion: The findings underscore that intention is a necessary, yet insufficient antecedent of physical activity for many. Successful translation of a positive intention into behaviour is nearly at chance. Incorporating mechanisms to overcome the intention-behaviour gap are recommended for clinical practice.

Introduction

An inactive lifestyle increases the risk of physical and mental diseases such as cardiovascular diseases (Lavie et al., 2019), cancer (Minihan et al., 2022), depression (Schuch et al., 2017), and dementia (Floud et al., 2020). Because of these serious health consequences of physical inactivity, guidelines for regular physical activity (PA) behaviour have been established (World Health Organization, 2020). Adults are advised to accomplish 150 minutes of moderate to vigorous PA (MVPA) or 60 minutes of vigorous PA per week and two days per week of muscle-strengthening activities (World Health Organization, 2020). Even though a large body of research underpins the health benefits of regular PA (Rhodes et al., 2017; Warburton et al., 2010; Warburton et al., 2007), almost one third of all adults worldwide are insufficiently active (Guthold et al., 2018). Therefore, promotion of PA is considered a central task of health promotion. Intention is a relevant correlate of PA, as evidenced in several meta-analyses (McEachan et al., 2011; Rhodes & Dickau, 2012; Sheeran & Webb, 2016). However, there is still considerable intention-behaviour discordance and the association between intention and behaviour change is considerably smaller in prospective study designs. For example, experimental studies show that a large change in intention results in only a small effect on behaviour (r = .07 in Rhodes & Dickau, 2012; Sheeran & Webb, 2016). This discrepancy between intention and behaviour is often coined the intention-behaviour gap and has long been a relevant topic in psychological research (Orbell & Sheeran, 1998; Sheeran, 2002; Sniehotta, 2009). This discrepancy is also relevant from a clinical perspective, because practitioners need to be aware of how successful their clients may be in translating their intentions into behaviour. Increasing awareness of this discrepancy can support the individuals concerned to apply additional behaviour change techniques that support successful implementation of intentions.

In the action control framework (Rhodes & de Bruijn, 2013) a four quadrant distribution of intention-behaviour profiles was suggested. The four quadrants include non-intenders who subsequently do not engage in behaviour, non-intenders who engage in the behaviour, intenders who fail to follow through with behaviour, and intenders who successfully engage in the behaviour. These four quadrants are helpful to understand the nature and distribution of the intention-behaviour gap and to quantify the convergence and divergence of the intention-behaviour relationship (Rebar et al., 2019; Sheeran, 2002). To our knowledge, only one review and meta-analysis has explored the relationship between intention and PA based on the intention-behaviour profiles (Rhodes & de Bruijn, 2013). In this review of ten samples, 21% of participants were non-intenders not exceeding intentions, 2% were non-intenders exceeding intentions, 36% were unsuccessful intenders, and 42% were successful intenders (Rhodes & de Bruijn, 2013). Considering only the individuals who had formed an intention, the authors quantified the intention-behaviour gap among these two profiles at 46%. The findings have two main implications. First, the analyses illustrated the clear asymmetry in the PA intention-behaviour relationship. Almost no one in these samples engaged in PA without an intention, thus intention appears a necessary construct for performing the behaviour. Second, however, the results also showed that the translation of intention into behaviour was nearly at chance; thus, much of the intention-behaviour concordance is being driven by non-intenders not engaging in PA. From a clinical perspective, on the one hand, it is important that patients form an intention to increase the likelihood of performing the behaviour. On the other hand, practitioners need to be aware of how likely it is that patients are not carrying out their intentions.

Despite the findings from the meta-analysis of Rhodes and de Bruijn (2013), there are several indicators that warrant sustained research and an update to these findings. First, the meta-analysis comprised only ten samples which mainly included undergraduate students. Because research in this area has increased considerably including also more diverse populations in recent years, an update to examine the reliability of the original findings is needed. Second, the meta-analysis provided only the point estimates of the results. It would be helpful to include heterogeneity estimates and confidence intervals to better understand the range of effects (Hagger, 2022). This will be useful for researchers and practitioners to understand whether their PA intention-behaviour discordance is within an average range. Finally, no moderator analyses were conducted to explain any possible heterogeneity of effects in the intention-behaviour gap.

Studies included in the meta-analysis in 2013 varied in their time-frame and measurement tools. An understanding of whether the intention and physical activity relationship is altered by these moderators seems a prudent next step to better contextualize the original estimates. With these limitations in mind, the purpose of this meta-analysis was to update the quantification summary of PA intention-behaviour profiles, including the key estimate of the intention-behaviour gap. The second aim of this meta-analysis was to identify potential sample, design, and measurement variables that may moderate the size of the intention-behaviour gap.

Methods

The systematic review and the meta-analysis were conducted according to the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines (Page et al., 2021). The review was submitted for preregistration on June, 16th and accepted on June, 27th 2022 under (https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42022340288).

Eligibility criteria

For this review, we set the following inclusion criteria: (1) a measure of PA, (2) an assessment of physical activity intention, and (3) employment of the intention–behaviour relationship in any capacity where it was divided into quadrants (intention high/low; behaviour high/low) (Sheeran, 2002). Physical activity was defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen et al., 1985, p. 126). Articles written in any other language than English were excluded. Only peer-reviewed articles involving participants aged 18 or older were eligible for this review.

Search strategy

The search was carried out in the databases Academic Search Complete, MEDLINE, PsycINFO, SPORTDiscus, and Web of Science on June, 16th 2022. An updated search was done on February, 20th 2023. Even though this meta-analysis is an update of Rhodes and de Bruijn (2013), the search was conducted without restrictions regarding the time frame due to small adaptions of the search terms. Our search terms

consisted of three parts: (1) constructs related to intention, (2) constructs related to physical activity, and (3) theoretical models that include the intention-behaviour relationship. The full search terms can be found in Appendix A. Additionally, manual cross-referencing of bibliographies was performed. Furthermore, corresponding authors who published more than one included article were contacted and asked to provide any additional articles relevant for the study topic.

Study selection

All references were imported into EndNote X9. Subsequently, all duplicates were removed by the software and through a second, manual search conducted by one reviewer (KF). The open source machine learning framework ASReview was used to screen the references (van de Schoot et al., 2021). This tool allowed sorting of references according to their relevance for the research topic. Specifically, five references that matched the inclusion criteria and five irrelevant references randomly suggested by the program were used to train the software (van Haastrecht et al., 2021). Based on these references, the software sorted all records beginning with the records that are most similar to the five references meeting the inclusion criteria. The software learned continuously which references are more important than others based on the reviewer's decisions and changed the order of references accordingly. One researcher (KF) screened titles together with their abstracts until no reference in a row of 50 references was included. A second researcher (JF) screened all titles and abstracts that were excluded by the first researcher. The remaining references were not screened and the title and abstract screening was completed. Full texts were read and assessed for eligibility by both researchers (KF and JF). Disagreements between the researchers were resolved by discussion or consulting a third researcher (RER).

Data extraction

One researcher (KF) extracted the data and another researcher (JF) checked the extracted data. Six pre-specified items were used for this procedure: study information (author, year, country), theoretical framework, sample and design, measures of intention and PA, definition for regular PA and intention-behaviour profile formulation, and profile results including the intention-behaviour gap.

Risk of bias assessment

The quality assessment tools developed by the National Heart, Lung, and Blood Institute (NHLBI, 2014) were used to rate the quality of included studies, because the provided assessment tools are adapted to different study designs (e.g., observational, experimental). Furthermore, previous systematic reviews including various study designs applied these assessment tools successfully (e.g., Bagias et al., 2021; Feil et al., 2021). Two of the tools were used, one for cross-sectional and prospective study designs and one for intervention designs. Both tools comprised 14 items regarding the validity of the intention and behaviour measures, problematic attrition, representativeness of the sample, and the power of the sample. Reviewers can respond to the items with "yes", "no", or "cannot determine/not reported/not applicable". Because answers other than "yes" are reason to consider a potential risk of bias, the sum of items that were answered with "yes" were used as a ranking for the quality of studies. High quality (i.e., low risk of bias) was considered for studies with scores of 11 to 14, moderate quality was considered for studies with scores of six to 10, and low quality (i.e., high risk of bias) was considered for studies with scores of zero to five (Bagias et al., 2021).

Data analysis

The aim of this meta-analysis was to quantify the PA intention-behaviour profiles in form of proportions. Therefore, proportions were calculated with confidence intervals for the four quadrants used to quantify PA intention-behaviour profiles. The first profile comprised non-intenders who remained inactive. The second profile encompassed non-intenders who were exceeding their intentions and were physically active. The third profile involved intenders who were unsuccessful in translating their intentions into action. The fourth profile contained intenders who were able to fulfil their PA intentions. If moderate and vigorous PA were assessed separately for each participant, we computed the means for each profile. If participants were differentiated by either doing moderate or vigorous PA (i.e., profiles for each intensity), proportions were added up to represent moderate and vigorous PA in each profile.

The intention-behaviour gap reflects the proportion of unsuccessful intenders in relation to all intenders. Meta-analyses were carried out based on random-effect models using proportions with correction for sampling error (Hunter & Schmidt, 2004). Data were analysed using Comprehensive Meta-Analysis 3 (Biostat Inc.). We assessed

publication bias using Egger's Regression intercept (Egger et al., 1997) in each of the four profiles and for the intention-behaviour gap. The heterogeneity across the samples was also of interest and so we also reported the Q-statistic from the random effects model and the I-squared and tau statistics from the fixed effect models (provided in Appendix G) to assist in interpretation. A significant Q-statistic indicates larger variation across studies rather than within participants in a study. The I-squared statistic reflects the percentage of variability in the parameter estimates across studies that is due to heterogeneity. For interpretation, we considered I-squared values of 25, 50, and 75 as low, moderate, and high, respectively (Higgins et al., 2003). The tau statistic indicates the between-study variance of the parameter estimates. We expected similar distributions of random errors and random effect terms as reflected in the previous meta-analysis from 2013 (Rhodes & de Bruijn, 2013).

Intention-behaviour gap sub-analyses were conducted when groups divided by the moderator comprised at least two samples. The following moderators were used to explore different sub-groups: design (cross-sectional, prospective, intervention), population (students, parents, adults with health risks, convenience adult samples), intention measure (likert scale, yes/no format, open-ended frequency), type of PA (resistance training, all other forms of PA), country (Canada, Netherlands, other), PA measure (GLTEQ, IPAQ, likert scale, yes/no format, objectively measured), profile formation (based on pre-defined regular PA, based on clusters/ median/ yes/no format), and risk of bias (high quality, low quality). The significance regarding the heterogeneity indicated if the proportion of the intention-behaviour gap between sub-groups divided by the moderator differed. If the test of heterogeneity was significant, it can be assumed that the proportions of grouped samples are significantly different from each other.

Equality, diversity, and inclusion statement

The author team consisted of a junior (female), a mid-career (male), and a senior researcher (male) from two different countries (Germany and Canada) with expertise in the disciplines of exercise science, sport psychology, and behavioural medicine. The population included a spectrum of ages, genders, ethnicities, and socioeconomic status.

Results

The screening process is presented in the flow diagram in Figure 11. The search yielded a total of 3 759 records of which 1 936 remained after duplicates were removed. Twenty-nine records did not have an attached abstract in EndNote and could not be uploaded into the ASReview software. These 29 records were checked manually by one reviewer (KF) and all of them did not fit the inclusion criteria. The remaining 1 907 records with an attached abstract were uploaded into the ASReview software. Of these, 403 records were screened for titles and abstracts by one reviewer (KF) until the predetermined cut-off point (i.e., 50 references in a row that were not relevant for the review) was reached. Through this screening process, 72 records were selected as eligible for full-text screening by one reviewer (KF). The excluded 330 records were again screened by another reviewer (JF) who found another study to be eligible for full-text screening. Of the 73 full-texts that were screened by two reviewers (KF and JF), 55 did not meet the inclusion criteria (see Figure 11 for exclusion reasons). Two additional records were found, one through cross-referencing of bibliographies and one through contacting corresponding authors. The updated search yielded 251 records published between June 2022 and February 2023. After removing duplicates, 123 titles and abstracts were screened manually by two reviewers (KF and JF). Five records were found to be eligible for full-text screening yielding two additional records that were included in the review. The total number of included records was 22 (see Appendix B for publication list). One study included four independent subsamples (Godin et al., 2004). Therefore, we treated them as different studies/samples for the description of study characteristics and the calculation of the meta-analysis.

Study characteristics

The study characteristics are summarized in Table 3. The sample size within studies ranged from 73 (Kerner et al., 2001) to 5259 (Godin et al., 2004, subsample 3). The time between the assessment of intention and PA in prospective and intervention studies varied between two (e.g., Rhodes et al., 2012) and 26 weeks (Rhodes et al., 2020). Only the two intervention studies had three measurement occasions for PA for which we computed the average, while all 12 prospective studies assessed PA only once. Two studies measured PA objectively, one with accelerometers (Rhodes et al., 2020), and one with tracking cardiovascular responses in a fitness centre (Kerner et al., 2001). All other

studies used self-reported measures (n = 23). The definition of regular PA varied between studies, but many were formulated according to the PA guidelines of either 150 minutes of moderate to vigorous PA (MVPA, n = 7) or 60 minutes of vigorous PA (n = 8). Some other studies defined regular PA similar to the international guidelines (n = 6, e.g., 30 minutes of MVPA four times a week). One study assessed moderate and vigorous PA separately for each participant which is why this study accounted for defining PA according to the guidelines of 150 minutes of MVPA and 60 minutes of vigorous PA (de Bruijn et al., 2009). When regular PA was not defined, studies used median scores (Kerner et al., 2001) or cluster analyses (in all four sub-samples of Godin et al., 2004) to split the sample into high and low PA groups. The data extraction of each study can be found in Appendix C.

Figure 11. *Flow diagram*

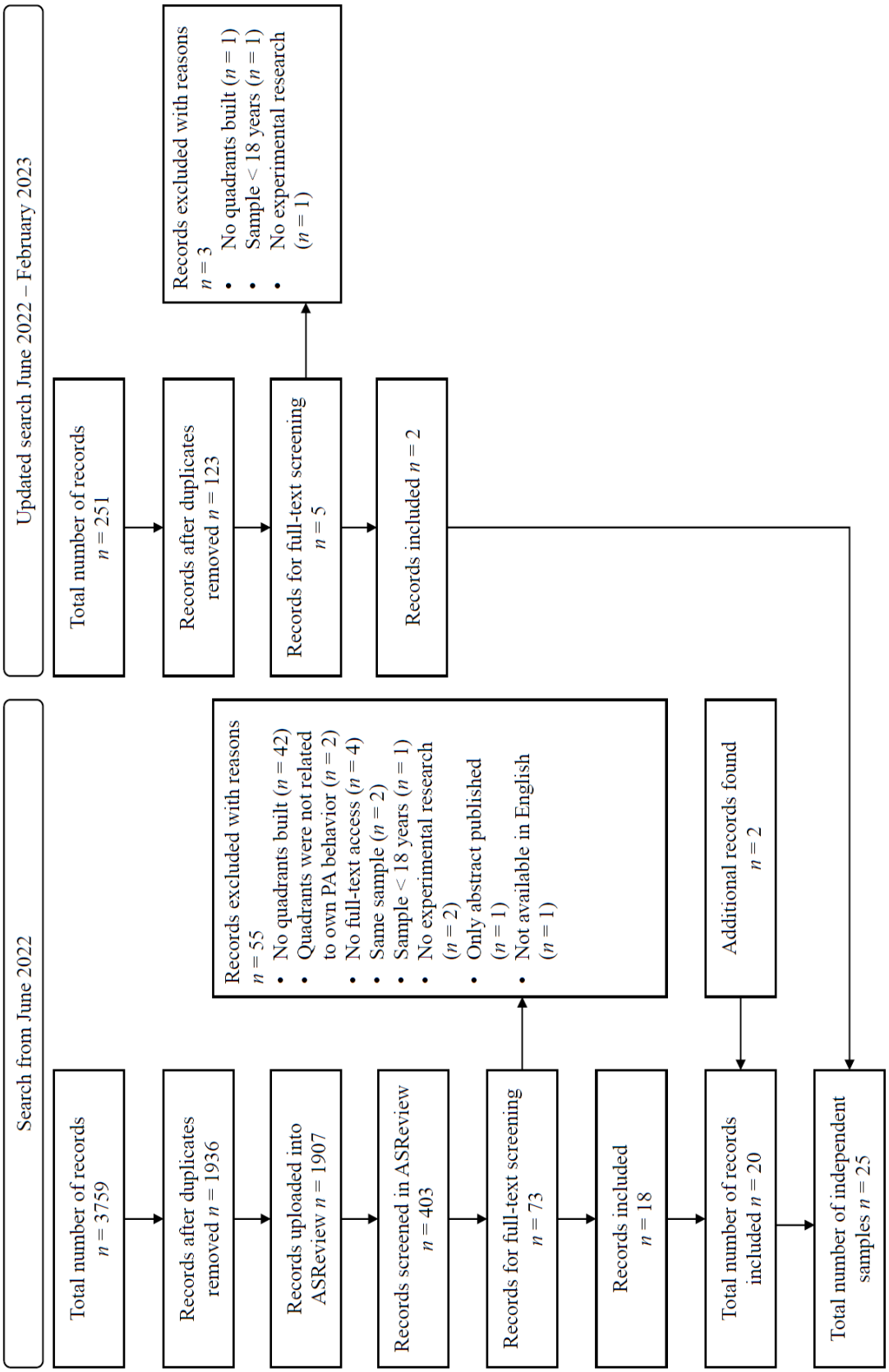


Table 3. *Study characteristics*

Characteristics	Samples (*n* = 25)
Country	
Canada	13
Netherlands	10
USA	1
UK/USA/Canada	1
Study design	
Prospective	12
Cross-sectional	11
Intervention	2
Population	
Convenient adults	12
Undergraduate students	7
Parents	3
Adults with health risks	3
Intention measurement	
Likert scales	11
Yes/no format	7
Open-ended frequency	7
PA measurement	
GLTEQ	12
IPAQ	4
Likert scales	5
Yes/no formats	2
Objective measures	2
Quality rating	
High quality	4
Moderate quality	21

Notes: GLTEQ: Godin Leisure-Time Exercise Questionnaire, IPAQ: International Physical Activity Questionnaire

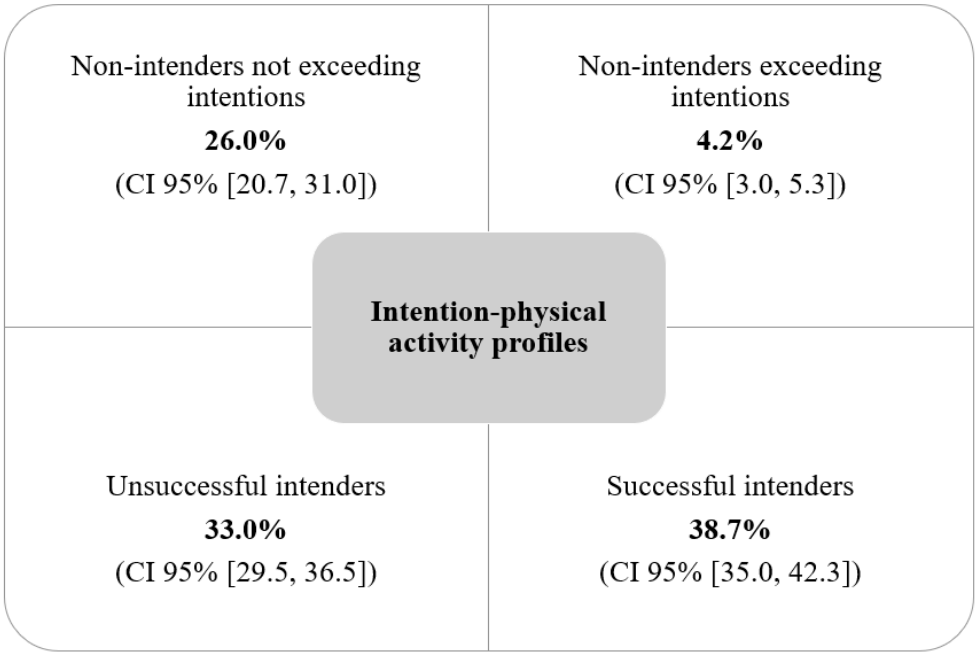
Risk of bias assessment

Twenty-one of the studies were rated with moderate quality with scores ranging from six (Grant et al., 2021) to 10 (e.g., Rhodes et al., 2010). Four studies were rated with high quality; two of them were intervention studies (Rhodes et al., 2021; Rhodes et al., 2020) and two were prospective studies (Fiala & Rhodes, 2010; Rhodes & Lithopoulos, 2022). These studies are characterized by high retention rates and controlling for confounding variables. The detailed ratings of items can be viewed in Appendix D. It was also tested if the study quality was a moderator of the intention-behaviour gap (for results see Table 4).

Meta-analysis of intention-behaviour profiles

The results for the four intention-behaviour profiles are presented in Figure 12.

Figure 12. *Intention-behaviour profiles*



The number of participants that were included in this meta-analysis was N = 29 600 while the total number of participants reported in the studies was N = 30 263. Some participants were not included in the meta-analysis as they were not allocated to one of the four quadrants due to dropout or incomplete data. The mean age of the participants was M_{age} = 35.18 years (SD = 11.42) with one study only providing age ranges (Godin et al., 2004). From N = 30 263 participants 44.89% were male, 54.53% were female, and 0.04% were transgender, while 0.54% did not provide information about gender. Non-intenders not exceeding intentions represented 26.0%* (CI 95% [20.7, 31.0]) of the participants within the samples, while non-intenders exceeding intentions reflected 4.2%* (CI 95% [3.0, 5.3]). Intenders who were not successful in transferring their intentions into sufficient PA behaviour comprised 33.0%* (CI 95% [29.5, 36.5]) of the four quadrants, and intenders who were successful represented 38.7%* (CI 95% [35.0, 42.3]) of the quadrants. Publication bias analyses were significant for the group of unsuccessful non-intenders (p < 0.04 (2-tailed)) indicating that larger proportions of unsuccessful non-intenders were associated with smaller samples. The other three quadrants and the intention-behaviour gap did not show evidence of publication bias (see Appendix E).

Tests of heterogeneity were not significant for non-intenders exceeding intentions ($Q(24) = 15.20$, $p = 0.915$, $I^2 = 0.00$) indicating that findings within this group were homogeneous. By contrast, findings reflect a considerable heterogeneity in the groups of non-intenders not exceeding intentions ($Q(24) = 461.27$, $p < 0.001$, $I^2 = 94.80$), unsuccessful intenders ($Q(24) = 212.56$, $p < 0.001$, $I^2 = 88.71$), and successful intenders ($Q(24) = 259.42$, $p < 0.001$, $I^2 = 90.75$).

For the meta-analysis of the intention-behaviour gap, all 25 samples ($N = 22\,482$) were included. The proportion of unsuccessful intenders to all intenders was 47.6 % (CI 95% [43.8, 51.3]). These findings ($Q(24) = 237.96$, $p < 0.001$, $I^2 = 89.91$) were heterogeneous suggesting further moderator analyses. Details of heterogeneity tests can be found in Appendix F.

Sub-analyses

Results of the moderator analyses for the intention-behaviour gap can be found in Table 4. Tests of heterogeneity were not significant for between random effect models regarding design ($Q(2) = 4.56$, $p = 0.102$), intention measure ($Q(2) = 4.70$, $p = 0.096$), type of PA ($Q(1) = 1.25$, $p = 0.263$), and profile formation ($Q(1) = 0.05$, $p = 0.821$) suggesting that differences regarding the intention-behaviour gap were not explained by these moderators. Random effect analyses were significant for population ($Q(3) = 9.79$, $p = 0.020$), PA measure ($Q(4) = 22.15$, $p < 0.001$), and risk of bias ($Q(1) = 5.61$, $p = 0.018$) indicating that these moderators influence the size of the intention-behaviour gap.

Discussion

The aim of this paper was to quantify profiles of the PA intention-behaviour relationship, particularly the intention-behaviour gap, and to identify possible moderators that determine the size of the gap. Importantly, this paper is a notable update and upgrade of the meta-analysis conducted by Rhodes and de Bruijn (2013). The sample size of this meta-analysis was 7-times larger with a more widespread population of samples compared to the publication in 2013, which mainly included undergraduate samples. Despite the improvements of this review and meta-analysis over the prior study, the findings of the present study show many similarities with the results calculated in the meta-analysis of 2013. This consistency shows that the intention-behaviour gap is a

robust and reproducible psychological phenomenon in the field of PA. In particular, our results showed that people are unlikely to be physically active without intentions, as only 4.2% of the participants across these samples were non-intenders exceeding their intentions. This finding can be considered reliable due to a low heterogeneity within this profile. Moreover, again similar to the results of the previous meta-analysis, 26.0% of the sample were non-intenders who were also not physically active. This proportion should

Table 4. *Moderator analyses of the intention-behaviour gap*

		Random effects model					Heterogeneity
Moderators	*k*	Point estimate	Lower limit	Upper limit	*z*-value	*p*-value	*Q*-value (df), *p*-value
Study design	25	0.487	0.415	0.554	11.433	< 0.001	4.56(2), 0.102
Prospective	12	0.505	0.448	0.557	14.895	< 0.001	
Cross-sectional	11	0.437	0.380	0.491	13.358	< 0.001	
Intervention	2	0.565	0.423	0.679	6.661	< 0.001	
Population	25	0.481	0.399	0.554	10.162	< 0.001	9.79(3), 0.020
Convenient adults	12	0.446	0.394	0.495	14.919	< 0.001	
Students	7	0.561	0.494	0.621	13.458	< 0.001	
Parents	3	0.504	0.385	0.608	7.262	< 0.001	
With health risks	3	0.400	0.288	0.501	6.530	< 0.001	
Intention measure	25	0.470	0.401	0.534	11.673	< 0.001	4.70(2), 0.096
Likert scale	11	0.523	0.466	0.575	15.206	< 0.001	
Yes/no format	7	0.434	0.357	0.504	10.059	< 0.001	
Open-ended	7	0.442	0.358	0.519	9.315	< 0.001	
Type of PA	25	0.482	0.427	0.534	14.751	< 0.001	1.25(1), 0.263
Mixed	23	0.469	0.430	0.507	20.001	< 0.001	
Resistance training	2	0.539	0.419	0.641	7.561	< 0.001	
PA measure	25	0.516	0.417	0.603	8.833	< 0.001	22.15(4), < 0.001
GLTEQ	12	0.445	0.389	0.498	13.760	< 0.001	
Likert scale	5	0.423	0.348	0.492	10.018	< 0.001	
IPAQ	4	0.598	0.515	0.669	11.282	< 0.001	
Yes/no format	2	0.433	0.309	0.543	6.275	< 0.001	
Objectively	2	0.708	0.578	0.803	7.741	< 0.001	
Profile formation	25	0.477	0.437	0.514	20.398	< 0.001	0.05(1), 0.821
Based on pre-defined regular PA	20	0.479	0.434	0.521	18.044	< 0.001	
Based on clusters, median or yes/no format	5	0.468	0.383	0.546	9.517	< 0.001	
Risk of bias	25	0.510	0.388	0.614	7.199	< 0.001	5.61(1), 0.018
high	4	0.573	0.486	0.648	10.635	< 0.001	
moderate	21	0.457	0.416	0.496	19.066	< 0.001	

be interpreted with caution, as there was publication bias detected in this specific group. At the same time, however, the finding that 33.0% of the sample were not physically active as intended despite having the intention to be suggests that, while intention is necessary, it is often not sufficient to perform the behaviour (Pfeffer & Strobach, 2019; Rebar et al., 2014). Of key impact, the size of the intention-behaviour gap was 47.6%, and thus comparably large. This again underpins the reliability of the results from 2013 and their reproducibility where the prior estimate was 46%. As behaviour change plans are part of clinical procedures, these results are of particular interest for practitioners. In order to increase the likelihood of performing intentions to behaviour change, additional support to bridge the intention-behaviour gap is needed (Rhodes et al., 2022). The use of outlined behaviour change techniques (Howlett et al., 2019) and the implementation of other relevant variables for long-term behaviour such as affective judgements (Rhodes & Kates, 2015) or habit formation (Feil et al., 2021) are recommended for successful physical activity interventions.

This updated meta-analysis also explored the heterogeneity of the intention-behaviour gap and the potential underlying study characteristic and methods moderators. We found that the intention-behaviour relationship was robust to study design, intention measure, type of PA, and the composition of the profile. Still, there were a few moderators of the intention-PA relationship. First, the population was a significant moderator, with students showing the largest intention-behaviour gap (56.1%) and participants with health risks showing the smallest intention-behaviour gap (40.0%). Populations with risk factors or suffering from health conditions may have a stronger motivation to engage in regular PA as the consequences of PA for physical and mental health is salient and proximal (Floud et al., 2020; Lavie et al., 2019; Minihan et al., 2022; Schuch et al., 2017), while going to college or university often decreases PA behavior (Allender et al., 2008; Wengreen & Moncur, 2009). Second, how PA was measured was a significant moderator of the intention-behaviour relationship. Specifically, studies with objectively measured PA had the largest intention-behaviour gap with 70.8% (Kerner et al., 2001; Rhodes et al., 2020), while the smallest intention-behaviour gap (42.3%) was using self-reported PA with likert scales (Godin et al., 2004; Rhodes et al., 2020). A known problem with self-assessments is that they are based on the individual's memory and often yield higher PA levels than objectively measured PA (Cholewa et al., 2020; Hagstromer et al., 2010). Third, risk of bias was a significant moderator with high-quality studies (Fiala & Rhodes, 2010; Rhodes et al., 2021; Rhodes & Lithopoulos, 2022; Rhodes et al., 2020) showing a

larger intention-behaviour gap (57.3%) than studies with moderate study quality (45.7%). Because high quality studies can be expected to yield more reliable and accurate results than studies with lower quality, it can be assumed that the size of the intention-behaviour gap is even larger than the average of 47.6%.

Clinical implications

In terms of clinical implications, practitioners should differentiate between patients who have already formed an intention to be physically active and those who have no intention to be physically active, as they may benefit from different treatments. For example, for patients who already have an intention, implementation strategies (e.g., action and coping planning, if-then plans, self-monitoring) should be provided to support translating intentions into action (Bélanger-Gravel et al., 2013; Kersten et al., 2015; Silva et al., 2018). Additionally, other psychological processes such as affective attitude, self-efficacy, or identity, can be relevant moderators of the intention-behaviour gap (Rhodes et al., 2022). Therefore, strategies focusing on these constructs are of interest. In contrast, for patients who have not formed an intention yet, education interventions providing information about the relationship between physical activity and health seem to be promising. While the knowledge about the impact of physical activity on quality of life can be considered as a positive predictor of physical activity motivation, potential barriers such as fatigue and depression should also be considered as they can reduce motivation in patients (Frikkel et al., 2020).

Limitations

Besides the previously acknowledged strengths of this paper, some limitations need to be mentioned. First, the search of eligible studies was limited to English language and conducted in five databases. Therefore, we cannot guarantee that all eligible studies were found. Second, given the heterogeneity of the study designs included in this review, causal conclusions should be drawn with caution. For example, the results of cross-sectional studies can also be interpreted to indicate that those who are more physically active have higher intentions. Third, this meta-analysis comprised only 25 samples. Due to this rather low number of studies, Q-static is reduced in power and I^2 and tau^2 can be biased. Therefore, the findings should be interpreted with caution. Fourth, not all studies

defined PA following the guidelines by the WHO in 2020 implying that participants with the same amount of PA could have been considered as successful intenders in one study, while as unsuccessful intenders in another study. In the same vein, it is important to consider that all individuals that did not fully meet their intentions were allocated to the profile of unsuccessful intenders. Future research exploring the magnitude of the intention-behaviour gap within individuals seems to be a worthwhile line of investigation that could provide more nuanced information. Fifth, findings were predominantly conducted in Canada and the Netherlands. Future research may focus on factors such as socioeconomic status, health status, education, and the environment explaining the discrepancies between intention and PA behaviour. Moreover, in light of the physical activity paradox (Holtermann et al., 2018), it seems interesting to address occupational PA in particular.

Conclusions

Based on the action control framework, this study aimed to quantify the relationship between intention and the actual PA behaviour. On the one hand, a remarkably large proportion of participants did not have an intention to change their PA behaviour and remained inactive, while only a small proportion was physically active despite having no intention. On the other hand, consistent with a previous meta-analysis (Rhodes & de Bruijn, 2013), almost half of the individuals who had the intention to be physically active did not engage in the behaviour. In conclusion, the results indicate that while intention is a necessary antecedent for behaviour, it is often not sufficient to perform the behaviour.

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Examining the role of anticipated enjoyment and intention in predicting attendance in exercise classes

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Abstract

Background: A large body of research shows that positive affect is related to higher physical activity levels. Building on this relation, a more novel approach suggests that also the anticipation of affective responses may play a role for physical activity participation. Thus, the purpose of this study was to examine the relation between anticipated enjoyment, intention and exercise class attendance in a prospective design with three measurement occasions.

Methods: In total, 363 adults (M_{age} = 32.28, *SD* = 14.11) were recruited from weekly exercise classes in Germany. Questionnaires for anticipated enjoyment and intention in relation to the next exercise class were sent to the participants in between two weekly exercise classes and the attendance of the next exercise class was subsequently assessed. Moreover, the maintenance of exercise classes was examined by assessing the attendance of five exercise classes after recruitment.

Results: Logistic regression analyses showed that anticipated enjoyment was related to exercise class attendance, but this effect was non-significant when intention was added as an additional predictor. While intention was a significant mediator of the relation between anticipated enjoyment and exercise class attendance, anticipated enjoyment was not a significant moderator of the relation between intention and exercise class attendance. Linear regression analyses yielded that anticipated enjoyment was significantly related to exercise class maintenance, but this effect was non-significant again when intention was added as an additional predictor. The results suggest that

anticipated enjoyment is associated with intention which is predictor of exercise class attendance.

Conclusions: The results suggest that in line with previous theoretical models, anticipated enjoyment is related to intention which is a predictor of exercising. Future research should include control variables to examine the impact of anticipated enjoyment on intention and physical activity behavior.

Keywords: anticipation, enjoyment, intention, exercise, prospective

Background

Physical inactivity has been associated with physical and psychological diseases such as obesity (Silveira et al., 2022), cardiovascular diseases (Lavie et al., 2019), metabolic syndrome (Amirfaiz & Shahril, 2019) or dementia (Floud et al., 2020). Therefore, the World Health Organization recommends regular moderate to vigorous physical activity of about 150 minutes per week for adults (World Health Organization, 2020). Despite the preventive health benefits of physical activity, many people fail to engage in regular physical activity. To achieve the recommended guidelines weekly exercise classes are particularly attractive for people who like to exercise in a group and with a professional trainer. However, in a study assessing the attendance of exercise classes over 13 weeks, it was shown that after the fourth week, only about half of the participants were still present (Finne et al., 2019). This was the case despite constantly high intention rates regarding the next weeks exercise class participation. Although intention is a relevant and necessary antecedent of physical activity, affective determinants of physical activity have received increasing attention in recent years. More specifically, the anticipation of affective responses was relevant for numerous health behaviors such as vaccination, cancer screening and physical activity in previous studies (Brewer et al., 2016; Feil et al., 2023).

Theoretical considerations

Recent theories in exercise research suggest that affective variables influence physical activity behavior. The Affective Reflective Theory (ART) is central to this understanding, suggesting that two distinct processes type-1 and type-2 govern physical activity behavior (Brand & Ekkekakis, 2019). Type-1 processes are automatic, reflexive

affective responses, such as acute affective reactions during exercise. In contrast, type-2 processes are slower, reflective, and require self-regulation, such as the intention to engage in physical activity. Affective variables can manifest as either type-1 or type-2 processes (Brand & Ekkekakis, 2019; Stevens et al., 2020; Williams et al., 2019). Type-1 processes occur without evaluative thinking, while type-2 processes involve cognitive appraisal, such as the anticipation of future affective responses to physical activity (Stevens et al., 2020). Anticipated affective responses are defined as affective responses that are expected to arise in the future in relation of an event (Williams et al., 2019).

Closely related to anticipated affect is affective attitude (Conner et al., 2015; Conner, 2018) defined as the affective evaluation of physical activity, focusing on hedonic emotions like enjoyment (Stevens et al., 2020; Williams et al., 2019). To assess affective attitude, participants are asked to indicate how enjoyable, boring or pleasant exercising would be for them (Conner et al., 2015; Conner, 2018). Affective attitude represents a general affective evaluation developed through repeated exercise experiences. In the present study we focus on anticipated enjoyment which differs from affective attitude in two ways. First, anticipated enjoyment was related to a specific exercise behavior (i.e., exercise classes) and second, the period of weekly exercise classes had just started suggesting that anticipated enjoyment was related to a new behavior for which an attitude needs to be built over time.

Many previous studies focused on anticipated self-conscious emotions such as regret, pride or shame which were associated with the absence of exercising or an alternative behavior (Abraham & Sheeran, 2003, 2004; Conner et al., 2015). Moreover, anticipated affect often focused on the outcome of a behavior after a longer period of time (Dunton & Vaughan, 2008). However, in a qualitative study, active and non-active participants anticipated a variety of emotions (e.g., enjoyment, shame, satisfaction, disappointment) suggesting that different anticipated emotions may be related differently to physical activity behavior (Feil et al., 2022). In addition, anticipated emotions during the next exercise session differed from anticipated emotions after the exercise session. Consequently, when comparing results regarding the relation between anticipated affect and physical activity behavior, the reference point (how one will feel during/after the behavior or when missing out), the emotion under research (enjoyment, regret, pride, etc.) and the timeframe (distance between anticipated affective construct and actual behavior) should be considered (for a recent scoping review on anticipated affect see Feil et al., 2023). A more general emotion theory suggests that the anticipation of emotions is

particularly relevant for decision making and behavior initiation (Baumeister et al., 2007). In addition, the previously mentioned qualitative study proposed a theoretical model on how anticipated emotions may be related to physical activity behavior (Feil et al., 2022). The authors suggest that previous experiences create specific expectations that develop into anticipated emotions. Furthermore, they hypothesize that anticipated emotions may be related to proximal determinants of the behavior such as the intention to exercise.

Anticipated affective responses and physical activity

Several reviews support the positive relation between reflective affect variables (e.g., affective attitude, anticipated affect) and physical activity behavior in different settings and ages (Klos et al., 2020; Nasuti & Rhodes, 2013; Rhodes et al., 2009; Rhodes et al., 2019; Rhodes & Kates, 2015; Stevens et al., 2020). Regarding the influence of anticipated affective responses on physical activity, a recent scoping review suggests that especially positive anticipated affective responses such as anticipated enjoyment are positively related to physical activity behavior (Feil et al., 2023). For example, in a prospective study, a positive correlation between positive anticipated affective responses during exercise and days of moderate physical activity four weeks later was found (Kwan, 2010). In the same study, positive anticipated affective responses after exercise were positively correlated with days of vigorous physical activity. While in this study participants were asked about their anticipated affective responses during and after exercise (Kwan, 2010), in another study participants indicated their anticipated affective responses if they would successfully complete 90 days of physical activity (Dunton & Vaughan, 2008). They found that the anticipation of positive affective responses before the 90 days started was associated with a higher likelihood of physical activity adoption and maintenance (Dunton & Vaughan, 2008). Several other studies found no direct association between specific anticipated emotions such as pride, shame and regret and physical activity behavior (Gilchrist et al., 2017; Gilchrist & Sabiston, 2018; Janssen & Waters, 2019).

Anticipated affective responses and intention

While a convincing amount of research focused on the relationship between anticipated self-conscious emotions (e.g., regret) and physical activity behavior, only

some studies examined the relation between positive anticipated affective responses and intention. Two studies found a small (Jackson et al., 2003) to moderate (Kwan, 2010) correlation between positive anticipated affective responses and physical activity intention. Another study found that anticipated affect about an exercise prescription for the following week was significantly associated with the odds of "very strong intention" to follow through with the prescribed exercise program (Kwan et al., 2017). In a longitudinal study, anticipated enjoyment prior to a 30-minute workout only marginally predicted exercise intention after the workout (Loehr & Baldwin, 2014). These findings are consistent with the theoretical model proposed in the discussion of a qualitative study on anticipated emotions (Feil et al., 2022), in which intention was proposed as a mediator between anticipated affect and physical activity behavior.

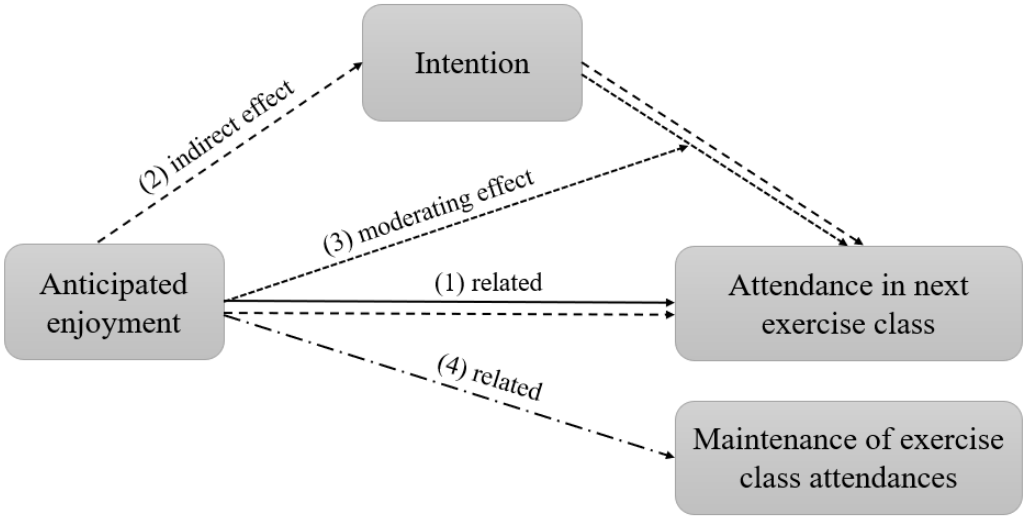
The role of intention in physical activity behavior has been debated over the past decade. Traditionally, intention has been considered a central predictor of behavior. This was underpinned by a meta-analysis which has shown a correlation of approximately r = .48 between intention and physical activity (McEachan et al., 2016). Notably, observational studies show that a large change in intention results in a small effect on behavior (Rhodes & Dickau, 2012; Sheeran & Webb, 2016). Therefore, many studies have focused on identifying moderators for the relation between intention and the subsequent behavior. With regards to the intention-physical activity relation, a recent systematic review found that anticipated regret (for missing physical activity opportunities) was a significant moderator of the intention-physical activity relation (Rhodes et al., 2022), but it seems unclear whether positive anticipated emotions (e.g., anticipated enjoyment) also moderate this relation.

The present study

While previous studies often focused on physical activity behavior in general, the present study assessed the attendance of weekly exercise classes as a specific exercise behavior. Weekly exercise classes are characterized as organized classes with professional instructors in stable contexts. Because we wanted to analyze the relation between anticipated enjoyment, intention and physical activity in different timeframes, we assessed exercise class attendance in a shorter and longer timeframe: one in which exercise class attendance was measured one to four days after anticipated enjoyment and intention, and another in which the exercise class attendance was assessed for the

following four classes. The purpose of this study was to examine the relation between anticipated enjoyment, intention and exercising (see Figure 13). For that four research questions have been outlined: (1) Is anticipated enjoyment related to the attendance at the next exercise class? (2) Is intention a mediator between anticipated enjoyment and exercise class attendance? (3) Is anticipated enjoyment a moderator of the relation between intention and exercise class attendance? (4) Is anticipated enjoyment related to exercise class maintenance? Based on the theoretical ideas and preliminary evidence presented above, we hypothesized that (1) anticipated enjoyment would be positively related to exercise class attendance, (2) intention would be a mediator between anticipated enjoyment and exercise class attendance, (3) anticipated enjoyment would act as a moderator of the relation between intention and exercise class attendance, and (4) anticipated enjoyment would be positively related to exercise class maintenance.

Figure 13. *The four research questions of the present study*



Material and methods

The four research questions of the study were registered in Open Science Framework prior to data collection on April 24, 2023 (osf.io/ewx6n). The university's data security commissioner and ethics committee approved the study.

Participants

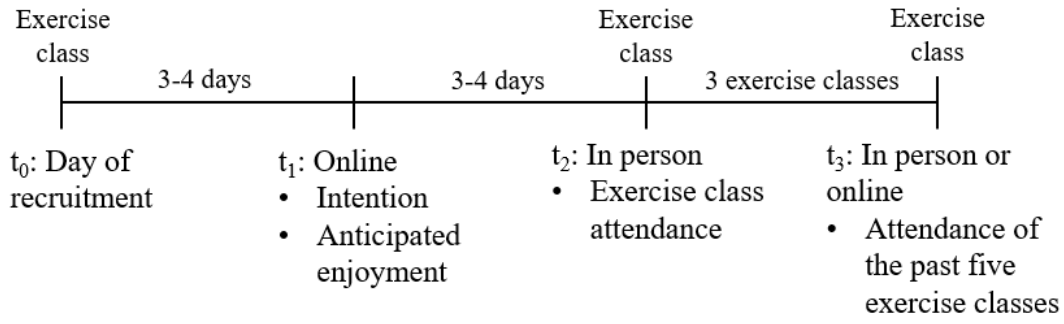
Participants were recruited from weekly exercise classes at a German university and two sports clubs located in Germany. The university offers exercise classes to students and employees who can purchase a membership for exercise classes lasting for one semester (i.e., six months). Exercise classes in the sports clubs were organized in cycles with each cycle lasting ten to 12 weeks. Data was collected from April to December 2023. Exercise classes comprised a variety of fitness classes (e.g., Yoga, Pilates, Zumba, Full-body workouts) and sports in a non-competitive setting (e.g., Badminton, Volleyball, Basketball). Participants of these classes were approached and informed about the purpose of the study at the end of an exercise class. The day of recruitment took place between the second and fourth week of the exercise programs. Eligible participants had to be at least 18 years old, understand German, and sign the written consent. The total sample size of the study was 476 at the day of recruitment, from which 363 participants filled out questionnaires about their anticipated enjoyment and intention to participate in the next exercise class at the next measurement occasion and were thus eligible for the analyses of this paper. The mean age of these 363 was M = 32.28 (SD = 14.11), 61.4% were female, and 59.0% were students (2 missings). The majority of participants attended exercise classes at the university (69.2%) and most participants were recruited from yoga classes (17.3%), handball (14.9%), and full-body fitness workouts (12.7%).

Procedures

Managers of the exercise programs and trainers of exercise classes were informed about the procedure of data collection. Participants were recruited directly after the exercise class and stated personal contact information which were stored separately from the collected data. Personal information and collected data could only be connected through individual codes. The first measurement occasion on the relevant variables (t_1) took place three to four days after recruitment (t_0) via e-Mail with a link to the online-platform SoSci-Survey measuring anticipated enjoyment and intention (see Figure 14). We have chosen the gap of three to four days to avoid a rebound effect from the exercise class at t0 that might have happened if the participants were asked directly after the exercise class (Box et al., 2020; Ekkekakis et al., 2011; Zenko & Ladwig, 2021). Moreover, we decided to give the participants time to complete the questionnaire at t_1

until 12am before the day of the next exercise class, because we wanted to avoid that t_1 and t_2 would coincide as a prospective study design was intended. The second measurement occasion (t_2) took place in-person one week after the day of recruitment assessing exercise class attendance. The third measurement occasion (t_3) took place after the fifth exercise class since the day of recruitment. This assessment was in-person after the exercise class or via SoSci-Survey in case participants did not attend the class at this specific day.* Additionally, experienced enjoyment (with PACES-S, Fritsch et al., 2022) and personality traits (with NEO-FFI, Körner et al., 2008) were measured for other study purposes that are not part of this paper. Participants that answered questions at all measurement occasions were part of a lottery if they gave their consent for it. Prizes promoted the programs of the university and the sports clubs (e.g., free memberships for one semester or one cycle).

Figure 14. *Study design and measurement occasions*



Measures

As outlined in the procedure, several variables were assessed at different measurement occasions. The order of the questionnaires was randomized at the measurement occasion t_1, because merely the assessment of these constructs at the same measurement occasion could have an effect on participants' answers (e.g., Abraham & Sheeran, 2003; Sandberg & Conner, 2011).

*In the preregistration of the study the third measurement occasion was planned five weeks after the day of recruitment. We changed it to five exercise classes since the day of recruitment because some exercise classes were cancelled and we wanted to ensure that every participant had the same number of exercise classes between the day of recruitment and the third measurement occasion.

Anticipated enjoyment. Anticipated enjoyment was assessed with an adopted form of PACES-S (Chen et al., 2021; Fritsch et al., 2022), which is a short version of the Physical Activity Enjoyment Scale (PACES, Kendzierski & DeCarlo, 1991). This short version focuses on the subjective experience of enjoyment related to physical activity. The item stem was "When I imagine to participate in this class again, then I expect that…" and the four items were "I will enjoy it", "I will find it pleasurable", "It will be very pleasant", and "It will feel good". Cronbach's α was 0.85 in the present study.

Intention. The intention to participate in the next exercise class was assessed with two items "I intend to participate in this class again next week" and "I am sure that I will participate in this class again next week". A seven-point response scale from "definitely not" to "definitely yes" was used for answering. The items had been widely used to measure intention (de Bruijn et al., 2014). Cronbach's α was 0.74 in the present study.

Exercise class attendance. A research assistant was present at t_2 and checked the attendance.

Exercise class maintenance. The participation of the following five exercise classes since t_0 was assessed at the third measurement occasion using two measures. First, one item assessed attendance of the four exercise classes between t_0 and t_3 asking "In the past four exercise classes I attended this class…". Five answers were used to rank the participation ("not once", "one time", "two times", "three times", "all four times"). Second, a research assistant was present at t_3 and checked the attendance at this day. Combining both measures, the variable exercise class maintenance ranged from 0 (no exercise class was attended since t_0) to 5 (all exercise classes were attended since t_0).

Statistical analyses

Two a priori power analyses with G Power 3.1.9.4 were done, one for logistic regression analyses (research questions 1-3) and one for linear regression analyses (research question 4) with $p < .05$ and power (1-ß) adjusted to .80. For both analyses, effect size describing the relation between anticipated enjoyment and physical activity were used from a study by Kwan (2010) showing a positive correlation between anticipated positive affect during exercise and the number of days being physically active on a moderate level ($OR = 1.94$ for logistic regression, $r = .17$ for linear regression). The power analysis for logistic regression analyses (X distribution binomial) revealed that $N = 339$ participants would be needed to reach the power of .80. The power analysis for

linear regression analyses (fixed model, R^2 increase) with one predictor showed that N = 266 participants would be needed. Based on the available data of the participants, presented samples in the results comprise N = 363 participants for logistic regression analyses and N = 267 participants for linear regression analyses.

Preliminary analyses were carried out screening the data for missing values concerning item-nonresponse resulting in one missing value for one participant of the anticipated enjoyment scale (item 2). The little's MCAR test was not significant suggesting that missingness was not related to the data (χ^2 = 1.0, df = 3, p = 0.800). The expectation-maximization algorithm for data imputation was used to avoid the deletion of the participant (Dempster et al., 1977; Jekauc et al., 2012).

To test the outlined research questions, four different statistical tests were carried out with SPSS (IBM SPSS Statistics 26). Regarding the first research question (i.e., assessing whether anticipated enjoyment would be related to exercise class attendance), we applied logistic regression analysis to examine the influence of anticipated enjoyment at t_1 (independent variable) on attendance of the exercise class at t_2 (dependent variable). Regarding the second research question (i.e., assessing whether intention would mediate the effect of anticipated enjoyment on exercise class attendance), we performed a logistic regression analysis with anticipated enjoyment and intention both at t1 as predictors and attendance at t_2. The reduction of the effect of anticipated enjoyment in the regression with intention as an additional predictor would indicate the presence of mediation. Additionally, we conducted a mediation analysis with Hayes' PROCESS macro (Hayes, 2022; Igartua & Hayes, 2021). Model 4 was applied which comprised a dependent variable Y (attendance at t_2), an independent variable X (anticipated enjoyment at t_1), and a mediator variable M (intention at t_1).

For the third research question (i.e., assessing whether anticipated enjoyment would moderate the effect of intention on exercise class attendance), a logistic regression analysis was carried out including anticipated enjoyment at t_1, intention at t_1, and the product of anticipated enjoyment and intention at t_1 as predictors of attendance at t_2.
For the fourth research question (i.e., assessing whether anticipated enjoyment would be related to the maintenance of exercise class attendances), a linear regression analysis was computed with anticipated enjoyment at t_1 as a predictor (independent variable) and the maintenance of exercise class attendances at t_3 (dependent variable). Significance level was set at $p < .05$ and reported p-values were divided by two for research questions one

and four because we formulated directed hypotheses. Further, Nagelkerkes R^2 was reported in logistic regression analyses and adjusted R^2 in linear regression analyses.

Results

Descriptive statistics

From the included 363 participants at t_1, 230 participants (63.4%) attended the exercise class at t_2. The descriptive statistics of all variables and the correlations between them can be found in Table 5.

Table 5. *Correlations and descriptive statistics of study variables*

	1	2	3	4
1. Anticipated enjoyment t_1	-	-	-	-
2. Intention t_1	.29*	-	-	-
3. Attendance at t_2	.11*	.31*	-	-
4. Maintenance of exercise class attendances	.16*	.27*	.33*	-
M	4.39	6.47	0.63	3.67
SD	0.66	1.02	0.48	1.26

Note: *$p < .05$

Effect of anticipated enjoyment on exercise class attendance (Hypothesis 1)

The logistic regression analysis showed a significant effect of anticipated enjoyment on exercise class attendance ($OR = 1.40$, Nagelkerkes $R^2 = .016$, $\chi^2 = 4.1$, $df = 1$, $p = .022$). If the anticipated enjoyment scale increased by one, the odds for attending the next exercise class increased by 39.6%. Thus, Hypothesis 1 was supported.

Intention as a mediator between anticipated enjoyment and exercise class attendance (Hypothesis 2)

When including intention as an additional predictor in the logistic regression, anticipated enjoyment was no more a significant predictor of exercise class attendance ($OR = 1.06$, $\chi^2 = .1$, $df = 1$, $p = .738$). However, intention turned out to be a significant predictor of exercise class attendance ($OR = 2.05$, $\chi^2 = 24.2$, $df = 1$, $p < .001$). This means that if the intention strength increased by one, the odds of attending the next exercise class

doubled. Since the effect of anticipated enjoyment on exercise class attendance disappeared when intention was added as a predictor, a mediation effect can be inferred.

To underpin the results, we conducted a mediation analysis using Hayes' PROCESS macro yielding similar results. In the first model (Table 6) with intention as the dependent variable and anticipated enjoyment as the independent variable, anticipated enjoyment was a significant predictor (B = .441, SE = .078, $t(1)$ = 5.652, p < .001). In the second model (Table 7) with exercise class attendance as the dependent variable and anticipated enjoyment and intention as independent variables, intention was a significant predictor (OR = 2.05, SE = .146, p < .001), while anticipated enjoyment was not a significant predictor anymore (OR = 1.06, SE = .187, p = .738).

Table 6. *Effect of anticipated enjoyment on intention*

Outcome variable: Intention at t_1	Regression coefficient *B*	*SE*	*t*	*p*	Lower *CI*	Upper *CI*
Anticipated enjoyment t_1	.441	.078	5.652	< .001	.288	.594
Constant	4.537	.346	13.130	< .001	3.858	5.217

Model summary: R^2 = .081, R = .285, F = 31.947, $df1$ = 1, $df2$ = 361, p < .001

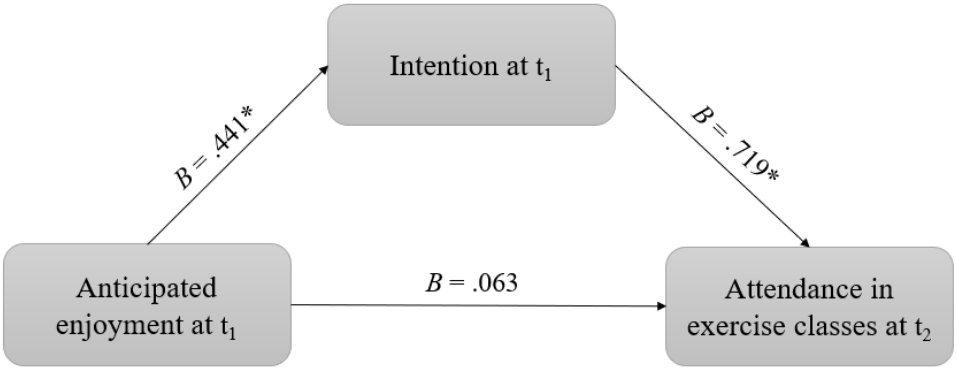
Table 7. *Effects of anticipated enjoyment and intention on exercise class attendance*

Outcome variable: Attendance at t_2	Regression coefficient *B*	*SE*	*z*	*p*	*Lower CI*	Upper *CI*	*OR*
Anticipated enjoyment t_1	.063	.188	.3348	.738	-.303	.428	1.06
Intention t_1	.719	.146	4.9195	< .001	.433	-.428	2.05
Constant	-4.377	1.088	-4.0239	< .001	-6.509	-2.245	-1.66

Model summary: Nagelkerkes R^2 = .131, $-2LL$ = 440.584, df = 2, p < .001

The direct effect anticipated enjoyment at t_1 on attendance at t_2 was .063 (SE = .188, z = .3, p = .738, CI = -.303-.428). The indirect effect of anticipated enjoyment via intention on exercise class attendance yielded a confidence interval from .114 to .137 confirming the mediation (SE = .114, z = 2.8, p = .006). Therefore, Hypothesis 2 was supported (see Figure 15).

Figure 15. *Results of mediation analysis*



Note: *p < .05

Anticipated enjoyment as a moderator of the relationship between intention and exercise class attendance (Hypothesis 3)

The logistic regression analysis indicated that both predictors anticipated enjoyment (*OR* = .68, *p* = .706) and intention (*OR* = 1.55, *p* = .487), as well as their interaction (*OR* = 1.07, *p* = .657) did not significantly influence the odd of attending the next exercise class (Table 8). Therefore, Hypothesis 3 was not supported.

Table 8. *Results of moderation analysis*

Outcome variable: Attendance at t_2	Regression coefficient *B*	*SE*	χ^2	*df*	*p*	*OR*
Anticipated enjoyment	-.388	1.026	.143	1	.706	.68
Intention	.441	.634	.484	1	.487	1.55
Interaction term	.069	.155	.197	1	.657	1.07
Constant	-2.572	4.124	.389	1	.533	.08

Effect of anticipated enjoyment on exercise class maintenance (Hypothesis 4)

The linear regression analysis revealed a small but significant effect of anticipated enjoyment on attendance of the next five exercises classes since t_0 (β = .157, *b* = .301, *t*(1) = 2.580, adjusted R^2 = .021, *p* = .005). If anticipated enjoyment increased by one unit, the number of exercise class attendances increased by 0.301. Anticipated enjoyment explained 2.1% of variance in the sum of exercise class attendances. Thus, Hypothesis 4

was supported. Additionally, we conducted an exploratory analysis with intention as an additional predictor in the linear regression yielding the same result as in the logistic regression analysis. While intention turned out to be a significant predictor of the attendance of the next five exercise classes (β = .245, b = .322, $t(2)$ = 3.832, adjusted R^2 = .069, $p < .001$), the effect of anticipated enjoyment disappeared (β = .065, b = .125, $t(2)$ = 1.017, p = .310).

Discussion

The purpose of this study was to examine the relation between anticipated enjoyment, intention, and exercise class attendance. Anticipated enjoyment was related to exercise class attendance, however, when intention was added as an additional predictor this effect was not significant anymore. Subsequent analyses suggest that anticipated enjoyment may be a predictor of intention, which in turn influences exercise class attendance. The moderation analysis, in which anticipated enjoyment was postulated as a moderator of the relation between intention and exercise class attendance, did not yield significant results. Moreover, anticipated enjoyment was significantly related to the exercise class maintenance. However, exploratory analyses revealed that the effect was no longer significant when intention was included as an additional predictor in the regression.

The significant relation between anticipated enjoyment and exercise class attendance is line with previous research (Dunton & Vaughan, 2008; Kwan, 2010). However, differences in the study design should be considered when comparing results. First, the reference point of the anticipated affective construct may differ between studies as suggested in a recent scoping review (Feil et al., 2023). In the present study, anticipated enjoyment was related to how participants would feel during the next exercise class (very similar in Kwan, 2010), while in a previous study positive anticipated affect was related to how participants would expect to feel after completing a 90-day physical activity period (Dunton & Vaughan, 2008). Second, the timeframe was different as in the present study anticipated enjoyment was related to an event occurring within the next day(s). On the contrary, in the previously mentioned study, anticipated affect was related to an event occurring after 90 days (Dunton & Vaughan, 2008).

The positive relation between anticipated enjoyment and exercise class attendance is also consistent with the theoretical considerations by a more general emotion theory

assuming that anticipated emotions are related to decision making and future behavior, here in form of exercise class attendance (Baumeister et al., 2007). However, as a theoretical model in exercise psychology suggested, anticipated emotions may be rather related to proximal determinants of exercise behavior such as intention than the behavior itself, which would explain why the effect of anticipated enjoyment was not significant anymore when intention was added as an additional predictor in the analysis (Feil et al., 2022). The relation between intention and exercise class attendance superimposed the effect of anticipated enjoyment, suggesting that the attendance of exercise classes as a more planned behavior may have been predicted by more regulative processes like intention (as suggested in Muschalik et al., 2018; Perugini, 2005). Attendance was assessed in the first half of the exercise programs in week two to four, when automatic processes may not have been developed yet, supporting the notion that attendance in the present study may have been a more planned behavior. Furthermore, a study focusing on different health behaviors showed that individuals who base their intention on affect rather than on cognitions have a stronger intention-behavior relation (Keer et al., 2014). This relation was mediated by the temporal stability of intention, suggesting that intention based on affect may be more stable over time and therefore more likely to be translated into behavior.

Consistent with previous research (Jackson et al., 2003; Kwan, 2010; Loehr & Baldwin, 2014), anticipated enjoyment was positively associated with the intention to exercise. Furthermore, the mediating effect of intention suggests that anticipated enjoyment may be a predictor of intention. Ajzen (2011) postulated that anticipated affect is closely related to affective attitudes and therefore does not add value to the prediction of intention (see also Ajzen & Sheikh, 2013). However, meta-analyses have shown that anticipated affect and affective attitude are separate constructs, as they independently predicted intention and behavior (Conner et al., 2015; Richard et al., 1996; Rivis et al., 2009; Sandberg et al., 2016). This was also the case when controlling for the variables subjective norms, attitude and perceived behavioral control (Conner et al., 2015) and especially in health-protective behaviors such as physical activity (Sandberg et al., 2016). However, we need to emphasize that we did not include these control variables which is why we cannot conclude from the results that anticipated enjoyment is an independent antecedent of intention.

We also tested whether anticipated enjoyment was a moderator of the intention-behavior relation. In contrast to previous studies showing that anticipated regret was a

significant moderator of the intention-behavior-relationship (e.g., Abraham & Sheeran, 2003; Abraham & Sheeran, 2004), we did not find such an effect in the present study. In a study that also examined exercise class attendance as an outcome variable over a period of 13 weeks, it was tested whether experienced affect after exercise classes was a moderator of the relation between intention and the re-participation in weekly exercise classes (Finne et al., 2022). No significant effects were found either on the between- or on the within-person level.

Furthermore, our study found that anticipated enjoyment was associated with exercise class maintenance. Based on the results of the second research question, we exploratively added intention as a predictor and found that the effect of anticipated enjoyment on exercise class maintenance was not significant anymore when intention was added. This finding supports again the theoretical idea that anticipated enjoyment predicts intention but not behavior itself (Feil et al., 2022). According to a recent scoping review on anticipated affect (Feil et al., 2023), only one study has examined the relation between anticipated affective responses and a 90 day physical activity program (Dunton & Vaughan, 2008). It was shown that positive anticipated affective responses after the period of 90 days predicted if a participant exercised regularly during this period of time or not. However, they did not include intention as an additional variable and the anticipated affective response was related to achievement of completing 90 days of regular exercising. Another study found that experienced affect predicted intentions at both the between-person and within-person levels (Finne et al., 2022). Similar to our findings, experienced affect predicted re-attendance, but this effect was non-significant when intention was added as a predictor. Moreover, a study that analyzed the attendance of weekly boot-camp classes showed that automaticity was a significant predictor of class participation of four consecutive weeks, while intention was not (Sas et al., 2023). The participants attended the boot-camp for four weeks prior to the study suggesting that more automatic processes may become more relevant for class attendance over time (as proposed in Strobach et al., 2020). In the present study, automatic processes were not included but could have influenced exercise class maintenance.

Strengths and limitations

The present study examined the role of anticipated affect as an understudied psychological construct in exercise class attendance and maintenance. A prospective

study design allowed for the analysis of the relation between anticipated enjoyment and the next exercise class attendance and maintenance, which included a total of five exercise classes. However, this study comes with several limitations. First, we were unable to control for exercise class characteristics (Wienke & Jekauc, 2016) and instructor competencies (Strauch et al., 2019) that may have influenced the relation between anticipated enjoyment, intention, and exercise class attendance. In the same vein, control variables that could have influenced the relation between anticipated enjoyment and exercise class attendance (e.g., momentary affect, remembered affect) or the relation between anticipated enjoyment and intention (e.g., perceived behavioral control, attitude, subjective norms) are missing. Second, analyses were conducted on the between-person level, because the data was not suitable for within-person analysis. Accordingly, no statements can be made about the extent to which changes in anticipated enjoyment could have caused changes in intention, exercise class attendance and maintenance. Third, participants received the online survey at t_1 three to four days after t_0 and had time to complete the questionnaire until 12 am before the day of the next exercise class (t_2). Thus, the exact time point of t_1 varied between participants. Fifth, consistent with previous research (Finne et al., 2022; Fritsch et al., 2022) participants reported high levels of anticipated enjoyment and intention, potentially leading to ceiling effects.

As a consequence of these limitations, future studies may benefit from using ambulatory assessment methods that allow within-person variation based on the repeated measures of anticipated enjoyment, intention, and behavior (Reichert et al., 2020). Frequent assessments of anticipated enjoyment and intention leading up to the moment of executing the behavior would provide a better understanding of the interplay between anticipated enjoyment, intention and behavior. Moreover, future studies should include additional variables that may influence this interplay such as other affective determinants of exercising, previous exercise experience and other predictors of intention.

Conclusions

The present study examined the role of anticipated enjoyment in exercise behavior and showed that anticipated enjoyment was indirectly related to exercise behavior via intention. This finding supports the relevance of intention as a predictor of behavior and suggests that anticipated enjoyment is a predictor of intention. However, if anticipated enjoyment is an independent and relevant antecedent of intention is still unclear due to

missing control variables. Future research is encouraged to include control variables that are relevant for intention and physical activity behavior. Additionally, collecting intensive longitudinal data would facilitate within-person analyses, potentially yielding more nuanced insights into these relationships.

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General discussion

The aim of this dissertation was to examine the role of anticipated affect and intention in physical activity behavior. In the first study (chapter 3), a qualitative analysis was conducted to identify anticipatory and anticipated emotion categories in regular and non-regular exercisers. Given the prominent relevance of anticipated emotions in the interviews of the first study and based on the literature, a theoretical model was derived that postulated a relationship between anticipated affect and physical activity. To provide an overview of the existing evidence on the relationship between anticipated affect and physical activity, a scoping review was conducted in the second article (chapter 4). The purpose of the article was to systematically provide recommendations regarding study design and methods for future studies. The third article (chapter 5) analyzed the intention-behavior relationship and provided a systematic review and meta-analysis using the action-control framework. Derived from the recommendations from the second and third study, the fourth article (chapter 6) examined the relationship between anticipated enjoyment as one specific anticipated emotion, intention and exercise class attendances in a prospective study. In this chapter, the main findings of the four studies are discussed and implications for future research are derived. In addition, strengths and limitations of the dissertation are presented followed by the conclusions.

Discussion of the findings

Based on the studies included in this dissertation, three topics for discussion emerged that are relevant to the current state of research. First, the distinction between anticipatory and anticipated affect and the impact of these constructs on health behaviors will be discussed in relation to previous research. Second, concerns about the influence of cognitive biases on anticipated affect, which have been neglected in most previous studies, are raised. Three aspects that may lead to cognitive biases will be considered. Third, possible moderators of the intention-behavior relationship will be examined based on current research. Fourth, the relationship between explicit processes and anticipated affect will be analyzed, as the prospective study found that intention, as an example of explicit processes, was a mediator between anticipated affect and exercise class attendance.

Anticipatory and anticipated affect

The dissertation examined the role of anticipated affect in physical activity using several approaches. To approach the topic broadly, a qualitative study was conducted focusing on anticipatory and anticipated emotion categories (Feil et al., 2022). It was found that the terms anticipatory and anticipated were often used and understood as synonyms both in everyday language and, to some extent, in previous research literature (e.g., Bagozzi et al., 1998). However, further literature clarifies that anticipatory and anticipated affect refer to different constructs that can be distinguished by both scientists and non-scientists when properly explained (Baumgartner et al., 2008). This was also the case in the qualitative study in this dissertation (Feil et al., 2022). The researcher explained to the participants previous to the interview that anticipatory emotions are defined as the emotions experienced at the moment when thinking about the next exercise session. Anticipated emotions were defined as expected emotions that may arise when participating in the next exercise session (Appendix, supplemental material chapter 3).

Theories have suggested that anticipated affect is more appropriate for predicting behavior, because reacting on momentary affect can lead to unhealthy decisions (Baumeister et al., 2007). However, very little research has been done to compare the two constructs in relation to future health behaviors such as physical activity. A meta-analysis focusing on health decisions yielded that anticipated emotions were associated with health intentions (r = 0.38, 95% CI 0.24–0.51) and behavior (r = 0.48, 95% CI 0.43 - 0.53), while correlations between anticipatory emotions and intention (r = 0.25, 95% CI 0.18 - 0.31) and between anticipatory emotions and behavior (r = 0.18, 95% CI 0.11 - 0.23) were rather small (Xu & Guo, 2019). The authors concluded that anticipated emotions would be more likely to promote healthy decisions and behaviors compared to anticipatory emotions. Considering the perceived risk of the participants, this was particularly the case for decisions regarding cancer screenings, genetic testing and vaccination. Subgroup analyses showed that anticipated emotions influenced intentions towards these detection behaviors (r = 0.19, 95% CI 0.11 - 0.26), but were even more likely to lead to intentions performing a prevention behavior (r = 0.46, 95% CI 0.32 - 0.59) such as physical activity (Xu & Guo, 2019). Although the meta-analyses did not include physical activity studies, because there were not enough at the time comparing the effect of anticipatory and anticipated affect, the results of the subgroup analyses point towards a relationship between anticipated affect and physical activity. This is in line with

the results of the scoping review in this dissertation where we conclude that future studies comparing the predictive power of anticipatory versus anticipated affect regarding future physical activity behavior would be of particular interest (Feil, Fritsch, Weyland, et al., 2023).

Cognitive biases influencing anticipated affect

We found in the scoping review that there seems to be a forecasting error as studies found a difference between anticipated and experienced emotions (Aitken et al., 2021; Loehr & Baldwin, 2014; Ruby et al., 2011). While participants tended to underestimate positive emotions (Aitken et al., 2021; Loehr & Baldwin, 2014), they tended to overestimate negative emotions (Aitken et al., 2021). This phenomenon can be explained through cognitive biases which could influence the anticipation process. In this chapter, three aspects will be discussed that may lead to cognitive biases as suggested by Jones and Zenko (2021): anticipatory affect, momentary affect, and remembered affect.

First, anticipatory affect could influence how one expects to feel as a response to future physical activity. Simply thinking about a future physical activity session could make one feel positive or negative influencing the valence of anticipated affect as discussed in the qualitative study (Feil et al., 2022). Participants were first interviewed regarding their anticipatory emotions when thinking about the next exercise session, before they described their anticipated emotions when they imagine to actually attend the next exercise session. Possible biases could have occurred during the interview. For example, one participant described anticipatory shame when thinking about the next exercise session, because she had not exercised for a while. The same participant reported to expect pride when participating in the next exercise session, because she simply managed to attend the class and most likely to reduce feelings of shame.

Second, momentary affect, that reflects the affective feelings in one specific moment, could influence the anticipation process. The difference to anticipatory affect is that momentary affect does not include a future perspective. For example, having a bad day and feeling depressive could negatively influence the positive anticipated affective response to the next exercise class. The influence of current mood on physical activity has been found in several studies using ambulatory assessment (Do et al., 2024; Dunton et al., 2014; Giurgiu et al., 2020). A systematic review showed that 12 studies consistently yielded a positive effect of positive mood on physical activity within the next few hours

(Liao et al., 2015). This relationship could also appear between momentary affect and anticipated affect. Moreover, thinking about the anticipated affect could lead to a spillover effect on momentary affective states (Castelfranchi & Miceli, 2011). For example, thinking about how much displeasure one expects to experience during the next exercise session could lead to feeling bad at the moment of thinking.

Third, past affective experiences most likely influence how one anticipates future affective experiences. Levine et al. (2018) pointed out the parallels between remembered and anticipated affective processes, as overlapping brain regions were active when thinking about past and future experiences in neuroscience studies (Benoit & Schacter, 2015; Mullally & Maguire, 2014). These findings suggest that memories are a key component of anticipation (Schacter & Addis, 2007). Remembered affect is an antecedent of anticipated affect, but can also bias the anticipation process as people tend to misremember previous experiences (Levine et al., 2009). For example, emotionally intense memories seem to be more accessible to people, even if they are unrepresentative, leading to irrational decisions (Morewedge et al., 2005). A prominent example is the terrorist attack of September 11, 2001, after which many Americans avoided flying, even though airplanes are considered the safest form of transportation. A study by Gigerenzer (2004) found that more Americans died on the roads after September 11 by avoiding flying than were killed in the terrorist attack. When it comes to physical activity, people may have several pleasant experiences and one unpleasant experience that distorts their memory of how physical activity will make them feel.

Relationship between intention and physical activity

Intention has been considered a key predictor of behavior and the third article examined extent to which intention is relevant to physical activity engagement. First, the results suggest that having the intention to exercise is necessary for engaging in physical activity behavior as only about 4% of the participants were physically active without having the intention. Second, the ratio of unsuccessful intenders to successful intenders, referred to as the intention-behavior gap, was about 48%, indicating a substantial discrepancy between intention and physical activity engagement. Sub-analyses showed that the population, the measurement of physical activity and the risk of bias significantly influenced the size of the intention-behavior gap. However, we did not examine whether

other psychological constructs could explain the difference between successful and unsuccessful intenders.

In a recent paper by Rhodes (2024), a meta-analysis was conducted based on the data published in (Feil, Fritsch, & Rhodes, 2023) and examined which of the psychological constructs in the included studies predicted the action-control profiles. For that, correlations and mean differences of the constructs in relation to the profiles were calculated. The constructs were grouped into three different processes: (1) reflective processes (e.g., affective attitude including expected pleasure, instrumental attitudes, perceived behavioral control), (2) regulatory processes (i.e., self-regulation) and (3) reflexive processes (i.e., habit, identity). All three processes were shown to contribute to the prediction of the profiles, with reflective processes being the largest predictor. In terms of intention formation, results indicated that all three processes influenced the difference between non-intenders and unsuccessful intenders, again with reflective processes being the strongest antecedent of intention formation. Regarding the fulfilment of intentions, all three processes were shown to be independent predictors of successful vs. unsuccessful intenders. More specifically, regulatory processes were significant in 73% of the studies, while perceived behavioral control (80% of the studies) and affective attitude (55% of the studies) were the most prominent reflective predictors. In addition, habit and identity were also significantly influencing the differentiation between unsuccessful and successful intenders (80% and 100% of the studies, respectively) with habit being particularly efficient in stable contexts and identity in unpredictable circumstances.

The presented evidence suggests that reflective, regulatory and reflexive processes influence whether intenders can translate their intention into action. However, Rhodes (2024) emphasizes the importance of reflexive processes in physical activity promotion programs where the intention to engage in physical activity has already been formed. Even more recent theories such as the PAAM model (Strobach et al., 2020) or the M-PAC framework (Rhodes, 2017) fall short in addressing the intention-behavior gap and how to overcome it. This critique is consistent with a recent editorial in the British Journal of Sports Medicine that focuses on the role of the automatic tendency to minimize effort in relation to the intention-behavior gap (Cheval et al., 2024). The authors suggest that humans tend to avoid physical effort which may explain the unsuccessful self-regulation of intenders. Based on this hypothesis, a prospective study with 401 university students using online surveys was conducted (Maltagliati et al., 2024). It was shown that automatic

approach and avoidance tendencies moderated the relation between intention and physical activity. This was only the case for vigorous physical activity, but not for moderate physical activity, consistent with the dual-mode theory by Ekkekakis (2003). The moderating effect of automatic processes was also found in a systematic review regarding potential moderators of the intention-behavior gap. From a pool of 138 independent samples, both reflective (including anticipated regret and affective attitude) and automatic (identity) processes were significant moderators of the intention-behavior gap. Based on the current evidence, future research should examine the effectiveness of the moderators in bridging the intention-behavior gap.

Explicit processes and anticipated affect

The presented research in this dissertation suggests that anticipated affect may be helpful to deepen the understanding of the intention-behavior relationship. The scoping review in this dissertation found that intentions to exercise were related to anticipated affect in several studies (Feil, Fritsch, Weyland, et al., 2023). This is supported by the results of the prospective study, in which intentions were a significant mediator of the relationship between anticipated enjoyment and exercise class attendance (Feil et al., submitted). Carrera et al. (2012) conducted a study on binge drinking behavior that examined the relationship between anticipatory emotions, anticipated emotions, binge drinking intentions, and the likelihood of binge drinking among college students. Anticipated enjoyment was added to a hierarchical model including the TPB variables and explained an additional 12% of the variance in binge drinking intentions. In contrast, they also found that anticipatory enjoyment was not related to binge-drinking intentions, but to students' reported likelihood of binge-drinking. The results support the strong relationship between anticipated positive emotions like enjoyment and health intentions, and question the argument by Ajzen (2011) that anticipated affect would not add additional explained variance to intentions.

In the prospective study, intentions to attend the next exercise class predicted the next week's exercise class attendance and maintenance (Feil et al., submitted). This effect superimposed the effect of anticipated enjoyment on exercise attendance. One explanation for this overlay effect of intention on exercise attendance may be that more reflective processes were involved. Attending a weekly exercise class as part of a closed program with a start and end date requires several steps in advance. Most participants had

to register for the exercise program and pay a fee before the program started. All measurement occasions occurred during the first half of the exercise program, which may have required more planning and self-control than the second half of the program. Therefore, more reflective and less automatic processes may have been involved. In the same vein, the double dissociation pattern suggests that spontaneous behavior is best predicted by the automatic system and deliberate behavior by the reflective system (Muschalik et al., 2018; Perugini, 2005). For example, taking the stairs instead of the elevator may be better explained by more automatic processes, whereas attending an exercise class may require more reflective/regulatory processes. Thus, in future studies, monitoring the exercise class for the entire cycle and including more automatic variables (e.g., habit) as well as more regulatory variables (e.g., self-control) would allow to investigate the influence of reflective/regulatory and automatic processes on behavior over time.

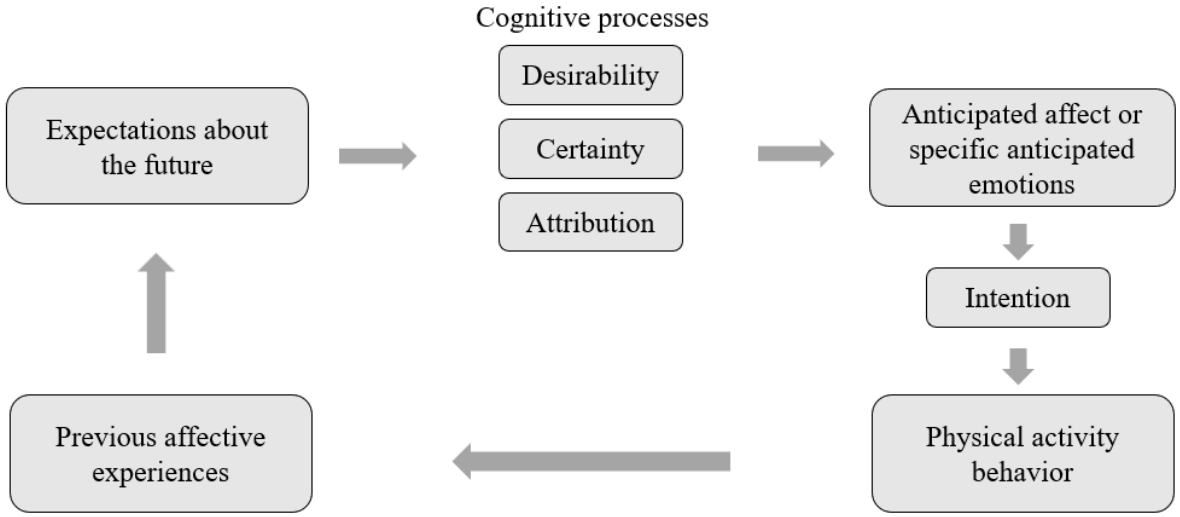
Neuroscientists follow similar hypotheses that more reflective processes are required in eating behavior. In a study by Kruschwitz et al. (2018), participants were asked to imagine negative consequences when giving in to cravings versus positive consequences when resisting cravings. The results show that the cognitive control network was active during the imaginations representing the need for self-control. However, also brain regions for affective processes were active during imagination. The authors concluded that anticipated affective consequences would influence self-control in regulating cravings. A more recent study showed that individuals that anticipated emotions regarding a future event had greater self-control in resisting short-term temptations and in achieving long-term goals (Kruschwitz et al., 2024). These results underpin the relevance and influence of anticipated emotions on more regulatory processes and subsequent behavior.

Revision of the theoretical model

The research results of the presented studies have several theoretical implications as presented in the previous section of this chapter. Based on these considerations, the theoretical model regarding anticipated affect in physical activity behavior can be revised (Figure 16). On the one hand, these theoretical implications concern appraisal processes that influence anticipated affect or its formation. On the other hand, the study results lead

to theoretical considerations about the relationship between anticipated affect and physical activity behavior.

Figure 16. *Revised theoretical model to investigate the role of anticipated affect in physical activity behavior*



Regarding the former, the first study suggests that appraisal processes influence the development of anticipated emotion categories (Feil et al., 2022). In particular, three appraisals may be relevant for future research focusing on the development and manipulation of anticipated affect: (1) desirability, (2) certainty and (3) attribution.

(1) The desirability of anticipated affective outcomes reflects whether future physical activity is associated with more positive or negative feelings (Ortony et al., 1988). Several aspects may be responsible for the anticipation of desirable or undesirable emotions regarding future physical activity such as the workout intensity or the group that participates. Future research focusing on the manipulation of anticipated affect should consider aspects that are relevant for building desirable (positive) and undesirable (negative) anticipated emotions.

(2) Certainty describes the perceived likelihood that the anticipated emotion will actually be experienced during physical activity. It reflects the individuals' confidence that the imagined situation and the anticipated emotions will come true. Anticipated emotions of hope and anxiety indicate that individuals are uncertain about how an exercise session will make them feel (as suggested by

Baumgartner et al., 2008). On the contrary, individuals who anticipate pure joy while exercising seem to be more confident about future exercise sessions.

(3) Attribution is a typical feature of self-conscious emotions such as pride, shame and guilt. The anticipation of self-conscious emotions provides information about an individuals' motivation to engage in physical activity (Sabiston et al., 2020). For example, participants who anticipate pride after a workout may complete the workout to experience an achievement or meet the expectations of others (Ortony et al., 1988), whereas participants that anticipate enjoyment during the workout may do it because it is fun which is an indicator for intrinsic motivation (Ryan & Deci, 2000).

The second part of theoretical implications focus on the relationship between anticipated affect, intention and physical activity. The results of the meta-analysis on the intention-behavior relationship showed that intention is still deemed necessary for physical activity but not sufficiently predicting exercise behavior due to the intention-behavior gap of about 48% (Feil, Fritsch, & Rhodes, 2023). Therefore, intention remains as a relevant determinant of physical activity behavior, but future investigations regarding efficient moderators of the intention-behavior gap are needed. As shown in the scoping review, a small number of studies showed consistently that positive anticipated affective responses and anticipated regret were positively associated with physical activity intention (Feil, Fritsch, Weyland, et al., 2023). Moreover, the third study of this dissertation yielded that positive anticipated affect is not directly related to exercising, but via intention as a mediator in this relationship (Feil et al., submitted). The modifications made in the theoretical model present intention as one proximal determinant of physical activity (Figure 16).

As discussed in the previous chapter, anticipated affect may be also related to other reflective and automatic processes. For example, it is unclear how anticipated affect may be related to more automatic processes (e.g., habit) that typically develop over a longer period of time. As habit formation has received increasing attention in exercise psychology in recent years, it serves as an example of automatic processes to illustrate how anticipated affect might be related to automatic processes. Several systematic reviews support the relevance of habits for regular exercise behavior (Feil et al., 2021; Gardner, 2015; Gardner et al., 2011; Rebar et al., 2016). From a theoretical point of view, anticipated affect could be involved in habit formation in two ways. First, previous

research has shown that anticipated affect is related to intention, which is an important part of habit formation. As proposed by Lally and Gardner (2013) in their framework, an intentional decision toward the behavior (stage 1) and action initiation (stage 2) are required to initiate habit formation. Anticipated affect could be an important predictor of these two stages in the habit formation process, prior to behavioral repetition (stage 3a) and the development of a cue-behavior association (stage 3b). Second, anticipated affect may serve as an expected reward that moderates the stimulus-response relationship that is critical for habit formation. De Wit and Dickinson (2009) suggest in their associative cybernetic model that rewards strengthen the stimulus-response relationship during behavioral repetition. In this regard, studies have shown that affective rewards can influence habit strength (Wiedemann et al., 2014) or automaticity (Weyland et al., 2020), which is a key feature of habit (Verplanken & Orbell, 2006). A recent intervention study demonstrates the complexity of manipulating affect successfully to facilitate habit formation (Weyland et al., 2022), which is a relevant area for future research.

Methodological considerations

Besides theoretical implications, the results of the conducted studies suggest several methodological considerations for future research. The scoping review provides detailed methodological recommendations based on the current state of research regarding the measurement of anticipated affect and relevant study designs (Feil, Fritsch, Weyland, et al., 2023). This section extends these recommendations regarding the manipulation of anticipated affect and the use of ambulatory assessment methods.

Manipulation of anticipated affect

Meta-analyses have shown that positive affect interventions increase physical activity rates (Chen et al., 2020; Rhodes et al., 2019). However, only very few intervention studies have been conducted on anticipated affect in the context of physical activity. In these studies, either anticipated affect or the exercise session was manipulated. Regarding the former, in a study by Kwan et al. (2017), participants received a positive affect manipulation, a negative affect manipulation, or no intervention at all. The affect manipulation included a reflection task. In the positive affect manipulation group aiming to increase positive anticipated affect, participants were told before exercising:

> *"Most people exercising at this intensity say that it feels good, and that it makes them feel energized and more positive, and more relaxed afterward. Thinking about your exercise prescription, please list the reasons or ways in which you, personally, might expect this exercise to lead to positive feelings, and what specifically about this exercise might make you, personally, feel good."* (Kwan et al., 2017, p. 7)

Participants in the negative affect manipulation group were told the opposite. Manipulation checks showed that the manipulation was successful (Kwan et al., 2017). Moreover, study results yielded that the positive anticipated affect manipulation had a positive effect on affective valence and arousal during exercising compared to the negative anticipated affect condition. However, no differences were found between the positive anticipated affect group and the control group. In a study by Helfer et al. (2015), one group of participants also received reinforcing information about how exercising will make them feel (good moods, happiness, contentedness, etc.) which had a positive effect on exercise intention compared to the group that received information about a bicycle. In addition, some participants in both groups were asked to elaborate on the information given (regarding positive affect or the bicycle) by writing down any thoughts they had about why exercise increases mood or about the bicycle. This reflection had no effect on the results. These two examples show that positive affect manipulation has an effect on experienced affect and intention. In the study by Kwan et al. (2017), elaborating and reflecting on the given information was part of the affect manipulation, whereas in Helfer et al. (2015), reflection did not have an additional effect on the results. However, Helfer et al. (2015) did not conduct manipulation checks and argued in the discussion that a more extensive reflection could lead to additional effects. In addition, a study by Ruby et al. (2011, study 4) showed that reflecting on separate workout phases (warm-up, main workout, cool-down) increased anticipated affect. Therefore, giving information how exercising will make one feel and additional reflection of separate workout phases may be a promising approach for anticipated affect interventions.

In addition, successful intervention techniques used in affect manipulations should be tested in anticipated affect interventions. For example, a meta-analysis by Chen et al. (2021) yielded that giving information on consequences of behavior in general, teaching to use cues, facilitating social comparisons, and receiving social support were significant intervention techniques that had a positive effect on affect or physical activity.

Furthermore, Wienke and Jekauc (2016) identified four facilitators of positive affect in physical activity: perceived competence, perceived social interaction, novelty experience, and perceived physical exertion. Depending on the intervention population, task-oriented teaching styles and attractive opportunities for physical activity (e.g., during school breaks) can also increase physical activity levels (Klos et al., 2020). These intervention techniques can be used to design attractive exercise session that induce positive anticipated affect in participants.

With regards to the manipulation of the exercise session, studies suggest that the order of exercises and the intensity may influence anticipated affect. The result of a study by Ruby et al. (2011, study 3) shows that participants anticipated higher enjoyment regarding the next workout when doing their favorite exercise fist comparing to doing their favorite exercise last. Beginning with attractive exercises seem do to have a positive effect on anticipated enjoyment. Furthermore, a study by Zenko et al. (2016) yielded that after the exercise, the decreasing-intensity group reported higher levels of anticipated pleasure regarding future exercising than the increasing-intensity group. In a similar study conducted by Ruby et al. (2011, study 2) intensity had no effect on anticipated affect. Given that a comprehensive amount of research showed that exercise intensity is related to affect (Ekkekakis et al., 2011), it may also play a role in anticipated affect. This is underpinned by a recent randomized control trial, in which an affect guided interval training was compared to high intensity training and a self-selected training (Zenko et al., 2024). In the affect guided interval training group, participants were asked to choose the highest intensity the still gives them pleasure while cycling. In the high intensity training group participants were cycling 90% of the watts corresponding to their peak power output and participants in the self-selected training chose the intensity they wanted. The results showed that all participants completed a vigorous training with the affect guided interval training group achieving significantly higher rates in experienced pleasure, remembered pleasure, enjoyment and anticipated pleasure regarding future trainings (Zenko et al., 2024). In addition, strong relations between affective constructs were revealed pointing towards cognitive biases that were previously discussed (Feil, Fritsch, Weyland, et al., 2023).

Ambulatory assessment

Collecting longitudinal data using questionnaires is often time-consuming and inflexible. Ambulatory assessment methods enable to assess behavior and behavior-related aspects such as context, physiological parameters, or experience in near real time and in real-life settings (Society for Ambulatory Assessment, 2024). These methods are also becoming increasingly popular in exercise science (Reichert et al., 2020; von Haaren-Mack et al., 2022). Ambulatory assessment can reduce bias from retrospective measurements and assess the dynamics of volatile variables over time. In addition, ambulatory assessment can be multimodal, combining e-diaries (e.g., reporting momentary affect) with wearables (e.g., accelerometers measuring physical activity) and geological data (e.g., GPS). These advantages enable within-person analyses which are more appropriate to investigate dynamic, psychological constructs (Kanning et al., 2013).

A compelling body of research using ambulatory assessment has shown that physical activity has a positive effect on affect or moods (Bossmann et al., 2013; Giurgiu et al., 2022; Liao et al., 2015). The systematic review by Liao et al. (2015) not only showed that physical activity predicts higher levels of positive affect and energetic feelings over the next few hours (e.g., Kanning, 2013; Kanning et al., 2012), but also provided evidence that positive affective states are positively associated with future physical activity (e.g., Dunton et al., 2009; Schwerdtfeger et al., 2010). A more recent study by Niermann et al. (2016) supports these findings, yielding that positive affect predicted objectively measured physical activity.

Ambulatory assessment has not only found its way into exercise studies including affective variables, but it is also increasingly being used to investigate the dynamics of social-cognitive variables. A recent systematic review showed that intention and self-efficacy were positively related to physical activity at a day level (Bittel et al., 2023). For example, in a study by Berli et al. (2018), participants answered e-diary questions for 28 days before going to bed. They were asked to indicate how much they intended to be physically active the next day on a scale from one to six. The results yielded that higher levels of intention predicted more minutes of physical activity the next day. Studies show contrary results when intention was related to physical activity within the next few hours (e.g., Arigo et al., 2022; Maher et al., 2017). For example, in a study by Maher et al. (2017), only 16% of participants who had the intention to be physically active within the next few hours were able to engage in at least 10 minutes of physical activity. However,

the odds of engaging in physical activity were higher with higher levels of positive affect pointing towards a positive effect of affective experiences on the intention-behavior relationship as discussed in chapter six.

This current state of research suggests that future studies focusing on the relationship between dynamic, psychological factors and physical activity should apply ambulatory assessment methods. In light of the results presented in chapter six, the use of ambulatory assessment would entail three major advantages for future studies focusing on anticipated affect in physical activity behavior. First, assessing anticipated affect and intention multiple times between exercise bounds would provide information about the stability of the constructs. As suggested in (Conroy et al., 2013), not only automatic but also social-cognitive constructs can vary on a daily basis resulting in changes in physical activity. Second, physical activity can be measured objectively with accelerometers and subjectively with questions regarding the quality of the activity (e.g., intensity). This allows for either a comprehensive assessment of physical activity or for detailed information regarding the characteristics of specific physical activity like a exercise class. Third, multiple measurement occasions enable multi-level analysis providing within-person and between-person results. Within-person analyses provide information about intra-individual changes over time in addition to between-person analyses that focus on changes across all participants.

Strengths and limitations

This dissertation comes with several strengths and limitations. A consecutive, three-step process was applied to examine the role of anticipated affect in physical activity behavior resulting four articles focusing on: (1) the development of anticipatory and anticipated emotions, (2) the current state of research on anticipated affect in the context of physical activity, (3) the proportion of intention-behavior profiles and intention-behavior gap in physical activity behavior, and (4) the relationship between anticipated affect, intention and physical activity.

Regarding the first, a qualitative account was chosen to deepen the understanding of anticipatory and anticipated emotions as there have been conflicting definitions in the past and no specific theoretical approach for physical activity behavior. Two theoretical models derived from the interviews, one regarding anticipated emotion categories and another regarding the interaction between anticipated emotions and physical activity (Feil

et al., 2022). A potential limitation of the application of these theoretical models lies in the small and young sample with $N = 16$ and $M_{age} = 26.63$ ($SD = 6.66$). Evidence suggests that affective experiences change throughout adulthood in that older adults report higher levels of positive affect (Barnett, 2013) or happiness (An et al., 2020) and less complex affective experiences (Brose et al., 2015). Young et al. (2021) even proposed an age-related emotion theory as they assume that appraisal processes change during adulthood.

Second, the first and so far, only review focusing solely on anticipated affect in the context of physical activity was conducted, offering detailed recommendations for future research. A combination of deductive and inductive classification was used to synthesize the rather heterogeneous studies, resulting in a total of five categories. Although this approach helped to guide the reader through the presented literature, the risk of oversimplification should be noted. Several studies provided results that fell into more than one category. For example, Kwan et al. (2017) conducted an intervention that manipulated anticipated affect and analyzed the effects on intention, affective experience, and subsequent physical activity. The various study findings by Kwan et al. (2017) appeared in four of the five categories which could lead to the assumption that they were each independent study results. To reduce potential confusion, we clearly stated that several studies provided more than one study result relevant to the research question, which is why the study appeared in multiple categories with different study results (Feil, Fritsch, Weyland, et al., 2023).

Third, an update of the meta-analysis by Rhodes and de Bruijn (2013) was conducted with a seven times larger sample size and moderator analyses to better understand the intention-behavior gap. The action-control framework, which provides four intention-behavior profiles, was used to describe the intention-behavior relationship. The WHO recommended guideline for regular physical activity was used in several studies to assign participants to the profiles, while other studies used alternative methods such as median scores or cluster analyses. As a result, participants could have been assigned to different profiles depending on the method used, reducing the comparability of the studies.

As a final step, a prospective study design derived from the implications outlined in the scoping review suggesting that intention might be a relevant variable when analyzing the relationship between anticipated affect and physical activity. The prospective study comprised four research questions that provided basic information about the relationship between anticipated enjoyment, intention and exercise class

attendance (Feil et al., submitted). Despite the prospective study design, within-person analyses were not possible due to the small number of measurement occasions. Therefore, intra-individual changes in anticipated enjoyment and intention cannot be considered based on the between-person results. Furthermore, social and environmental aspects were not taken into account, but could have influenced the results.

Conclusions

Conclusions from this dissertation can be drawn on two levels, one focusing on the development of anticipated affect and one focusing on the relationship between anticipated affect and physical activity. First, based on a qualitative account, this dissertation showed that anticipated emotions may result from a combination of different appraisals. Furthermore, active and inactive individuals appear to anticipate a variety of positive and negative emotions related to physical activity. This finding suggests that the relationship between anticipated affect and physical activity may be more complex than focusing solely on affective valence. Second, based on a scoping review and on a quantitative account, anticipated affect appears to be related to physical activity behavior. However, only very few previously published studies provided results regarding this relationship and used between-person analyses. A more convincing number of studies suggested that the intention to exercise plays a key role in the relationship between anticipated affect and physical activity. The importance of the intention to exercise for subsequent behavior is supported by the meta-analysis examining the intention-behavior relationship. However, despite the importance of having an initial intention to exercise, there still appears to be a substantial gap of approximately 48% between intention and physical activity engagement. While anticipated enjoyment was not a significant moderator of the intention-behavior relationship in the prospective study, the results suggest that anticipated enjoyment is related to intention. Overall, this dissertation supports the relevance of anticipated affect and intention in physical activity behavior.

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Appendix

Supplemental material chapter 3

Interview manual

Information about the study and the interview:

First of all, I would like to thank you for participating in the study and am pleased that we could find a date to carry out the interview. My name is Katharina Feil and I am conducting this study. I studied sports science with the profile physical activity and health at the KIT. My focus is on health psychology and the question of what motivates people to stay fit and healthy. This study is about finding out which emotions arise when thinking about future exercise sessions. As a side note, I will not respond to your answers as often as I would in a normal conversation in order to prevent my judgment influencing the interview. This might feel a bit unusual at the beginning, but just take the chance to talk without any interruption. At the beginning, I would like to know what kind of sport or exercise you do and what your sports program currently looks like. Later on, the interview will be divided into two parts, but they might seem very similar to you. In the first part, you have to describe the feelings you have right now when you think about something. In the second part you have to imagine yourself in a situation and think about how you may feel in this situation. The difference is that, in the first part, you have to describe your current feelings and, in the second part, you have to reflect and describe the emotions that you expect to arise in the future. Do you have any questions about this explanation?

To facilitate the evaluation, I would like to record our conversations. Do you consent to the conversation being recorded? All information provided will of course be treated anonymously, confidentially and with the utmost care. Participation is voluntary and you have the option at any time to not answer a question or to terminate the interview. Do you have any questions about the process? Otherwise, we would start the interview now.

Getting to know the participant:

- Ice-Breaker: In what kind of sport or exercise are you most involved in at the moment?

- How did you get involved?
- What does your sport or exercise program look like at the moment?
- How long have you been practicing in the way you are doing it at the moment?

Role of exercising in the participants' life:

- What are the reasons for you exercising the way you do at the moment? Regarding the frequency, the place, the provider.
- How important is sport or exercising in your life?
- What are the reasons for why exercising should be part of your life?

Part 1: Anticipatory emotions

We begin now with the first part which regards your emotions at the moment. You probably remember that I mentioned this earlier.

- What do you feel right now when you think about your next sport or exercise session?
    - Can you describe this feeling in more detail?
    - What thoughts come to your mind spontaneously when you think about the next sport or exercise session?
    - What physical sensations can you feel?
    - What name would you give this emotion?
    - Can you describe a situation in the past from which this feeling might have developed/ in which this feeling arises?
    - Why do you think this feeling is related to the situation?

- Do any other feelings come up when you think about the next exercise session? If so:
    - Can you describe this feeling in more detail?
    - What thoughts come to your mind spontaneously when you think about the next sport or exercise session?
    - What physical sensations can you feel?
    - What name would you give this emotion?
    - Can you describe a situation in the past from which this feeling might have developed/ in which this feeling arises?
    - Why do you think this feeling is related to the situation?

Part 2: Anticipated emotions

We begin now with the second part, in which you are supposed to imagine what your next sports or exercise session will look like. If it helps you, you can close your eyes for a moment and think about all the things that will be part of your next sports or exercise session.

- What feelings are you expecting during the next sport or exercise session?
    - Can you describe this feeling in more detail?
    - What physical sensations can you feel during the sports or exercise session?
    - What name would you give this emotion?
    - Why do you think you will feel this way?

- Do you expect any other feelings in the next sports or exercise session? If yes:
    - Can you describe this feeling in more detail?
    - What physical sensations can you feel during the sports or exercise session?
    - What name would you give this emotion?
    - Why do you think you will feel this way?

- What feelings are you expecting immediately after the next sport or exercise session?
    - Can you describe this feeling in more detail?
    - What physical sensations can you feel during the sports or exercise session?
    - What name would you give this emotion?
    - Why do you think you will feel this way?

Supplemental material chapter 4

Appendix A: Search term

("anticipat* affect*" OR "anticipat* emotion*" OR "anticipat* mood*" OR "anticipat* feeling" OR "anticipat* regret" OR "anticipat* anxiety" OR "anticipat* enjoy*" OR "anticipat* pride" OR "anticipat* shame" OR "anticipat* pleasure" OR "anticipat* displeasure") AND ("physical activity" OR sport* OR exercis* OR training OR fitness)

Appendix B: Study characteristics of included studies

Characteristics	**Studies (*n* = 33)**
Theory	
Extended version of Theory of Planned Behavior (TPB)	Abraham & Sheeran, 2003 study 1, 2, 3 Abraham & Sheeran, 2004 study 1, 2 Esposito et al., 2016 Jackson et al., 2003 Ruby et al., 2011, study 1, 2, 3, 4 Sandberg & Conner, 2011 Wang et al., 2011
Emotions-as-feedback perspective	Aitken et al., 2021 Feil et al., 2022
Transtheoretical Model (TTM) and Prospect Theory	Dunton & Vaughan, 2008
Affect and health behavior framework (AHBF)	Gilchrist & Sabiston, 2018 Kwan et al., 2017
Health Action Process Approach (HAPA)	Janssen et al., 2018 Waters et al., 2021
Model of goal-directed behavior	Bagozzi et al., 1998 Perugini & Bagozzi, 2001
Multi-Process Action Control Framework (M-PAC)	Vallerand et al. 2019
Elaboration Likelihood Model	Helfer et al., 2015
n.a.	Crane et al., 2021 Davis & Stenling, 2020 Gilchrist et al., 2017 Janssen & Waters, 2019 Loehr & Baldwin, 2014 Rhodes & Mistry, 2016 Sala et al., 2016 Zenko et al., 2016
Population	
Adults	Bagozzi et al., 1998 Dunton & Vaughan, 2008 Esposito et al., 2016 Feil et al., 2022 Jackson et al., 2003 Janssen et al., 2018 Janssen & Waters, 2019 Kwan et al., 2017 Sala et al., 2016 Waters et al., 2021

Appendix B: Study characteristics of included studies (continued)

Characteristics	**Studies (*n* = 33)**
Population (continued)	
University students	Abraham & Sheeran, 2003 study 1, 2, 3 Abraham & Sheeran, 2004, study 1, 2 Gilchrist & Sabiston, 2018 Helfer et al., 2015 Kwan, 2010 Loehr & Baldwin, 2014 Perugini & Bagozzi, 2001 Rhodes & Mistry, 2016 Sandberg & Conner, 2011 Wang, 2011
University/college setting	Jackson et al., 2003 Ruby et al., 2011, study 4 Zenko et al., 2016
Athletes	Aitken et al., 2021 Davis & Stenling, 2020 Gilchrist et al., 2017
Gym members	Ruby et al., 2011, study 1, 2, 3
Patients	Crane et al., 2021 Vallerand et al., 2019
Study design	
Cross-sectional	Abraham & Sheeran, 2004, study 1 Dunton & Vaughan, 2008 Esposito et al., 2016 Janssen & Waters, 2019
Longitudinal	Abraham & Sheeran, 2003, study 1, 3 Aitken et al., 2021 Bagozzi et al., 1998 Crane et al., 2021 Davis & Stenling, 2020 Dunton & Vaughan, 2008 Gilchrist et al., 2017 Gilchrist & Sabiston, 2018 Jackson et al., 2003 Kwan, 2010 Loehr & Baldwin, 2014 Perugini & Bagozzi, 2001 Ruby et al., 2011, study 1 Sala et al., 2016 Wang, 2011
RCT	Abraham & Sheeran, 2003, study 2 Abraham & Sheeran, 2004, study 2 Helfer et al., 2015 Janssen et al., 2018 Kwan et al., 2017 Ruby et al., 2011, 2, 3, 4 Sandberg & Conner, 2011 Vallerand et al., 2019 Waters et al., 2021 Zenko et al., 2016
Qualitative	Feil et al., 2022 Rhodes & Mistry, 2016

Appendix B: Study characteristics of included studies (continued)

Characteristics	Studies (*n* = 33)
Design of anticipated affective measurement	
Single item with response scale	Abraham & Sheeran, 2003, study 1, 2, 3 Abraham & Sheeran, 2004, study 1, 2 Kwan et al., 2017 Loehr & Baldwin, 2014 Ruby et al., 2011, study 1, 2, 3, 4 Sandberg & Conner, 2011 Vallerand et al., 2019 Zenko et al., 2016
Multiple items assessing one affective state/emotion	Gilchrist & Sabiston, 2018 Ruby et al., 2011, study 4
Anticipated affect (affective states/emotions/mood) with response scale	Aitken et al., 2021 Bagozzi et al., 1998 Dunton & Vaughan, 2008 Gilchrist et al., 2017 Helfer et al., 2015 Janssen et al., 2018 Janssen & Waters, 2019 Kwan, 2010 Perugini & Bagozzi, 2001 Sala et al., 2016 Wang, 2011 Waters et al., 2021
Anticipated affect (affective states/emotions/mood) with dimensional scale	Crane et al., 2021 Esposito et al., 2016 Jackson et al., 2003
Anticipated feeling scale	Davis & Stenling, 2020 Kwan, 2010
Anticipated felt arousal scale	Kwan, 2010
Reference point of anticipated affect	
Anticipated affect was related to successfully reaching a PA goal or not	Bagozzi et al., 1998 Dunton & Vaughan, 2008 Esposito et al., 2016 Gilchrist et al., 2017 Gilchrist & Sabiston, 2018 Kwan, 2010 Perugini & Bagozzi, 2001
Anticipated affect was related to the consequences of attending or missing PA	Abraham & Sheeran, 2003, study 1, 2, 3 Abraham & Sheeran, 2004, study 1, 2 Jackson et al., 2003 Janssen et al., 2018 Janssen & Waters, 2019 Rhodes & Mistry, 2016 Sala et al., 2016 Sandberg & Conner, 2011 Vallerand et al., 2019 Wang, 2011 Waters et al., 2021
Anticipated affect was related to PA behavior	Aitken et al., 2021 Crane et al., 2021 Davis & Stenling, 2020 Feil et al., 2022 Helfer et al., 2015 Kwan, 2010 Kwan et al., 2017 Loehr & Baldwin, 2014

Appendix B: Study characteristics of included studies (continued)

Characteristics	**Studies (*n* = 33)**
Time of measuring/manipulating anticipated affective response	
Same measurement occasion as related anticipated affective response	Abraham & Sheeran, 2004, study 1, 2 Esposito et al., 2016 Jackson et al., 2003 Janssen et al., 2018 Janssen & Waters, 2019 Vallerand et al., 2019 Wang, 2011 Waters et al., 2021
Several days/weeks before related anticipated affective response was measured	Abraham & Sheeran, 2003, study 1, 2, 3 Aitken et al., 2021 Bagozzi et al., 1998 Dunton & Vaughan, 2008 Gilchrist et al., 2017 Gilchrist & Sabiston, 2018 Kwan, 2010 Perugini & Bagozzi, 2001 Sandberg & Conner, 2011
Directly before related anticipated affective response was measured	Crane et al., 2021 Davis & Stenling, 2020 Helfer et al., 2015 Kwan et al., 2017 Loehr & Baldwin, 2014 Ruby et al., 2011, study 1, 2, 3, 4 Sala et al., 2016
After related anticipated affective response was measured	Zenko et al., 2016

Appendix C: Relevant anticipated affective response of included studies

Anticipated affective response	**Studies (*n* = 33)**
Angry/self-anger/irritable	Bagozzi et al., 1998 Crane et al., 2021 Feil et al., 2022 Perugini & Bagozzi, 2001 Wang, 2011
Anxiety confirmed/despair	Feil et al., 2022
Ashamed/embarrassed	Bagozzi et al., 1998 Feil et al., 2022 Gilchrist et al., 2017 Kwan, 2010 Perugini & Bagozzi, 2001
Bored/not excited	Crane et al., 2021 Esposito et al., 2016
Delightful/fulfilled	Bagozzi et al., 1998 Dunton & Vaughan, 2008 Perugini & Bagozzi, 2001
Depressed/unhappy	Bagozzi et al., 1998 Esposito et al., 2016 Perugini & Bagozzi, 2001
Disappointed	Bagozzi et al., 1998 Feil et al., 2022 Perugini & Bagozzi, 2001

Appendix C: Relevant anticipated affective response of included studies

Anticipated affective response	**Studies (*n* = 33)**
Dissatisfied/displeased	Davis & Stenling, 2020 Dunton & Vaughan, 2008 Feil et al., 2022 Jackson et al., 2003 Wang, 2011
Distressed	Dunton & Vaughan, 2008 Kwan et al., 2017
Energetic/enthusiastic/upbeat/lively	Crane et al., 2021 Helfer et al., 2015 Kwan, 2010 Kwan et al., 2017
Enjoyment	Feil et al., 2022 Loehr & Baldwin, 2014 Ruby et al., 2011, study 1, 2, 3, 4 Zenko et al., 2016
Excited	Aitken et al., 2021 Bagozzi et al., 1998 Esposito et al., 2016 Perugini & Bagozzi, 2001
Feared/anxious	Bagozzi et al., 1998 Dunton & Vaughan, 2008 Feil et al., 2022 Kwan et al., 2017 Perugini & Bagozzi, 2001
Frustrated	Aitken et al., 2021 Bagozzi et al., 1998 Perugini & Bagozzi, 2001
Glad	Bagozzi et al., 1998 Perugini & Bagozzi, 2001
Great pain	Crane et al., 2021
Guilty	Bagozzi et al., 1998 Jackson et al., 2003 Kwan, 2010 Perugini & Bagozzi, 2001 Wang, 2011
Happy	Bagozzi et al., 1998 Dunton & Vaughan, 2008 Esposito et al., 2016 Helfer et al., 2015 Kwan et al., 2017 Perugini & Bagozzi, 2001
Hope	Feil et al., 2022
Madness	Janssen et al., 2018 Janssen & Waters, 2019 Waters et al., 2021
Miserable/discouraged/crummy	Helfer et al., 2015 Kwan, 2010
Nervous	Aitken et al., 2021 Dunton & Vaughan, 2008 Helfer et al., 2015
No pain	Crane et al., 2021
Not proud	Esposito et al. 2016

Appendix C: Relevant anticipated affective response of included studies

Anticipated affective response	**Studies (*n* = 33)**
Proud	Aitken et al., 2021 Bagozzi et al., 1998 Esposito et al., 2016 Feil et al., 2022 Gilchrist et al., 2017 Gilchrist & Sabiston, 2018 Kwan, 2010 Perugini & Bagozzi, 2001 Sala et al., 2016
Regret	Abraham & Sheeran, 2003, study 1, 2, 3 Abraham & Sheeran, 2004, study 1, 2 Janssen et al., 2018 Janssen & Waters, 2019 Kwan, 2010 Rhodes & Mistry, 2016 Sala et al., 2016 Sandberg & Conner, 2011 Vallerand et al., 2019 Wang, 2011 Waters et al., 2021
Relaxed/peaceful/calm/at ease	Dunton & Vaughan, 2008 Kwan, 2010 Kwan et al., 2017 Wang, 2011
Relief	Feil et al., 2022
Sad	Bagozzi et al., 1998 Dunton & Vaughan, 2008 Perugini & Bagozzi, 2001
Satisfied/pleased/content	Bagozzi et al., 1998 Crane et al., 2021 Davis & Stenling, 2020 Feil et al., 2022 Jackson et al., 2003 Kwan, 2010 Perugini & Bagozzi, 2001 Wang, 2011 Zenko et al., 2016
Self-assured/self-confident	Aitken et al., 2021 Bagozzi et al., 1998 Kwan, 2010 Perugini & Bagozzi, 2001
Strong	Crane et al., 2021
Tensed	Dunton & Vaughan, 2008 Wang, 2011
Tired/fatigued/worn-out/exhausted	Crane et al., 2021 Kwan, 2010 Kwan et al., 2017
Uncomfortable	Bagozzi et al., 1998 Perugini & Bagozzi, 2001
Weak	Crane et al., 2021
Worried	Bagozzi et al., 1998 Perugini & Bagozzi, 2001

Appendix D: Results of the Mixed Methods Appraisal Tool

Qualitative methods					
Article	Is the qualitative approach appropriate to answer the research question?	Are the qualitative data collection methods adequate to address the research question?	Are the findings adequately derived from the data?	Is the interpretation of results sufficiently substantiated by data?	Is there coherence between qualitative data sources, collection, analysis and interpretation?
Feil et al. (2022)	✓	✓	✓	✓	✓
Rhodes & Mistry (2016)	✓	✓	✓	✓	x

Quantitative non-randomized methods					
Article	Are the participants representative of the target population?	Are measurements appropriate regarding both the outcome and intervention (or exposure)?	Are there complete outcome data?	Are the confounders accounted for in the design and analysis?	During the study period, is the intervention administered (or exposure occurred) as intended?
Abraham & Sheeran (2003), study 1	x	x	x	✓	✓
Abraham & Sheeran (2003), study 3	x	x	x	x	✓
Abraham & Sheeran (2004), study 1	x	✓	x	x	✓
Aitken et al. (2021)	x	✓	x	x	✓
Bagozzi et al. (1998)	x	✓	x	✓	✓
Crane et al. (2021)	✓	x	✓	x	✓
Davis & Stenling (2020)	x	x	x	x	✓
Dunton & Vaughan (2008)	✓	x	x	✓	✓
Esposito et al. (2016)	x	✓	x	x	✓
Gilchrist et al. (2017)	✓	x	x	✓	✓
Gilchrist & Sabiston (2018)	x	x	✓	x	✓
Jackson et al. (2003)	✓	x	x	✓	✓
Janssen & Waters (2019)	✓	x	x	✓	✓
Kwan (2010), study 1	✓	x	x	x	✓
Loehr & Baldwin (2014)	✓	x	x	x	✓
Perugini & Bagozzi (2001)	x	x	✓	x	✓
Sala et al. (2016)	✓	x	x	✓	✓
Wang (2011)	x	x	✓	✓	✓

Quantitative randomized controlled trials					
Article	Is randomization appropriately performed?	Are the groups comparable at baseline?	Are there complete outcome data?	Are outcome assessors blinded to the intervention provided?	Did the participants adhere to the assigned intervention?
Abraham & Sheeran (2003), study 2	x	x	x	✓	✓
Abraham & Sheeran (2004), study 2	x	x	✓	✓	✓
Helfer et al. (2015)	x	✓	x	✓	✓
Janssen et al. (2018)	x	x	x	✓	✓
Kwan et al. (2017)	✓	✓	✓	✓	✓
Ruby et al. (2011), study 1	✓	x	✓	x	✓
Ruby et al. (2011), study 2	x	x	✓	x	✓
Ruby et al. (2011), study 3	x	x	✓	x	x
Ruby et al. (2011), study 4	x	x	✓	x	✓
Sandberg & Conner (2011)	x	✓	x	✓	✓
Vallerand et al. (2019)	✓	x	x	x	✓
Waters et al. (2021)	✓	✓	x	✓	x
Zenko et al. (2016)	✓	✓	x	✓	✓

Note. ✓ = denotes criterion is met; x = denotes criterion is not met or cannot tell.

Supplemental material chapter 5

Appendix A: Search term

(intention* OR "action control*" OR "action plan*" OR "intention-behavior profil*" OR self-regulat* OR "internal-external control*") AND ("physical activit*" OR exercis* OR "resistance train*" OR MVPA OR "physical exertion" OR "strength train*" OR "motor activit*" OR fitness OR walk*) AND (M-PAC OR "transtheoretical model" OR "theory of planned behavior" OR "multi-process action control" OR "protection motivation theory" OR "reason* action*" OR HAPA OR "health action process approach")

Appendix B: List of included records

1. de Bruijn G-J, de Groot R, van den Putte B, Rhodes R. Conscientiousness, extroversion, and action control: comparing moderate and vigorous physical activity. Journal of Sport and Exercise Psychology. 2009;31(6):724-42.
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15. Rhodes RE, Lim C. Understanding action control of daily walking behavior among dog owners: a community survey. BMC Public Health. 2016;16(1):1165.
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17. Rhodes RE, Beauchamp MR, Quinlan A, Downs DS, Warburton DER, Blanchard CM. Predicting the physical activity of new parents who participated in a physical activity intervention. Social Science and Medicine. 2021;284.
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19. Rhodes RE, Sui W, Nuss K, Liu S. Reflecting on physical activity across 2 years of the COVID-19 pandemic: Predictors of intention-behavior profiles. Applied Psychology: Health and Well-Being. 2022.
20. Sassen B, Kok G, Schaalma H, Kiers H, Vanhees L. Cardiovascular risk profile: cross-sectional analysis of motivational determinants, physical fitness and physical activity. BMC Public Health. 2010;10:592.
21. Tabaczynski A, Arbour-Nicitopoulos KP, Rhodes RE, Sabiston CM, Trinh L. Correlates of Physical Activity Participation among Individuals Diagnosed with Cancer: An Application of the Multi-Process Action Control Framework. International Journal of Environmental Research and Public Health. 2023;20(5).
22. Vallerand JR, Rhodes RE, Walker GJ, Courneya KS. Understanding strength exercise intentions and behavior in hematologic cancer survivors: an analysis of the intention-behavior gap. Journal of Cancer Survivorship: Research and Practice. 2016;10(6):945-55.

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
De Bruijn et al. (2009), Netherlands	Applying TPB to exercise action control, five-factor model	186 participants from a convenience sample of adults in a one-month prospective design	Intention: open-ended frequency for moderate and vigorous PA separately PA: IPAQ	Regular PA was defined as 150 minutes of moderate-to-vigorous or 60 minutes of vigorous intensity PA. Profiles were formulated with Intention and PA being dichotomized at 150 minutes per week (moderate PA) and 60 minutes per week (vigorous PA).	Moderate PA: Non-intenders not exceeding intentions (9.14 %, *n*= 17), non-intenders exceeding intentions (2.69 %, *n* = 5), unsuccessful intenders (32.26 %, *n* = 60), successful intenders (55.91%, *n* = 104), intention-behaviour gap (36.59 %, *n* = 60/164) Vigorous PA: Non-intenders not exceeding intentions (19.35 %, *n* = 36), non-intenders exceeding intentions (2.69 %, *n* = 5), unsuccessful intenders (17.74 %, *n* = 33), successful intenders (60.22 %, *n* = 112), intention-behaviour gap (22.76 %, *n* = 33/145) On average: Non-intenders not exceeding intentions (14.52 %, *n* = 27), non-intenders exceeding intentions (2.69 %, *n* = 5), unsuccessful intenders (25.27 %, *n* = 47), successful intenders (58.06 %, *n* = 108), intention-behaviour gap (30.32 %, *n* = 47/155)
De Bruijn (2011), Netherlands	Applying TPB to exercise action control including habit strength	330 undergraduate students in a two-week prospective design	Intention: mean of two items on 7-point likert scales PA: relevant items from the IPAQ	Regular PA was defined as vigorous exercise at least 20 minutes per bout at least 3x per week. Profiles were formulated with Intention being dichotomized at midscale values and PA being dichotomized at meeting the exercise norm or not.	Non-intenders not exceeding intentions (50 %, *n* = 165), non-intenders exceeding intentions (0.61 %, *n* = 2), unsuccessful intenders (31.52 %, *n* = 104), and successful intenders (17.88 %, *n* = 59), intention-behaviour gap (63.8 %, *n* = 104/163)

Appendix C: Data extraction (continued)

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
De Bruijn et al. (2012), Netherlands	Applying TPB to exercise action control including self-identity	347 undergraduate students in a two-week prospective design	Intention: mean of two items on 7-point likert scales PA: relevant items from the IPAQ	Regular PA was defined as vigorous exercise at least 20 minutes per bout at least 3x per week. Profiles were formulated with Intention being dichotomized at midscale values and PA being dichotomized at meeting the exercise norm or not.	Non-intenders not exceeding intentions (31.99 %, *n* = 111), non-intenders exceeding intentions (0.86 %, *n* = 3), unsuccessful intenders (37.46 %, *n* = 130), successful intenders (29.68 %, *n* = 103), intention-behaviour gap (55.79 %, *n* = 130/233)
De Bruijn & van den Putte (2012), Netherlands	Self-identity, TPB	522 undergraduate students in a cross-sectional design	Intention: mean of two items on 7-point likert scales PA: relevant items from the IPAQ	Regular PA was defined as vigorous exercise at least 20 minutes per bout at least 3x per week. Profiles were formulated with Intention being dichotomized at midscale values and PA being dichotomized at meeting the exercise norm or not.	Non-intenders not exceeding intentions (57.66 %, *n* = 301), non-intenders exceeding intentions (0 %), unsuccessful intenders (32.76 %, *n* = 171) successful intenders (9.58 %, *n* = 50), intention-behaviour gap (77.38 %, *n* = 171/221)

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
Fiala & Rhodes (2010), Canada	Applying TPB to exercise action control	337 undergraduate students in a two-week prospective design	Intention: open-ended frequency PA: open-ended frequency (GLTEQ)	PA was defined as moderate or vigorous PA at least 20+ min per bout. Profiles were dichotomized at intending and executing PA 4+ times per week for moderate and vigorous intensity separately.	Total sample: Non-intenders not exceeding intentions (36.8 %, *n* = 124), non-intenders exceeding intentions (3.9 %, *n* = 13), unsuccessful intenders (34.12 %, *n* = 115), successful intenders (25.22 %, *n* = 85), intention-behaviour gap (57.5 %, *n* = 115/200) Moderate PA (*n* = 158): Non-intenders not exceeding intentions (31.65 %, *n* = 50), non-intenders exceeding intentions (3.8 %, *n* = 6), unsuccessful intenders (18.4 %, *n* = 62), successful intenders (11.9 %, *n* = 40), intention-behaviour gap (60.78 %, *n* = 62/102) Vigorous PA (*n* = 179): Non-intenders not exceeding intentions (21.96 %, *n* = 74), non-intenders exceeding intentions (2.08 %, *n* = 7), unsuccessful intenders (15.7 %, *n* = 53), successful intenders (13.4 %, *n* = 45), intention-behaviour gap (54.08 %, *n* = 53/98)
Godin et al. (1986), Canada	TRA	163 university employees in a two-month prospective design	Intention: 7-point likert scale PA: open-ended frequency (GLTEQ)	Regular PA was defined as vigorous PA at least 2x per week. Intention was dichotomized by high intention representing the top 3 response categories. PA was dichotomized at 2+ times per week.	Non-intenders not exceeding intentions (25.77 %, *n* = 42), non-intenders exceeding intentions (1.23 %, *n* = 2), unsuccessful intenders (27.61 %, *n* = 45), and successful intenders (45.39 %, *n* = 74), intention-behaviour gap (37.82 %, *n* = 45/119)
Godin et al. (2004), subsample 1, Canada	TTM with variables of TRA	4904 participants from a convenience sample of adults in a cross-sectional design	Intention: 5-point likert scale PA: 7-point likert scale	Regular PA was not defined. Profiles were built through cluster analysis (SAS Fastclus procedure).	Non-intenders not exceeding intentions (10.24 %, *n* = 502), non-intenders exceeding intentions (3.92 %, *n* = 192), unsuccessful intenders (42.21 %, *n* = 2070), successful intenders (43.64%, *n* = 2140), intention-behaviour gap (49.17 %, *n* = 2070/4210)

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
Godin et al. (2004), subsample 2, Canada	TTM with variables of TRA	4976 participants from a convenience sample of adults in a cross-sectional design	Intention: 5-point likert scale PA: 7-point likert scale	Regular PA was not defined. Profiles were built through cluster analysis (SAS Fastclus procedure).	Non-intenders not exceeding intentions (10.65 %, *n* = 530), non-intenders exceeding intentions (4.22 %, *n* = 210), unsuccessful intenders (39.81 %, *n* = 1981), successful intenders (45.32 %, *n* = 2255), intention-behaviour gap (46.77 %, *n* = 1981/4236)
Godin et al. (2004), subsample 3, Canada	TTM with variables of TRA	5259 participants from a convenience sample of adults in a cross-sectional design	Intention: 5-point likert scale PA: 7-point likert scale	Regular PA was not defined. Profiles were built through cluster analysis (SAS Fastclus procedure).	Non-intenders not exceeding intentions (18.48 %, *n* = 972), non-intenders exceeding intentions (4.89 %, *n* = 257), unsuccessful intenders (30.77 %, *n* = 1618), successful intenders (45.86 %, *n* = 2412), intention-behaviour gap (40.15 %, *n* = 1618/4030)
Godin et al. (2004), subsample 4, Canada	TTM with variables of TRA	5021 participants from a convenience sample of adults in a cross-sectional design	Intention: 5-point likert scale PA: 7-point likert scale	Regular PA was not defined. Profiles were built through cluster analysis (SAS Fastclus procedure).	Non-intenders not exceeding intentions (21.33 %, *n* = 1071), non-intenders exceeding intentions (4.46 %, *n* = 224), unsuccessful intenders (36.53 %, *n* = 1834), successful intenders (37.68 %, *n* = 1892), intention-behaviour gap (49.22 %, *n* = 1834/3726)
Grant et al. (2021), Canada	M-PAC	162 mothers with at least one child under the age of 5 years in a cross-sectional design	Intention: single item yes/no format PA: open-ended frequency (GLTEQ)	Regular PA was defined as at least 150 minutes of moderate-to-vigorous PA per week. Profiles were formulated with Intention being dichotomized through yes/no format and PA being dichotomized at meeting the exercise norm or not.	Non-intenders not exceeding intentions (20.99 %, *n* = 34), non-intenders exceeding intentions (8.64 %, *n* = 14), unsuccessful intenders (24.69 %, *n* = 40), successful intenders (44.44 %, *n* = 72), intention-behaviour gap (35.71 %, *n* = 40/112)

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
Kerner et al. (2001), USA	TRA	73 members of a fitness centre in a five-month prospective design	Intention: 7-point likert scale PA: counts of daily logs of cardiovascular responses in the fitness centre	Regular PA was not defined. Profiles were formulated with intention and PA being dichotomized through the median scores.	Non-intenders not exceeding intentions (20.55 %, *n* = 15), non-intenders exceeding intentions (24.66 %, *n* = 18), unsuccessful intenders (28.77 %, *n* = 21), successful intenders (26.03 %, *n* =19), intention-behaviour gap (52.5 %, *n* = 21/40)
Rhodes et al. (2003)	TRA	300 undergraduate students in a two-week prospective design	Intention: open-ended frequency PA: open-ended frequency (GLTEQ)	Regular PA was defined as vigorous intensity, at least 20+ min per bout. Profiles were formulated with intention and PA being dichotomized at exercising 3+ times per week.	Non-intenders not exceeding intentions (33 %, *n* = 99), non-intenders exceeding intentions (2 %, *n* = 6), unsuccessful intenders (27 %, *n* = 81), successful intenders (38 %, *n* = 114), intention-behaviour gap (41.54 %, *n* = 81/195)
Rhodes & Plotnikoff (2006), Canada	TTM, TRA	1192 community dwelling adults in a six-month prospective design	Intention: single item yes/no format PA: single item yes/no format	Regular PA was defined as vigorous intensity, 3 times per week for 20+ minutes per bout. Profiles were formulated with intention and PA being dichotomized around yes/no responses.	Non-intenders not exceeding intentions (9.31 %, *n* = 111), non-intenders exceeding intentions (1.59 %, *n* = 19), unsuccessful intenders (42.87 %, *n* = 511), successful intenders (46.22 %, n = 551), intention-behaviour gap (48.12 %, *n* = 511/1062)
Rhodes et al. (2008), Canada	TPB, TTM, PMT	611 adults of a workplace sample in a six-month prospective	Intention: single item yes/no format PA: single item yes/no format	Regular PA was defined as moderate or vigorous intensity, 4+ times per week, at least 30 min per bout. Profiles were formulated with intention and PA being dichotomized around yes/no responses.	Non-intenders not exceeding intentions (5.73 %, *n* = 35), non-intenders exceeding intentions (2.29 %, *n* = 14), unsuccessful intenders (34.86 %, *n* = 213), successful intenders (57.12 %, *n* = 349), intention-behaviour gap (37.9 %, *n* = 213/562)

Appendix C: Data extraction (continued)

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
Rhodes et al. (2010), Canada	TPB, habit	153 undergraduate students in a two-week prospective design	Intention: open-ended frequency PA: open-ended frequency (GLTEQ)	Regular PA was defined as moderate and vigorous intensity, at least 30+ min per bout. Profiles were formulated with intention and PA being dichotomized at 4+ times per week.	Non-intenders not exceeding intentions (34.64 %, *n* = 53), non-intenders exceeding intentions (7.19 %, *n* = 11), unsuccessful intenders (20.92 %, *n* = 32), successful intenders (37.25 %, *n* = 57), intention-behaviour gap (35.96 %, *n* = 32/89)
Rhodes et al. (2012), Canada	Applying TPB to exercise action control	220 undergraduate students in a two-week prospective design	Intention: open-ended frequency PA: open-ended frequency (GLTEQ)	Regular PA was defined as vigorous intensity, at least 20+ min per bout. Profiles were formulated with intention and PA being dichotomized at 3+ times per week.	Non-intenders not exceeding intentions (14.35 %, *n* = 31), non-intenders exceeding intentions (1.85 %, *n* = 4), unsuccessful intenders (36.11 %, *n* = 78), successful intenders (49.54 %, *n* = 107), intention-behaviour gap (42.16 %, *n* = 78/185)
Rhodes & Lim (2016), Canada	M-PAC	227 dog owners in a cross-sectional design	Intention: open-ended frequency PA: open-ended frequency (GLTEQ)	Regular PA was defined as mild, moderate and vigorous walking at least 20+ min per bout. Profiles were formulated with intention and PA being dichotomized at 7+ days of walking per week.	Non-intenders not exceeding intentions (25.99 %, *n* = 59), non-intenders exceeding intentions (0.88 %, *n* = 2), unsuccessful intenders (33.04 %, *n* = 75), successful intenders (40.09 %, *n* = 91), intention-behaviour gap (45.18 %, *n* = 75/166)

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
Rhodes et al. (2020), Canada	TPB, M-PAC	102 parents in an intervention study	Intention: two items using a 7-point likert scale PA: accelerometers for 7 consecutive days for at least 10h a day	Regular PA was defined as 150 minutes of moderate PA per week. Profiles were formulated with intention and PA being dichotomized at meeting the exercise norms or not for 3 time periods separately.	Baseline intention to 6 weeks: Non-intenders not exceeding intentions (0.98 %, *n* = 1), non-intenders exceeding intentions (0 %), unsuccessful intenders (78.43 %, *n* = 80), successful intenders (20.59 %, *n* = 21), intention-behaviour gap (79.21 %, *n* = 80/101) 6 weeks intention to 13 weeks: Non-intenders not exceeding intentions (4.9 %, *n* = 5), non-intenders exceeding intentions (0.98 %, *n* = 1), unsuccessful intenders (72.55 %, *n* = 74), successful intenders (21.57 %, *n* = 22), intention-behaviour gap (77.08 %, *n* = 74/96) 13 weeks intention to 26 weeks: Non-intenders not exceeding intentions (6.86 %, *n* = 7), non-intenders exceeding intentions (0 %), unsuccessful intenders (73.53 %, *n* = 75), successful intenders (19.61 %, *n* = 20), intention-behaviour gap (78.95 %, *n* = 75/95) on average: Non-intenders not exceeding intentions (3.92 %, *n* = 4), non-intenders exceeding intentions (0 %), unsuccessful intenders (74.51 %, *n* = 76), successful intenders (20.59 %, *n* = 21), intention-behaviour gap (78.35 %, *n* = 76/97)

Appendix C: Data extraction (continued)

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
Rhodes et al. (2021), Canada	TPB, M-PAC	264 parents in an intervention study	Intention: single item with yes/no format PA: open-ended frequency (GLTEQ)	Regular PA was defined as 150 minutes of moderate PA per week. Profiles were formulated with intention being dichotomized around yes/no responses and PA being dichotomized at meeting the exercise norms or not for 3 time periods separately.	Baseline intention to 6 weeks: Non-intenders not exceeding intentions (5.30 %, *n* = 14), non-intenders exceeding intentions (1.89 %, *n* = 5), unsuccessful intenders (29.92 %, *n* = 79), successful intenders (56.06 %, *n* = 148), intention-behaviour gap (34.80 %, *n* = 79/227) 6 weeks intention to 12 weeks: Non-intenders (7.95 %, *n* = 21), non-intenders exceeding intentions (5.30 %, *n* = 14), unsuccessful intenders (25 %, *n* = 66), successful intenders (53.79 %, *n* = 142), intention-behaviour gap (31.73 %, *n* = 66/208) 12 weeks intention to 6 months: Non-intenders not exceeding intentions (10.61 %, *n* = 28), non-intenders exceeding intentions (5.68 %, *n* = 15), unsuccessful intenders (23.11 %, *n* = 61), successful intenders (52.65 %, *n* = 139), intention-behaviour gap (30.50 %, *n* = 61/200) on average: Non-intenders (7.95 %, *n* = 21), non-intenders exceeding intentions (4.17 %, *n* = 11), unsuccessful intenders (26.14 %, *n* = 69), successful intenders (54.17 %, *n* = 143), intention-behaviour gap (32.55 %, *n* = 69/212)

Authors, year, country	**Theoretical framework**	**Sample and design**	**Measures of intention and PA**	**Definition for regular PA, intention-behaviour profile formulation**	**Profile results, quantification of intention-behaviour gap**
Rhodes & Lithopoulos (2022), Canada	M-PAC	1338 adults in a two-week prospective study	Intention: single item yes/no format PA: open-ended frequency (GLTEQ) adapted for resistance training	Regular PA was defined as at least 15+ min per bout once a week. Profiles were formulated with intention being dichotomized around yes/no response and PA being dichotomized at 1+ times per week.	Non-intenders not exceeding intentions (41.41 %, *n* = 554), non-intenders exceeding intentions (2.17 %, *n* = 29), unsuccessful intenders (32.88 %, *n* = 440), successful intenders (23.54 %, *n* = 315), intention-behaviour gap (58.28 %, *n* = 440/755)
Rhodes et al. (2022), Canada	M-PAC	971 adults in a cross-sectional design	Intention: single item yes/no format PA: open-ended frequency (GLTEQ)	Regular PA was defined as 150 minutes of moderate PA per week. Profiles were formulated with intention being dichotomized around yes/no responses and PA being dichotomized at meeting the exercise norms of 150 minutes per week.	Non-intenders not exceeding intentions (29.87 %, *n* = 290), non-intenders exceeding intentions (6.59 %, *n* = 64), unsuccessful intenders (21.83 %, *n* = 212), successful intenders (41.71 %, *n* = 405), intention-behaviour gap (34.36 %, *n* = 212/617)
Sassen et al. (2010), Netherlands	TPB	989 adults with one or more cardiovascular risk factors in a cross-sectional design	Intention: two items on a 7-point likert scale PA: two items on a 7-point likert scale	Regular PA was reached when scoring above 4.5 regarding being active for 60 minutes every day. Profiles were formulated with intention being dichotomized by ‘definitely yes’/all other answers and PA being dichotomized by the score of 4.5+.	Non-intenders not exceeding intentions (37.71 %, *n* = 373), non-intenders exceeding intentions (11.93 %, *n* = 118), unsuccessful intenders (10.52 %, *n* = 104), successful intenders (39.84 %, *n* = 394), intention-behaviour gap (20.88 %, *n* = 104/498)

Appendix C: Data extraction (continued)

Authors, year, country	Theoretical framework	Sample and design	Measures of intention and PA	Definition for regular PA, intention-behaviour profile formulation	Profile results, quantification of intention-behaviour gap
Tabaczynski et al. (2023), UK/USA/Canada	M-PAC	347 adults with cancer diagnosis in a cross-sectional design	Intention: open-ended frequency PA: open-ended frequency (GLTEQ)	Regular PA was defined as 150 minutes of moderate PA per week. Profiles were formulated with intention being dichotomized around yes/no responses and PA being dichotomized at meeting the exercise norms of 150 minutes per week.	Non-intenders not exceeding intentions (24.21 %, *n* = 84), non-intenders exceeding intentions (4.9 %, *n* = 17), unsuccessful intenders (35.16 %, *n* = 122), successful intenders (35.73 %, *n* = 124), intention-behaviour gap (49.59 %, *n* = 122/246)
Vallerand et al. (2016), Canada	M-PAC	606 hematologic cancer survivors in a cross-sectional design	Intention: single item yes/no format PA: open-ended frequency (GLTEQ) modified for resistance training	Regular PA was defined as resistance training 2x per week. Profiles were formulated with intention being dichotomized around yes/no responses and PA being dichotomized at 2+ times per week.	Non-intenders not exceeding intentions (39.93 %, *n* = 242), non-intenders exceeding intentions (1.82 %, *n* = 11), unsuccessful intenders (28.38 %, *n* = 172), successful intenders (29.87 %, *n* = 181), intention-behaviour gap (48.73 %, *n* = 172/353)

Notes: TPB: Theory of Planned Behaviour, IPAQ: International Physical Activity Questionnaire, TTM: Transtheoretical Model, TRA: Theory of Reasoned Action, M-PAC: Multi-Process Action Control, MVPA: Moderate to Vigorous Physical Activity, PMT: Protection Motivation Theory, GLTEQ: Godin Leisure-Time Exercise Questionnaire

Study	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Overall rating
de Bruijn et al. (2009)	Yes	No	NA	No	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	NA	Yes	moderate
de Bruijn et al. (2011)	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	No	No	Moderate
de Bruijn et al. (2012)	Yes	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NA	No	No	Moderate
de Bruijn & van den Putte (2012)	Yes	Yes	Yes	Yes	No	No	NA	Yes	Yes	No	Yes	NA	NA	No	Moderate
Fiala & Rhodes (2010)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	High
Godin et al. (1986)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	No	Moderate
Godin et al. (2004), studies 1-4	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No	Yes	NA	NA	No	Moderate
Grant et al. (2021)	Yes	Yes	NA	Yes	No	No	No	Yes	Yes	No	Yes	NA	NA	No	Moderate
Kerner et al. (2001)	Yes	Yes	NA	No	No	Yes	Yes	Yes	Yes	No	Yes	NA	No	Yes	Moderate
Rhdoes & Plotnikoff (2006)	Yes	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NA	No	No	Moderate
Rhodes et al. (2003)	Yes	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Moderate

Study	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Overall rating
Rhodes et al. (2008)	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	No	No	Moderate
Rhodes et al. (2010)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	No	Moderate
Rhodes et al. (2012)	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	No	Moderate
Rhodes & Lim (2016)	Yes	Yes	NA	Yes	Yes	No	NA	Yes	Yes	No	Yes	NA	NA	Yes	Moderate
Rhodes et al. (2020), intervention	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High
Rhodes et al. (2021), intervention	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High
Rhodes & Lithopoulos (2022)	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	Yes	High
Rhodes et al. (2022)	Yes	Yes	NA	Yes	Yes	No	NA	Yes	Yes	No	Yes	NA	NA	Yes	Moderate
Sassen et al. (2010)	Yes	Yes	NA	Yes	No	No	NA	Yes	Yes	No	Yes	NA	NA	No	Moderate
Tabaczynski et al. (2023)	Yes	Yes	NA	Yes	No	No	NA	Yes	Yes	No	Yes	NA	NA	Yes	Moderate
Vallerand et al. (2016)	Yes	Yes	NA	Yes	No	No	NA	Yes	Yes	No	Yes	NA	NA	Yes	Moderate

Notes: NA: not applicable

Criteria for the quality assessment tool for observational cohort and cross-sectional studies:

1. Was the research question or the objective in this paper clearly stated?
2. Was the study population clearly specified and defined?
3. Was the participation rate of eligible persons at least 50%?
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?
5. Was a sample size justification, power description, or variance and effect estimates provided?
6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?
7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g. categories of exposure, or exposure measured as continuous variable)?
9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?
10. Was the exposure(s) assessed more than once over time?
11. Were the outcome measures (dependent variable) clearly defined, valid, reliable, and implemented consistently across all study participants?
12. Were the outcome assessors blinded to the exposure status of participants?
13. Was loss to follow-up after baseline 20% or less?
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?

Criteria for the quality assessment tool for intervention studies:

1. Was the study described as randomized, a randomized trial, a randomized clinical trial, or an RCT?
2. Was the method of randomization adequate (i.e., use of randomly generated assignment)?
3. Was the treatment allocation concealed (so that assignments could not be predicted)?
4. Were study participants and providers blinded to treatment group assignment?

5. Were the people assessing the outcomes blinded to the participants' group assignments?
6. Were the groups similar at baseline on important characteristics that could affect outcomes (e.g., demographics, risk factors, co-morbid conditions)?
7. Was the overall drop-out rate from the study at endpoint 20% or lower of the number allocated to treatment?
8. Was the differential drop-out rate (between treatment groups) at endpoint 15 percentage points or lower?
9. Was there high adherence to the intervention protocols for each treatment group?
10. Were other interventions avoided or similar in the groups (e.g., similar background treatments)?
11. Were outcomes assessed using valid and reliable measures, implemented consistently across all study participants?
12. Did the authors report that the sample size was sufficiently large to be able to detect a difference in the main outcome between groups with at least 80% power?
13. Were outcomes reported or subgroups analysed prespecified (i.e., identified before analyses were conducted)?
14. Were all randomized participants analysed in the group to which they were originally assigned, i.e., did they use an intention-to-treat analysis?

Ranking:
High quality = 14-11
Moderate quality = 10-6
Low quality = 5-0

Appendix E: Publication bias using Eggers regression intercept

	Intercept	Lower limit	Upper limit	*t*-value	*p*-value (2-tailed)
Non-intenders not exceeding intentions	3.03	0.16	5.90	2.18	0.040
Non-intenders exceeding intentions	-0.05	-0.62	0.53	0.16	0.871
Unsuccessful intenders	-1.29	-3.36	0.78	1.29	0.210
Successful intenders	-1.53	-3.80	0.74	1.39	0.177
Intention-behaviour gap	0.47	-1.68	2.62	0.45	0.656

Appendix F: Results of the intention-physical activity profiles

	Random effects model						Fixed effects model: Heterogeneity					
Intention-physical activity profiles	*k*	Point estimate	Lower limit	Upper limit	*z*-value	*p*-value	Q-value	df (Q)	*p*-value	I^2	Tau^2	SE
Non-intenders not exceeding intentions	25	0.260	0.207	0.310	9.406	< 0.001	461.266	24	< 0.001	94.797	0.017	0.009
Non-intenders exceeding intentions	25	0.042	0.030	0.053	7.162	< 0.001	15.203	24	0.915	< 0.001	< 0.001	< 0.001
Unsuccessful intenders	25	0.330	0.295	0.365	17.140	< 0.001	212.556	24	< 0.001	88.709	0.007	0.085
Successful intenders	25	0.387	0.350	0.423	18.693	< 0.001	259.419	24	< 0.001	90.749	0.009	0.005

	Fixed effect model						Heterogeneity			
Moderators	*k*	Point estimate	Lower limit	Upper limit	*z*-value	*p*-value	*Q*-value (df)	*p*-value	I^2	Tau² (SE)
Study design	25	0.464	0.454	0.474	75.227	< 0.001	14.46(2)	< 0.001	89.91	0.01(0.01)
Prospective	12	0.505	0.481	0.529	33.903	< 0.001	98.29(11)	< 0.001	88.81	0.03(0.02)
Cross-sectional	11	0.455	0.443	0.466	66.550	< 0.001	93.21(10)	< 0.001	89.27	0.01(0.00)
Intervention	2	0.509	0.420	0.587	9.761	< 0.001	32.00(1)	< 0.001	96.88	0.24(0.35)
Population	25	0.464	0.454	0.474	75.227	< 0.001	40.28(3)	< 0.001	89.91	0.01(0.01)
Convenient adults	12	0.461	0.450	0.472	69.950	< 0.001	80.28(11)	< 0.001	86.30	0.00(0.00)
Students	7	0.570	0.532	0.606	23.045	< 0.001	53.58(6)	< 0.001	88.80	0.04(0.03)
Parents	3	0.472	0.393	0.543	10.395	< 0.001	34.71(2)	< 0.001	94.24	0.13(0.14)
With health risks	3	0.373	0.321	0.423	12.934	< 0.001	29.11(2)	< 0.001	93.13	0.04(0.04)
Intention measure	25	0.464	0.454	0.474	75.227	< 0.001	1.06(2)	0.589	89.91	0.01(0.01)
Likert scale	11	0.467	0.455	0.478	67.031	< 0.001	177.44(10)	< 0.001	94.36	0.01(0.01)
Yes/no format	7	0.455	0.429	0.480	29.677	< 0.001	46.04(6)	< 0.001	86.97	0.01(0.01)
Open-ended	7	0.451	0.405	0.494	16.923	< 0.001	13.42(6)	0.037	55.27	0.01(0.01)
Type of PA	25	0.464	0.454	0.474	75.227	< 0.001	16.62(1)	< 0.001	89.91	0.01(0.01)
Mixed	23	0.459	0.449	0.470	72.450	< 0.001	217.52(22)	< 0.001	89.89	0.01(0.01)
Resistance training	2	0.553	0.510	0.592	20.659	< 0.001	3.82(1)	0.051	73.80	0.01(0.01)
PA measure	25	0.464	0.454	0.474	75.227	< 0.001	56.261(4)	< 0.001	89.91	0.01(0.01)
GLTEQ	12	0.462	0.434	0.489	28.318	< 0.001	49.50(11)	< 0.001	77.78	0.01(0.01)
Likert scale	5	0.456	0.444	0.468	63.650	< 0.001	74.07(4)	< 0.001	94.60	0.01(0.01)
IPAQ	4	0.608	0.561	0.651	19.455	< 0.001	47.10(3)	< 0.001	93.63	0.08(0.07)
Yes/no format	2	0.447	0.407	0.485	19.328	< 0.001	5.53(1)	0.019	81.91	0.01(0.01)
Objectively	2	0.724	0.632	0.796	10.493	< 0.001	5.51(1)	0.019	81.82	0.09(0.15)
Profile formation	25	0.464	0.454	0.474	75.227	< 0.001	0.065(1)	0.799	89.91	0.01(0.01)
Based on pre-defined regular PA	20	0.466	0.447	0.486	39.723	< 0.001	203.42(19)	< 0.001	90.66	0.03(0.01)
Based on clusters, median or yes/no format	5	0.463	0.451	0.475	63.885	< 0.001	34.48(4)	< 0.001	88.4	0.00(0.00)
Risk of bias	25	0.464	0.454	0.474	75.227	< 0.001	24.28(1)	< 0.001	89.91	0.01(0.01)
high	4	0.563	0.524	0.600	22.570	< 0.001	34.38(3)	< 0.001	91.27	0.04(0.04)
moderate	21	0.458	0.447	0.468	71.931	< 0.001	179.31(20)	< 0.001	88.85	0.01(0.01)

List of publications

Feil, K., Fritsch, J., Weyland, S., Rittmann, L. M., Schmidt, D., & Jekauc, D. (2024). WiN-Reha-effectiveness and durability of effects of orthopedic rehabilitation programs and the study of psychological determinants of aftercare behaviors: a study protocol. *Frontiers in Rehabilitation Sciences, 5*, 1333924. https://doi.org/10.3389/fresc.2024.1333924

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Fritsch, J., **Feil, K.**, Weyland, S., Schmidt, D., & Jekauc, D. (2021). Effectivity of a mHealth intervention for individuals with obesity: a study protocol for a controlled intervention study. *BMC Sports Science, Medicine and Rehabilitation*, *13*(1), 112. https://doi.org/10.1186/s13102-021-00337-6

Feil, K., Allion, S., Weyland, S., & Jekauc, D. (2021). A Systematic Review Examining the Relationship Between Habit and Physical Activity Behavior in Longitudinal Studies. *Frontiers in Psychology*, *12*, 626750. https://doi.org/10.3389/fpsyg.2021.626750

Klos, L.*, **Feil, K.***, Eberhardt, T., & Jekauc, D. (2020). Interventions to Promote Positive Affect and Physical Activity in Children, Adolescents and Young Adults - A Systematic Review. *Sports*, *8*(2). https://doi.org/10.3390/sports8020026
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