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**Motivation, Volition, and Gym Attendance -  
A Longitudinal Prospective Study**

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*Dreifach ist der Schritt der Zeit:  
Zögernd kommt die Zukunft hergezogen,  
pfeilschnell ist das Jetzt entflohen,  
ewig still steht die Vergangenheit.*

*-Friedrich Schiller-*

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## List of Publications

### First author peer-reviewed quartile 1 (Q1) journal publications

**Kopp, P. M.**, Senner, V., & Gröpel, P. (2020). Regular exercise participation and volitional competencies. *Sport, Exercise, and Performance Psychology*, 9(2), 232-243. <https://doi.org/10.1037/spy0000197>

**Kopp, P. M.**, Senner, V., Kehr, H. M., & Gröpel, P. (2020). Achievement motive, autonomous motivation, and attendance at fitness center: A longitudinal prospective study. *Psychology of Sport and Exercise*, 51, 101758. <https://doi.org/10.1016/j.psychsport.2020.101758>

### Co-author peer-reviewed quartile 1 (Q1) journal publication

(Note. The journal paper was not part of the present dissertation)

Schönbrodt, F.D., Hagemeyer, B., Brandstätter, V., Czirkmantori, T., Gröpel, P., Hennecke, M., Israel, L. S. F., Janson, K., Kemper, N., Köllner, M., **Kopp, P. M.**, Mojzisch, M., Müller-Hotop, R., Prüfer, J., Quirin, M., Scheidemann, B., Schiestel, L., Schulz-Hardt, S., Sust, L. N. N., Zygar-Hoffmann, C., & Schultheiss, O. C., (2020). Measuring implicit motives with the picture story exercise (PSE): Databases of expert-coded german stories, pictures, and updated picture norms. *Journal of Personality Assessment*, 1-14. <https://doi.org/10.1080/00223891.2020.1726936>

## Summary

This dissertation was part of a funded research project and is comprised of two quartile 1 (Q1) journal publications. Both scientific contributions investigated the relationship between psychological variables (i.e., motivational variables and volitional competencies) and exercise participation to gain a better understanding of dispositional characteristics of individuals that may affect, or be affected by, the routine of long-term exercise engagement.

Physical activity (PA) and exercise are fundamental means of improving people's physical and mental health, but the benefits cannot be maintained if this activity is not regular. Attending fitness facilities offers a common opportunity for such activities. Fitness centers and gyms have proliferated in recent years all over the world. Based on this rapid growth and popularity, using such a service appears to provide an appealing opportunity to adopt and then maintain exercise behavior as a regular component of an individual's lifestyle. However, many people who attempt to engage in PA often fail to stay on track and maintain exercise programs in the long run, experiencing a relapse to an inactive lifestyle or quitting. Such findings indicate that many people have difficulty maintaining, rather than commencing, PA and exercise. Understanding why people adhere to PA and examining the variables predicting exercise maintenance is therefore crucial to effectively promote a healthy lifestyle. Contemporary approaches to promoting PA emphasize the importance of motivation in facilitating (or hindering) PA engagement; however, the literature remains unclear on the role motivation plays in different phases of PA as its relative impact may vary over time in response to an exercise program (e.g., gym membership), thus affecting exercise participation patterns. In addition, research has highlighted the importance of volitional competencies (e.g., self-control, self-regulation) in regular PA when striving for a goal becomes difficult; however, associations between volitional competencies and regular exercise behavior have not yet been clearly established through longitudinal research. In particular, it remains unclear whether strong volitional skills are an antecedent or consequence of regular exercise behavior. The present research addresses these limitations of the extant literature. Hence, this dissertation is specifically concerned with the impact of motivation on exercise adherence (publication 1), and the bidirectional relationship between volitional competencies and exercise participation (publication 2) to capture dispositional characteristics of individuals (i.e., new gym members) that may affect, or be affected by, the routine of long-term exercise engagement. Specifically, the goal in publication 1 was to determine the role played by the achievement motive (implicit, explicit and its congruence) as well as autonomous forms (e.g., intrinsic motivation, identified

regulation) and controlled forms (e.g., introjected regulation, external regulation) of motivation in the evolution of gym attendance; journal paper 2 explored whether people's dispositional competencies for self-control predict gym attendance (predispositional model) or may develop as a consequence of better exercise adherence (socialization model).

To examine the research questions, a (quantitative) longitudinal prospective study ( $N=229$ ) was conducted under real-life settings with repeated measurements in four waves ( $T_{\text{week1}}$ ,  $T_{\text{week4}}$ ,  $T_{\text{week15}}$ ,  $T_{\text{week30}}$ ) over a 30-week period, performed in a large network of gyms spread across Germany, targeting individuals who had newly joined a fitness center. Both journal publications (i.e., sub-studies) are based on this study design, which served as a common database; however, to address the research question of journal paper 2, a sub-sample of  $N=196$  subjects of this database was used and analysed for a reduced 15-week period ( $T_{\text{week1}}$ ,  $T_{\text{week15}}$ ).

Two well-established motivational frameworks were applied to gain an understanding of the role of motivation to predict the individuals' gym attendance: The Achievement Motive Theory and the Self-Determination Theory. Kuhl's Theory of Volition was also used as a concept to test the competing hypotheses of the predisposition and socialization models.

Multilevel growth modeling was employed as the main statistical analysis method for both publications. Journal paper 1 revealed no evidence of an impact from the achievement motive on PA frequency, but a beneficial effect from autonomous motivation. Therefore, continuous and regular participation in an exercise program is more likely when individuals enjoy the program and consider it important personally. In particular, helping people to maintain high levels of autonomous motivation in the first weeks of their gym membership seems to be an effective way to promote regular participation in PA and exercise. The findings of publication 2 support the notion that volitional traits do not necessarily predict behavior, but that behavior (e.g., gym attendance) over time can positively influence aspects of self-control. These results are applicable because the motivation to regularly attend a gym does not have to be embraced first; the simple behavior of attending a gym may positively impact the related volitional competencies. In sum, the results of the long-term multicenter gym study contribute to understanding the psychological factors that facilitate persevering with regular PA or can be improved as a result. The insights gained provide meaningful guidance to athletes, practitioners, and gym owners and also apply to all types of physical activities beyond gym exercise. Second, the findings provide important information about predicting objective behavior. Building up on this, the results also suggest directions for future research.

## Zusammenfassung

Diese Dissertation war Teil eines geförderten Forschungsprojekts und besteht aus zwei Quartil 1 (Q1) Journal-Publikationen. Beide wissenschaftliche Beiträge untersuchten die Beziehung zwischen psychologischen Variablen (d.h. Motivationsvariablen und volitionalen Kompetenzen) und Sportteilnahme, um ein besseres Verständnis von individuellen Dispositionsmerkmalen zu erlangen, die die Ausübung langfristiger sportlicher Betätigung beeinflussen oder von dieser beeinflusst werden können.

Körperliche Aktivität und Bewegung sind wesentliche Faktoren für die physische und psychische Gesundheit. Allerdings kann der damit verbundene gesundheitliche Nutzen ohne regelmäßige körperliche Aktivität nicht aufrechterhalten werden. Der Besuch von Fitnessseinrichtungen ist eine Möglichkeit für körperliche Aktivität. Die Anzahl an Fitnesszentren oder Fitnessstudios hat in den letzten Jahren weltweit stark zugenommen. Aufgrund dieses raschen Wachstums und der zunehmenden Beliebtheit scheint der Besuch eines Fitnessstudios folglich eine attraktive Option darzustellen, das Bewegungsverhalten als einen festen Bestandteil des individuellen Lebensstils zu übernehmen und anschließend aufrechtzuerhalten. Allerdings scheitern viele Menschen häufig daran, sich körperlich zu ertüchtigen bzw. Trainingsprogramme auf Dauer durchzuführen und erleben vielmehr einen Rückfall in einen inaktiven Lebensstil oder kündigen ihre Mitgliedschaft. Diese Beobachtungen deuten darauf hin, dass viele Menschen mehr Schwierigkeiten damit haben, langfristig aktiv zu bleiben als das Bewegungsverhalten zu initiieren. Um einen gesunden Lebensstil wirksam zu fördern, ist ein Verständnis dafür, warum Menschen an körperlicher Aktivität festhalten und damit die Untersuchung von psychologischen Variablen, die die Aufrechterhaltung dieser Aktivität vorhersagen, von entscheidender Bedeutung. Gegenwärtige Ansätze zur Förderung körperlicher Aktivität betonen die Bedeutung von Motivation in der Förderung (oder Hemmung) körperlicher Ertüchtigung. Allerdings ergibt sich aus der Literatur nicht, welche Rolle Motivation in verschiedenen Phasen physischer Aktivität spielt, da ihr relativer Einfluss als Reaktion auf ein Sportprogramm (z.B. Mitgliedschaft in einer Fitnessseinrichtung) im Laufe der Zeit variieren und somit die Muster sportlicher Aktivität beeinflussen kann. Darüber hinaus hat die Wissenschaft volitionalen Kompetenzen (z.B. Selbstkontrolle, Selbstregulierung) bei regelmäßiger körperlicher Aktivität eine hohe Bedeutung beigemessen, gerade wenn das Streben nach einem Ziel Schwierigkeiten bereitet. Allerdings sind Zusammenhänge zwischen volitionalen Kompetenzen und regelmäßigem Bewegungsverhalten durch Längsschnittuntersuchungen noch nicht eindeutig belegt. Insbesondere bleibt unklar, ob ein



hohes Maß dieser Kompetenzen eine Voraussetzung oder eher Folge regelmäßiger sportlicher Aktivität ist. Die hier vorgestellte Untersuchung adressiert die Limitationen der vorhandenen Literatur. Um die Lücke in der Literatur zu schließen, befasst sich diese Dissertation sowohl mit dem Einfluss von Motivation auf Sportteilnahme (Publikation 1) als auch mit der bidirektionalen Beziehung zwischen volitionalen Kompetenzen und Sportteilnahme (Publikation 2), mit der Absicht, Dispositionsmerkmale neuer Fitnessstudio-Mitglieder zu erfassen, die langfristige Sportteilnahme beeinflussen oder von dieser beeinflusst werden können. Insbesondere bestand das Bestreben von Publikation 1 darin, die Rolle sowohl des Leistungsmotivs (implizit, explizit und seine Kongruenz), der autonomen (z.B. intrinsische Motivation, identifizierte Regulation) als auch kontrollierten Motivationsformen (z.B. introjizierte Regulation, externe Regulation) bei der Entwicklung von Fitnessstudiobesuchen zu bestimmen. Publikation 2 untersucht indessen ob dispositionale Kompetenzen zur Selbstkontrolle die Frequenz von Fitnessstudiobesuchen vorhersagen (Prädispositionsmodell) oder sich als Folge einer höheren Übungsadhärenz entwickeln können (Sozialisationsmodell).

Zur Untersuchung der Forschungsfragen wurde eine (quantitative) prospektive Längsschnittstudie ( $N=229$ ) unter realen Bedingungen mit Messwiederholungen ( $T_{\text{week1}}$ ,  $T_{\text{week4}}$ ,  $T_{\text{week15}}$ ,  $T_{\text{week30}}$ ) über einen Zeitraum von 30 Wochen in Fitnessstudios durchgeführt. Personen, die gerade erst als neues Mitglied einem Fitnessstudio beigetreten waren, wurden als Stichprobe akquiriert. Beide Publikationen (d.h. Teilstudien) basieren auf diesem Studiendesign, das als gemeinsame Datengrundlage diente. Zur Beantwortung der Forschungsfragen von Publikation 2 wurde jedoch nur eine Teilstichprobe von  $N=196$  Probanden verwendet und über einen verkürzten Zeitraum von 15 Wochen ( $T_{\text{week1}}$ ,  $T_{\text{week15}}$ ) analysiert.

Zwei etablierte Motivationstheorien wurden angewandt, um ein Verständnis für die Rolle von Motivation bei der Vorhersage von Fitnessstudiobesuchen zu erhalten: die Achievement Motive Theory und die Self-Determination Theory. Ferner wurde die Volitionstheorie nach Kuhl als theoretisches Konzept verwendet, um die Hypothesen des Prädispositions- und Sozialisationsmodells zu testen.

Multi-Level Growth Models wurden als statistische Analyseverfahren für beide Publikationen herangezogen. Publikation 1 zeigt keine Evidenz für einen Einfluss des Leistungsmotivs, jedoch einen positiven Effekt von autonomer Motivation auf Sportpartizipation. Dementsprechend ist eine regelmäßige Sportteilnahme wahrscheinlicher, sofern das Sport-/Trainingsprogramm als angenehm bzw. persönlich wichtig erachtet wird. Insbesondere scheint für die Aufrechterhaltung der Sportpartizipation gerade in den ersten

Wochen der Mitgliedschaft im Fitnessstudio ein hohes Maß autonomer Motivation essentiell zu sein, um regelmäßiges Training zu fördern. Die Ergebnisse von Publikation 2 tragen dazu bei, dass volitionale Fähigkeiten nicht zwingend ein bestimmtes Verhalten (z.B. den Besuch des Fitnessstudios) vorhersagen, (regelmäßiges) Verhalten allerdings Aspekte von Selbstkontrolle im Laufe der Zeit positiv beeinflussen kann. Die Ergebnisse sind insofern bedeutsam, da die Motivation ein Fitnessstudio regelmäßig aufzusuchen, zunächst nicht aufgebracht werden muss; vielmehr können die volitionalen Kompetenzen durch das einfache Verhalten eines Fitnessstudiobesuchs positiv beeinflusst werden. Die Ergebnisse der multizentrischen Langzeitstudie tragen zum Verständnis psychologischer Faktoren bei, die die Kontinuität regelmäßiger körperlicher Aktivität erleichtern oder durch diese verbessert werden können. Die hierbei gewonnenen Erkenntnisse bieten Sporttreibenden, Trainern und Studiobesitzern eine hilfreiche Orientierung und sind auch auf andere Sportdisziplinen übertragbar, die über das reine Training im Fitnessstudio hinausgehen. Des Weiteren liefern die Erkenntnisse wichtige Informationen zur Vorhersage objektiven Verhaltens und geben Anregungen für zukünftige Forschungsarbeiten.

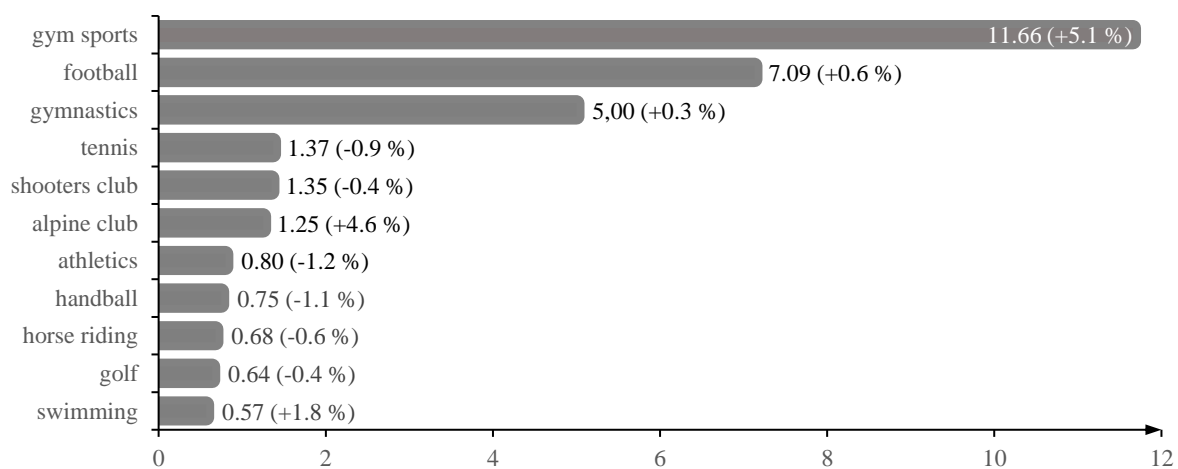
# 1 Introduction

## 1.1 Research Motivation

Regular participation in physical activity (PA) and exercise is generally promoted due to the variety of benefits to physical and mental health (Angevaeren et al., 2008; Harber et al., 2017; Li & Siegrist, 2012; Marcus et al., 2000; Sallis et al., 2016; Schulz et al., 2012; Warburton et al., 2006). Similarly, research links regular PA to reduced cardiovascular and other (chronic) illnesses, such as diabetes mellitus Type 2, obesity, hypertension, coronary heart disease, stroke, musculo-skeletal disorders, some types of cancer, and in clinical studies, to depression (cf. Byers et al., 2002; Guh et al., 2009; Pedersen & Saltin, 2015; Ross et al., 2000; Stathopoulou et al., 2006; Warburton et al., 2006). PA and exercising therefore facilitates achieving and maintaining physical and mental health. In contrast, physical inactivity or substantially reducing PA has been linked to a host of adverse health outcomes leading to healthcare and insurance costs, therefore exerting a heavy burden on societies and healthcare systems (cf. Ding et al., 2016; Klein et al., 2016; Lee et al., 2012; Mujika & Padilla, 2000; Warburton et al., 2006). However, in spite of public exhortations and private benefits, only 40% of adults in western societies report engaging in PA at a level compatible with most evidence-based public health guidelines put forward by international organizations (Hallal et al., 2012; National Center for Health Statistics, 2013; Sallis et al., 2016; Sisson & Katzmarzyk, 2008; World Health Organization, 2010). Hence, PA inactivity is currently one of the most pressing societal issues (Ding et al., 2016). Given the many health benefits of exercise and potential problems related to insufficient activity, understanding why people adhere to PA or discontinue an exercise program is a central concern (cf. Boyd, 2013). Gaining a better understanding of factors that drive individuals to participate in disease-preventing, health-enhancing PA or exercise is therefore crucial to effectively promoting a healthy lifestyle throughout the lifetime of an adult (cf. Sibley & Bergman, 2018).

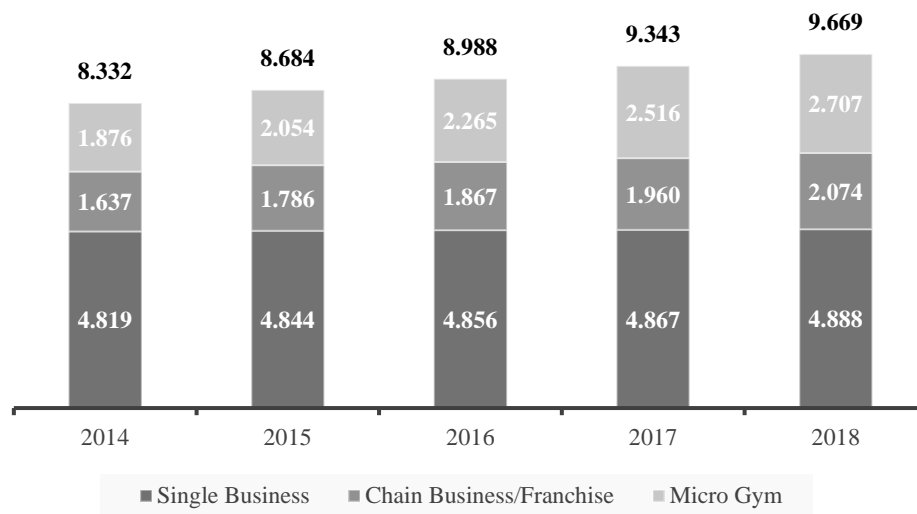
Exercise is generally defined as “a subset of PA that is planned, structured, and repetitive and has as a final or intermediate objective the improvement or maintenance of PA” (Caspersen et al., 1985, p. 126) and therefore represents an opportunity to avoid the health disadvantages of physical inactivity (cf. Brand & Ekkekakis, 2018). Nowadays, people do a substantial amount of their regular exercise in fitness centers or gyms (Deutscher Sportstudio Verband [DSSV], 2019; Rohde & Verbeke, 2017). Attending a gym has long been recognized a health-

related, preventive and promising option for regular PA for those to whom traditional sport or individual exercise (e.g., jogging or cycling) may not appeal (cf. Haskell et al., 2007; Ntoumanis et al., 2017). Hence, exercising in gyms is a practical approach to avoiding health issues and assuring regular, structured, and supervised exercise opportunities in both affiliative and achievement-relative surroundings (Body Life, 2008; Body Life, 2010; DSSV, 2019). The range of services promoted include supervised exercise programs for endurance building, group-based fitness classes (e.g., aerobics), resistance training, and muscle strengthening (e.g., body-weight and weightlifting exercises) (DIN 33961-1:2015-11; DSSV, 2017 Paoli & Bianco, 2015). The evident widespread availability and tremendous growth in popularity of gym exercising suggests that the majority of patrons recognize these benefits (DSSV, 2019; Ntoumanis et al., 2017). Gyms and fitness centers have shown the strongest growth in members (5.1 % in 2019) compared to all other training or sports clubs, such as gymnastics, athletics or football clubs (see Figure 1) (DSSV, 2020). Improving physical fitness and/or weight reduction are only two motives for going to a gym (DSSV, 2017; Kamberovic & Schwarze, 1999; Samsel, 1999; Wanjek et al., 2016).



**Figure 1.** Member popular forms of exercising in Germany by memberships 2019 (in millions, changes compared to the previous year in brackets) (cf. DSSV, 2020).

Currently, about 11.7 million Germans are enrolled in one of approximately 9700 operating gyms (see Figure 2), which corresponds to 14 % of the total German population (Deutscher Olympischer Sportbund, 2019; DSSV, 2020).



**Figure 2.** Growth in operating gyms since 2014 classified by types of business (cf. DSSV, 2020).

Based on this popularity and rapid growth, joining a gym appears to provide an appealing fitness option for many individuals. Accordingly, this commercial sports sector is a potential contributor to a population's fitness and maintenance of good health (cf. DSSV, 2017). Yet, the turnover in gym attendees is high (cf. Berger et al., 2002) and many gym members experience a relapse from an active to an inactive lifestyle (Ntoumanis et al., 2017; Sallis et al., 1990). Despite the health benefits, empirical studies have shown that roughly 45 % of the participants in exercise programs discontinue during the first six months (Della Vigna & Malmendier, 2006; Dishman & Buckworth, 1996; Fitness Industry Association [FIA], 2001; James et al., 2008; Marcus et al., 1996; Middelkamp et al., 2016), with the sharpest dropout rate in the first three months after starting the program (FIA, 2001). German gyms also struggle with constantly high dropout rates, ranging from 25 % to 58 %, depending on the type of business (e.g., single business vs. franchise vs. chain business) (cf. DSSV, 2019). Consequently, the original motivation to attend a gym regularly does not always sustain the behavior in the longer term, which indicates that people tend to have trouble maintaining, rather than commencing, PA and exercise. These declining participation trends render it essential to understand underlying factors influencing the perseverance in an exercise program (cf. Ntoumanis et al., 2017; Rand et al., 2020). Even though important advances have been made to understand factors leading to participation in PA, relatively little research has investigated psychological variables predicting maintenance and/or variation in PA behavior (or vice versa) over a specific (and longer) period of time (Burton et al., 1999; Jekauc et al., 2015; Mâsse et al., 2011). Accordingly, more

empirical research is needed, especially in a long-term and naturalistic setting to enhance our knowledge on the maintenance of PA (cf. Mâsse et al., 2011). Understanding why people adhere to PA and examining determining factors predicting exercise adherence seem important (Amireault & Godin, 2015; Nigg et al., 2008). Motivational and volitional determinants are commonly recognized factors that might impact continuation in a fitness program, given their key role in sustaining exercise engagement (cf. Martinent & Decret, 2015; Teixeira et al., 2012). While motivation is often enough to drive behavior when everything goes smoothly, volition supports motivation, or takes over, when things become difficult. Therefore, to promote the adoption and then maintenance of health-related PA, the relationship between both motivational and volitional variables and regular exercise behavior (i.e., gym attendance) are addressed. In particular, this work aims to identify motivational and volitional variables associated with sustained PA behavior to better understand dispositional characteristics of individuals that may affect, or be affected by, regular exercise. These research objectives will be addressed (in more detail) in two quartile 1 journal publications (see Chapter 3), which are based on a 30-week quantitative longitudinal multicenter study under real-life conditions in 16 German gyms (see Chapter 2). Publication 1 is motivationally grounded and provides insight into the predictive validity of motivational variables (i.e., implicit and explicit achievement motive) on self-reported and actual gym attendance during the study period. As the impact of motivation (i.e., quality of motivation) in different phases of an exercise program might change over time (e.g., motives to initiate exercise might differ from those which motivate to maintain an exercise program), the article further captures changes in motivation in order to analyze changes in gym attendance or withdrawal from regular exercise. In contrast, journal paper 2 deals with volitional determinants (i.e., self-control/-regulation traits) and introduces two models to account for the bidirectional association between volitional competencies and (actual) PA behavior, the predisposition and socialization model, to determine whether robust volitional skills are an antecedent (i.e., predisposition model) or consequence (i.e., socialization model) of regular exercise behavior. In addition, this article identifies specific volitional competencies that could be strengthened from regular participation in sport and exercise. The results of both publications should reveal useful clues and implications for practitioners, trainers, and gym owners to reverse declining participation rates and/or discontinuing gym exercise programs (cf. Abula et al., 2018); however, the study provides important information about predicting objective behavior beyond the field of sports because the results apply to all types of physical activities. This dissertation and its research questions were part of a funded research project, briefly outlined in the following section.

## 1.2 Research Project

This work was part of a collaborative research project entitled *Sustainable Fitness Service* between the Technical University of Munich (TUM), represented by the Associate Professorship of Sport Equipment and Sport Materials, and the German University of Applied Sciences for Prevention and Health Management (DHfPG), located in Saarbrücken, Germany. Since many people who take out memberships at fitness centers fail to stay on track and maintain exercise in the long run (Dishman & Buckworth, 1996; FIA, 2001), the project was conducted to understand important psychological factors influencing the course of a gym membership, a significant applications- and health-oriented topic centered in the area of motivation and willpower (i.e., volition). Accordingly, theoretical research aimed to identify psychological variables predicting (long-term) exercise adherence. From an applied perspective, the main goal was to provide recommendations for promoting more frequent gym attendance and exercise engagement for both gym owners and gym patrons since little is known about the factors that are associated with continued (or discontinued) attendance at gyms (Rand et al., 2020). The project involved a longitudinal component and real-life conditions in commercial gyms while using different research approaches and a mixed methodology (see below) to fill the gaps in the literature. Both publications followed the guidelines specified by the research project and, therefore contribute to the field. The investigation was initiated, planned, and executed by the dissertation author. However, hypothesis formation and study set-up, were drawn up jointly with the TUM-Chair of Psychology and the Division of Sport Psychology of the University of Vienna, Austria.

The collaboration, enabled by a Research and Development contract, covered the period from May 2015 to April 2019. The project, reviewed and approved by the DHfPG research board in May 2015, received DHfPG funding for the whole project term. In addition, it supported data collection by providing access to a large network of German gyms and fitness centers.

### 1.3 Structure of the Present Research

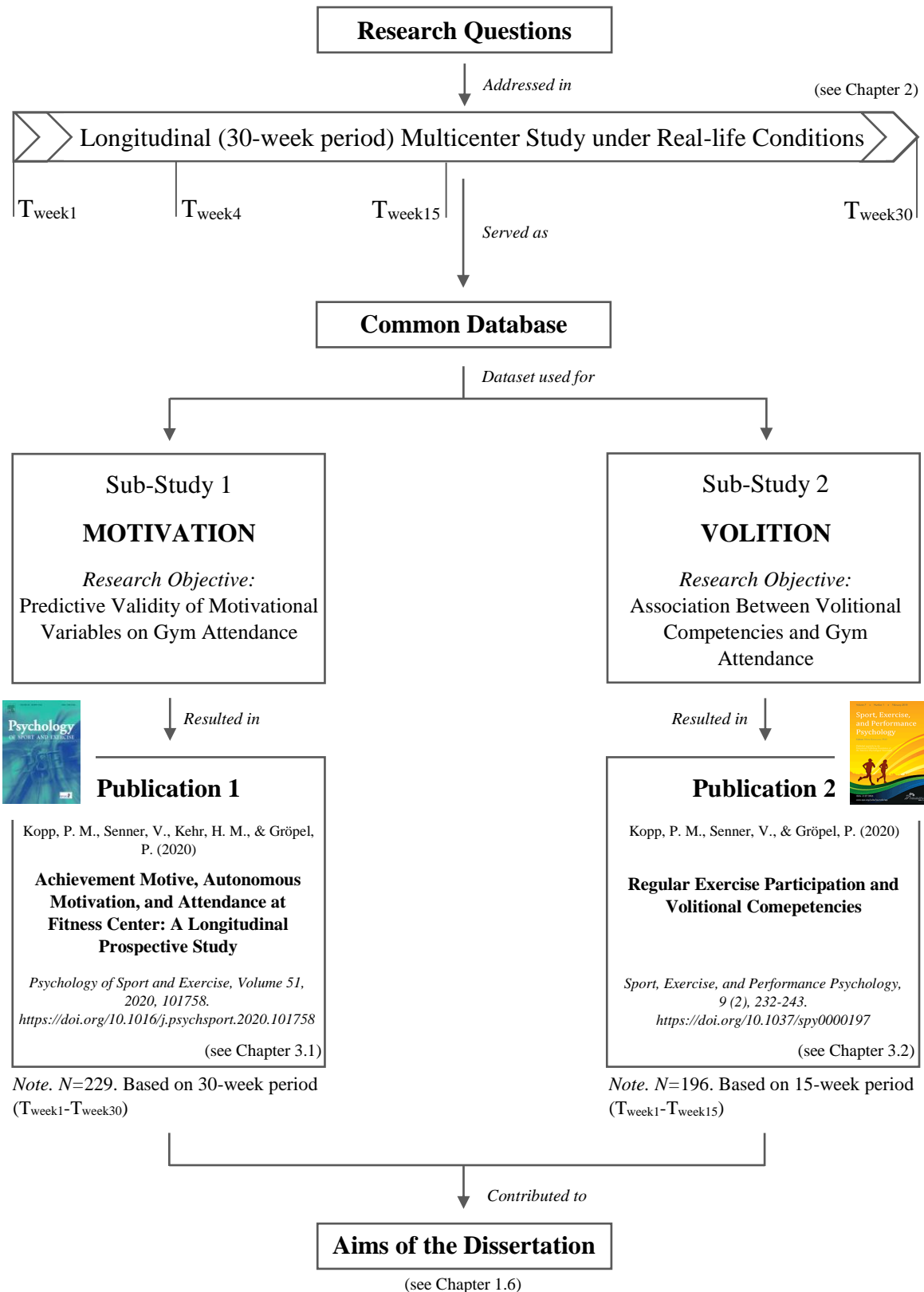
The present dissertation is comprised of two journal publications. Both scientific contributions provide a better understanding of dispositional characteristics (i.e., motivation and volitional competencies) of individuals that may affect, or be affected by, the routine of long-term exercise participation and therefore contribute to the realization of the goals of this work. These goals are: 1) to capture the predictive validity and role of motivational variables in the evolution of exercise participation (publication 1), and 2) to analyse the bidirectional association between volitional competencies and exercise participation (publication 2) to determine whether a person with a stronger will adheres more to exercise programs or regular (i.e., longitudinal) exercise behavior strengthens volitional skills (see also Section 1.6).

Please note that both research questions (i.e., sub-studies<sup>1</sup>) were addressed in a 30-week longitudinal multicenter study design under real-life conditions (see Chapter 2) including repeated measurements in four waves ( $T_{\text{week}1}$ ,  $T_{\text{week}4}$ ,  $T_{\text{week}15}$ ,  $T_{\text{week}30}$ ), which was set up as a conceptual framework for joint data collection, serving as a common database for the resulting journal papers. However, while article 1 ( $N=229$ ) covers the entire study period ( $T_{\text{week}1}$ - $T_{\text{week}30}$ ), journal paper 2 used a sub-sample of  $N=196$  subjects of this database, which was analysed for a reduced 15-week period ( $T_{\text{week}1}$ ,  $T_{\text{week}15}$ ). Figure 5 illustrates the structure of this dissertation.

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<sup>1</sup> *Note.* Publication, scientific contribution, journal paper, and sub-study are used interchangeably since each sub-study resulted in a journal article/publication.





**Figure 3.** Structural setup of the dissertation. Flowchart on common data base used for both journal publications.

## 1.4 Theoretical Background

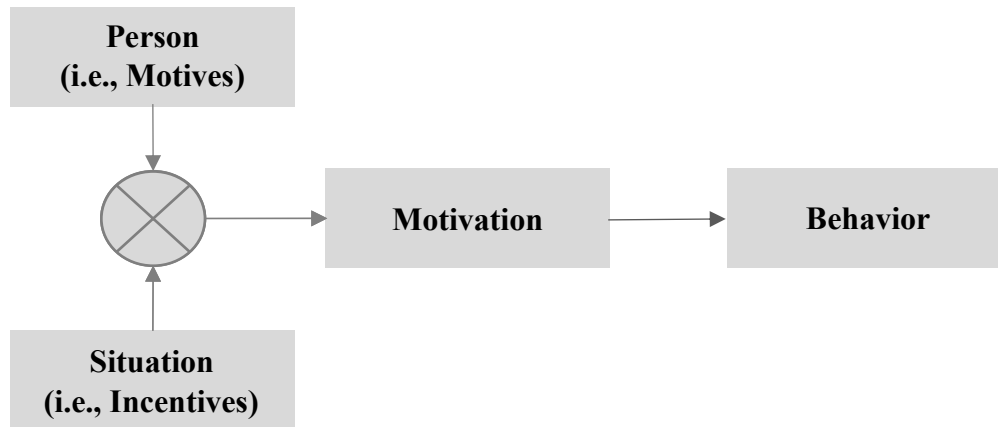
This section explicates the psychological theories employed in this work. Studying motivation and volition (i.e., self-control, self-regulation) associated with PA behavior is important given its crucial role in participation in PA and sport and exercise performance (Englert, 2016; Englert et al., 2020). Both constructs can interplay in all phases, with motivation more likely to be dominant in the decision and evaluation phases and volition having a stronger role in the planning and action phases. Furthermore, motivation is often sufficient to drive behavior when everything goes smoothly, while volition supports motivation, or takes over, when things become difficult. Therefore, this research investigates both motivational and volitional processes relevant for regular participation in sport and exercise (Martinet & Decret, 2015). However, the inclusion of both motivational and volitional predictors in each sub-study would exceed the scope of each publication, especially as they did not interact in the present dataset.

Since publication 1 (i.e., sub-study 1) is motivationally grounded, this facet of research is theoretically guided by the Achievement Motive Theory (AMT; McClelland, 1987; McClelland et al., 1953) and the Self-Determination-Theory (SDT; Ryan & Deci, 2000; Ryan & Deci, 2017). Both theories have been widely applied in the sport and exercise context to study motivation for PA. While AMT emphasizes an individual motivational need that, once aroused, can make people more naturally inclined to exercise behavior, SDT adds the importance of quality of motivation based on more general internal or external reasons. In short, AMT addresses the quantity or strength factor (e.g., the stronger the achievement motive, the stronger motivation to exercise), whereas SDT focuses on qualitative features of motivation (e.g., the more autonomous the reasons for exercise, the stronger the motivation to exercise) to strengthen exercise participation. Therefore, both theories are complementary in the present research.

In addition, publication 2 (i.e., sub-study 2) is based on volition (i.e., self-control and self-regulation), which is another vital aspect of participation in PA (Buckley et al., 2014). Therefore, Kuhl's (2000) theory of volition is used as a theoretical concept to provide a deeper understanding of the underlying processes of the competing hypotheses of the predisposition and socialization models. This section first highlights the theoretical fundament and then the relationships to PA while outlining the critique and limitations of the current research.

### ***1.4.1 Achievement Motive Theory***

The Achievement Motive Theory (McClelland, 1987; McClelland et al., 1953) proposes that individuals have a natural need to attain high levels of success in various pursuits, such as when striving for improvement in physical exercise settings. A feeling of accomplishment is an important ingredient in motivation and the most thoroughly studied motive (Brunstein & Maier, 2005; Gröpel et al., 2016). A behavior can be considered achievement motivated when it involves a competition with a certain standard of excellence, such as doing activities well, better than others, or best of all (McClelland et al., 1953; McClelland, 1987). Hence, achievement-motivated people seek further satisfaction from the autonomous mastery of challenging tasks in order to succeed and feel proud. In addition, people with a high achievement motive enjoy improving personal skills and strive for excellence and efficacy measured against quality standards. Thus, people may compare their current performance with their own previous performance (e.g., to exceed one's own performance) or with that of others (e.g., to rival or surpass others) (Brunstein & Maier, 2005). However, people with a low achievement motive tend to avoid such situations. Therefore, the level of achievement motive likely contributes to participation in exercise programs and thus gym attendance. Indeed, people typically report challenges and improvement in fitness or health as their primary motivation for sport and exercise participation (Frederick & Ryan, 1993; Kilpatrick et al., 2005). Following the classic person x situation interactionist approach, (Lewin, 1935; Rheinberg & Vollmeyer, 2012) (see Figure 4) individuals' motives are expected to be inspired by motive specific incentives. From this perspective, *persons/motives* are defined as relative stable preferences for a specific class of incentives that are affectively charged (McClelland, 1980); *situations/incentives*, in turn, represent situational stimuli and cues from the environment that can lie in the outcome/purpose or in the activity itself (cf. Koestner et al., 1991; Müller & Cañal-Bruland, 2019, Rheinberg, 1989). Accordingly, a high achievement motive is only expected to yield increases in motivation, likely resulting in behavior if a given situation provides achievement-specific incentives to individuals with stable preferences for this incentive (Müller & Cañal-Bruland, 2019; Schattke, 2011). For instance, a person who has a stable preference for challenges (achievement motive) is presumably only likely to work out in a gym if it provides such challenging incentives (e.g., group-based fitness classes such as spinning courses). Rising to these challenges would then have affective consequences, such as enjoying working out or being proud of mastering certain skills, that contribute to amplifying and strengthening behaviors that previously led to experiencing positive effects (e.g., joining a fitness class).



**Figure 4.** *The classical approach to motivation. The interaction between personal (e.g., motives) and situational variables (e.g., incentives) lead to motivation. Motivation then makes behavior likely. Adapted from Rheinberg and Vollmeyer (2012).*

Exercising in fitness centers or gyms always includes opportunities to reach a goal (e.g., feeling less exhausted after three sets of weightlifting), therefore providing a myriad of achievement incentives/features, such as challenges, opportunities to improve one's competencies (e.g., technique in exercise performance) or physical condition (e.g., stamina in a fitness course) or competition with oneself or others (cf. Gröpel et al., 2016). Building on this, the achievement motive might be of relevance for behavior change in different PA settings such as gym attendance. This work, therefore, involved the achievement motive as a predictor of PA (i.e., gym attendance).

***Implicit and explicit achievement motive as driving factors behind PA behavior/performance.*** In the literature, two structural components of motives have been discussed: Implicit and explicit motives. In the following, both characteristics are briefly outlined for the achievement motive, since this motive is focused on in the gym context only.

The *implicit* achievement motive is a stable, enduring motivational disposition to do things well and is based on early, prelinguistic affective experiences (McClelland et al., 1989). Therefore, it is largely inaccessible to the self (e.g., via self-reports) and operates outside of the individual's awareness, necessitating the use of (semi-)projective (operant) measures, such as the Picture Story Exercise (cf. Sokolowski et al., 2000; Winter, 1994) in which people are asked to write short imaginative stories in response to a set of picture cues (for more on this, see Methods). According to McClelland et al. (1989), this motive is inspired by task intrinsic achievement incentives, which are experienced when people deal with or face challenges, task

contingency, achievement work content, and time pressure (Brunstein, 2008; Spangler, 1992). Since the implicit achievement motive is affectively based, a positive effect or emotion, such as pride upon completing a challenging task represents the reward for satisfying this motive. These rewarding affective consequences, in turn, make similar behaviors (e.g., going to the gym) more likely in the future. Indeed, implicit motives predict operant behavior, i.e., spontaneous behavior and long-term behavioral trends (Brunstein & Maier, 2005).

The *explicit* achievement motive, in contrast, represents a fundamentally different construct, with self-ascribed needs and values built upon explicit teaching by others as to what values (cf. Hofer et al., 2006) or goals (Hofer & Chasiotis, 2003) should be pursued (Brandstätter et al., 2013; McClelland et al., 1989). Thus, this motive is consciously rooted in and inspired by explicit, often social achievement incentives, such as external rewards for challenging goals set by others, prompts, expectations (e.g., challenging goals set by a trainer), or demands (McClelland et al., 1989; Spangler, 1992). Since the explicit achievement motive is cognitively based, it results in a positive evaluation (e.g., perceived value of an activity) rather than an affect or emotion as a reward (McClelland, 1987, 1989). Therefore, anticipating rewards after having mastered an achievement goal presumably promotes the likelihood of initiating the goal-oriented behavior. Indeed, this motive predicts a variety of respondent behaviors, such as immediate responses to specific situations or choice behavior (i.e., conscious, elaborated decisions). Researchers have employed questionnaire-based, self-report measures (e.g., Unified Motive Scales; Schönbrodt & Gerstenberg, 2012) to assess explicit motives (cf. Jackson, 1984).

Given these differences between implicit and explicit achievement motives, it is reasonable that both the implicit and explicit achievement motives impact PA behavior (e.g., gym attendance).

***Congruence between implicit and explicit achievement motives.*** Since implicit and explicit motives are independent motive systems, they may conflict with and undercut behavior; however, they might also combine and facilitate behavior (McClelland et al., 1989; Baumann et al., 2005; Gröpel et al., 2016; Schüller et al., 2009). Individuals who express a desire go to a gym to work out (high explicit motive) and regularly do so (high implicit motive) presumably experience motive congruence, that is, high levels of both implicit and explicit motives. Researchers who have focused on additive or interactive effects of both motive types (e.g., Wegner & Teubel, 2014) assumed that the interaction of a high implicit and a high explicit motive (i.e., motive congruence) results in higher task motivation and predicts well-being

(Baumann et al., 2005; Gröpel, 2008; Kehr, 2004a), flow experience (Rheinberg, 2010; Schüler, 2010), development of ego identity (Hofer et al., 2006), and immediate behavior (Brunstein & Maier, 2005). Therefore, these interactive effects might also affect performance (e.g., gym attendance) because they have the highest motivational potential to drive behaviors (Kehr, 2004b). Consequently, this research investigates whether the congruence between the implicit and explicit achievement motives predicts long-term behavior (i.e., gym attendance) as well. If the interaction of both a high implicit and a high explicit motive system promotes task motivation, then people high in both the implicit and explicit achievement motive should visit the gym more frequently than people low in one or both of these motive systems (Gröpel et al., 2016).

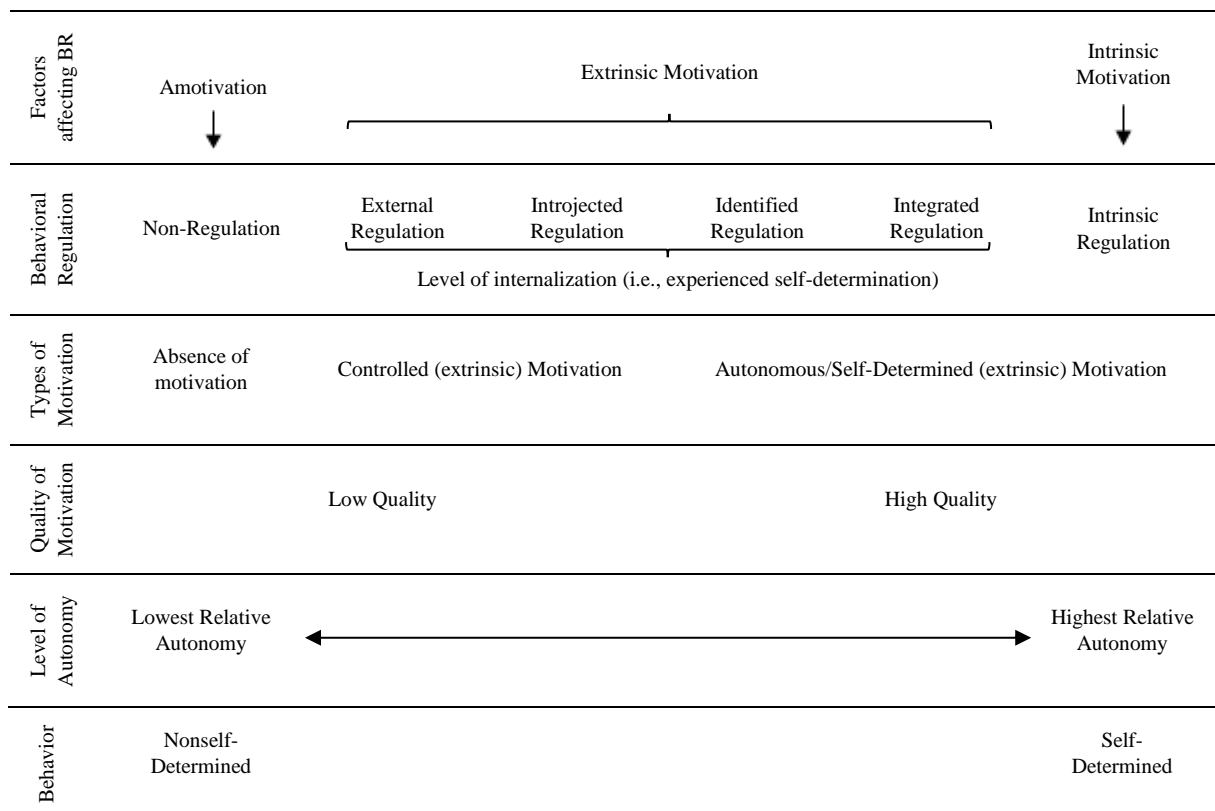
***Achievement motive and exercise participation.*** Within sport and exercise psychology, there is a relatively large body of research on how achievement motives (and its congruence) are linked to performance (see the most recent review by Müller & Cañal-Bruland, 2019, which includes 46 publications). Almost half of these papers ( $N = 22$ ) have been published in the last decade, indicating that the achievement motive theory is being widely used in the contemporary sport and exercise psychology research. Sport and exercise provide ample achievement incentives. Therefore, stronger achievement motive may be associated with higher participation in sport and exercise (Gabler, 2002; Gröpel et al., 2016; Halvari, 1991). In line with this, Gabler (2002) observed more frequent participation in training activities in swimmers with a strong implicit achievement motive. Gröpel et al. (2016) tested different samples including amateur, recreational, and elite athletes and found that the implicit achievement motive consistently predicted regular engagement in sport and exercise activities, while the explicit achievement motive did not. Halvari (1991) found an indirect impact of the explicit achievement motive on maximal aerobic power through perceived intrinsic instrumentality. However, although previous research appears to underline the impact that acts of the achievement motives have on PA, no empirical evidence exists on whether and how the achievement motive facilitates or predicts a *new* exercise behavior over time. In addition, previous research has not yet found empirical evidence for the effect of motive congruence on (long-term) participation in sport and exercise (Gröpel et al., 2016). This lack might be due to methodological reasons. Little research employs longitudinal studies in a real-life setup on PA maintenance over longer periods, such as three months of engagement and more than two measurement occasions (Miquelon & Castonguay, 2017). Moreover, retrospective (study-) designs limit implications derived from the research on achievement motive and exercise behavior. Further restrictions pertain to the

evaluation of PA behavior, since previous studies are almost exclusively limited (Jekauc et al., 2015) to self-report data of PA and exercise. Recent studies have shown that individuals over-reported their participation when prompted to self-report their PA behavior than when their actual behavior was measured (Dyrstad et al., 2014; Kaushal & Rhodes, 2015). Hence, additional research is needed to examine the relative importance of the achievement motive on actual and long-term PA behavior. Employing the systematic measurement of implicit motives, explicit motives and their interplay (i.e., interaction of both motive systems) the present research helps integrate findings on psychological variables with actual PA behavior to the field.

#### ***1.4.2 Self-Determination Theory***

***Theoretical background.*** Self-Determination Theory (SDT; Ryan & Deci, 2000) is a highly promising theoretical approach to understanding how motivation promotes PA adoption and maintenance (Deci & Ryan, 1985; Ryan & Deci, 2000; Ryan & Deci, 2017), as its theoretical framework allows researchers to investigate various types of motivation (cf. Miquelon & Castonguay, 2017). New gym members face psychological, physiological, and social demands and stressors as well as persistent temptations (e.g., remaining sedentary). In this achievement context, they may attend the gym for pleasure and inherent satisfaction, but also due to external control (e.g., medical advice) when the target behavior is not perceived as inherently enjoyable. However, intrinsic motivation for attending a gym, and the corresponding sport participation, might shift toward more controlled forms of motivation or just the other way around (Jordalen et al., 2018). Therefore, to investigate these processes in daily life, the present research applied SDT. This theory is comprised of three broad types of motivation along a continuum (see Figure 5), ranging from amotivation to controlled motivation to autonomous motivation, all distinctively different. *Amotivation* reflects a lack of intention and motivation to act and, therefore, a lack of either self-determined or controlled motivation for behavioral engagement (e.g., I have started running but I don't really know if it is worth continuing). *Controlled* motivation is less self-determined than autonomous motivation and encompasses extrinsic reasons that reflect a low degree of valuing an activity, such that the action is completed to avoid guilt or internal pressure (introjected regulation) or to satisfy an external demand or reward contingency (external regulation). Hence, controlled motivation predominates when the activity is perceived as a means to an end and is based on a feeling of

forced rather than voluntary participation. *Autonomous* motivation or *self-determined* motivation encompasses intrinsic reasons that reflect feelings of enjoyment or personal accomplishment while doing an activity (termed “intrinsic motivation”) as well as extrinsic reasons that reflect a conscious valuing of an activity, such that the action is congruent with the self (integrated regulation) or accepted as personally important (identified regulation). These different types of motivation reflect the degree to which individuals have internalized the reason why they participate in sport and exercise and, therefore, show qualitatively different types of motivation, i.e., they attend the gym for inherent reasons and pleasure: or for external reasons such as a doctor’s advice (cf. Jordalen et al., 2018; Ryan & Deci, 2000). However, as indicated, the motivational profile and therefore the quality of motivation may change, develop, or fluctuate on this regulation continuum over time (e.g., different phases of exercise engagement). Furthermore, the motivational profile may be both intrinsically and extrinsically regulated/motivating at the same time (cf. Box et al., 2019; Jordalen et al., 2018).



**Figure 5.** The self-determination (internalization) continuum showing types of motivation with their regulatory styles and level of autonomy (cf. Ryan & Deci, 2000). Note. BR=Behavioral Regulation.



Researchers have typically tested these types of motivation separately as well as in the form of a composite score, the Relative Autonomy Index (RAI), by which individual regulations are weighted and summed to provide an index of the extent to which a person's behavior is more or less autonomously regulated (Teixeira et al., 2012; Vallerand et al., 2008).

***Quality of motivation.*** According to the theory, SDT has the potential to focus not only on the quantity, but also on the quality, of motivation. Therefore, the stability of one's motivation (e.g., to engage in behaviors such as PA and exercise) also depends on qualitative features (Muraven, 2008; Ntoumanis et al., 2018). Quantity of motivation might not necessarily be beneficial as some types of motivation reflect internal and external pressures to support sustained exercise engagement, which might result in high quantity, but low quality, motivation in terms of behavioral engagement. (cf. Edmunds et al., 2006; Miquelon & Castonguay, 2017; Ntoumanis et al., 2018). Building upon the quality of motivation, SDT further distinguishes between high quality (i.e., autonomous motivation) and low quality (i.e., amotivation or controlled motivation), so it describes the role motivation plays in different phases of behavior such as PA. In this regard, exercise motivation will be sustainable in the long term, so high in quality, when the three basic psychological needs—the key factors in supporting or thwarting/hindering self-determined motivation for PA—are met for those exercising (Ryan & Deci, 2000). These needs are for *autonomy* (i.e., level of perceived autonomy) when actions accord with ones' own interests, values, and personal goals (e.g., "I run because I want to"); *relatedness* when a person feels connected to and cared for by others ("I get along well with my running buddy"); and *competence* when a person feels able to effectively meet the challenges faced (e.g., "I am good at running") (Deci & Ryan, 1985). Accordingly, autonomous motivation (i.e., high quality motivation) is more likely when individuals experience feelings of competence, relatedness, and autonomy while doing an activity. In contrast, individuals are likely to develop more controlled or amotivated reasons for behavioral engagement (i.e., low quality motivation) if the needs discussed above are impeded.

***Autonomous and controlled forms of motivation and exercise participation.*** A central tenet of SDT is that people can change the quality of their motivation and progress (or regress) on the continuum between amotivation and intrinsic motivation (Ryan & Deci, 2000). So among those who adhere to exercise programs for the longer term, a shift might be possible in the quality of motivation from being more controlled to more autonomous or vice versa, resulting in a change in psychological need satisfaction during exercise programs (cf. Rahman

et al., 2011; Wilson et al., 2003). Therefore, unlike the achievement motive, which is rather stable, autonomous motivation can increase, or decrease, over time. Consequently, since the consistency of a person's motivation is governed by some of its qualitative features and, therefore, can change over time in response to an exercise program, PA engagement based on controlled motivations is likely to lead to less persistence and, in the end, to a relapse into inactivity (Miquelon & Castonguay, 2017). In contrast, PA engagement based on autonomous motivations should lead to greater resolve because individuals endorse their own actions and act with full volition. Indeed, applied research provides supportive evidence for the role of autonomous motivation in promoting exercise behavior and adherence (Chatzisarantis et al., 2003; Vansteenkiste et al., 2004). In this regard, Teixeira et al. (2012) suggested that identified regulation might be more relevant for initiating a new exercise behavior, whereas intrinsic motivation appears to be more important for long-term adherence. However, no strong empirical evidence and no clear data exist supporting this hypothesis since the conclusions are based on retrospective data, cross-sectional designs and experimental studies (cf. Abula et al., 2018, Cheon & Reeve, 2013; Ntoumanis et al., 2017). Additionally, the data on PA engagement were mainly restricted to self-reported statements on exercise frequency. The systematic review of Teixeira et al. (2012) revealed only four studies (5.6%) that employed behavioral measurements, such as pedometry and only two studies (2.8%) that included follow-ups. This review, therefore, highlights the need for further investigations, especially under daily life conditions. Moreover, no study has yet to investigate whether the evolution of autonomous and controlled forms of motivation predict exercise behavior over time, crucial as the psychological aspects may change during an exercise program or stages of exercise adaption.

### ***1.4.3 Volition in Sport and Exercise***

A new or regular exercise behavior is often demanding and frequently requires individuals to face a multitude of stressors (e.g., conflicts of interests, present-biased preferences or lack of fun): performing in demanding circumstances, feeling insufficiently skilled or competent at PA, or adjusting to setbacks in pursuit of the goal (MacNamara et al., 2010; Sarkar & Fletcher, 2014; Teixeira et al., 2012). In particular, individuals commencing gym exercise frequently force themselves to work on straining exercises according to their workout plans (e.g., Wagstaff, 2014), or force themselves to comply with exercise plans over an extended period of time (e.g., Martin Ginis & Bray, 2010). Hence, adherence to an exercise program requires considerable willpower (cf. Bandura, 2005; Maes & Karoly, 2005), such as anticipating and developing plans to overcome exercise barriers (Sniehotta et al., 2006), creating exercise plans and schedules (Arbour-Nicitopoulos et al., 2009), managing exercise-related pain and discomfort, or dealing with controlling, pressurizing environments (e.g., media exposure). Accordingly, gym patrons need to control their cognitive, emotional, and motor processes, as well as behavioral tendencies (cf. Bertrams & Englert, 2013; Wagstaff, 2014). They also need to make tough decisions in facing social, physical, and especially psychological demands that might be sources of short-lived persistence (Rouse et al., 2013).

The concept of volition has been characterized as a set of conscious and unconscious processes to exert control over thoughts, emotions, desires, and behaviors (Baumeister et al., 2007) thereby supporting goal-related cognitions and emotions against competing temptations (Kuhl, 2000). Alternative terms that have often been considered similar constructs for volition in the literature include willpower (Metcalfe & Mischel, 1999), self-control (Muraven & Baumeister, 2000), as well as self-regulation (Carver & Scheier, 1998) and involve overriding or inhibiting competing urges, behaviors or desires (Duckworth & Seligman, 2005). In particular, self-control and self-regulation are generally used interchangeably (Baumeister et al., 2007). However, unlike a large body of literature that has used the terms self-regulation and self-control synonymously (e.g., Muraven & Baumeister, 2000; Kehr, 2004a), Kuhl's (2000), the theory of volition describes volition as a superordinate concept with self-control and self-regulation differentiated into two basic modes of volition that help accomplish the volitional tasks.

***Kuhl's (2000) theory of volition.*** According to this theoretical concept, self-control is the self-disciplining mode of volition that supports the maintenance of an active goal, whereas self-regulation is the self-integrating mode of volition that supports the task of maintaining

one's action in line with oneself. People typically use both self-regulation and self-control simultaneously by directing their behavior. However, in situations when important goals are not (yet) compatible with, or supported by, intrinsic aspects of the self, self-regulation and self-control can alternate serially. If, for example, the goal to exercise regularly has been introjected (e.g., through doctor's advice; Ryan & Deci, 2000), the person might effectively pursue this goal, as long as it can help reach other self-concordant goals (i.e., maintaining good health).

*Volition and participation in sport and exercise.* Volition is a crucial aspect for a variety of sport and exercise behaviors and is linked to a host of positive adaptive behaviors in life (Tangney et al., 2004) such as weight control, healthy eating, and good psychological or physical health (cf. Buckley et al., 2014; Englert et al., 2020). Researchers on self-control have provided initial evidence that self-control strength may foster exercise adherence to focal goals (Rouse et al., 2013). However, more conclusive evidence is needed, especially in real-life settings (e.g., gym setup) and participants going about their daily lives. In contrast, a growing body of literature based on the theoretical rationale of the strength model of self-control (Baumeister et al., 2007) suggests that training self-control by repeatedly overriding dominant responses/temptations (i.e., practicing) should lead to broad improvements in self-control capabilities or skills over time (cf. Friese et al., 2017), but even these links have not yet been clearly established through longitudinal research under real-life demands, so evidence is scarce. Specifically, what still remains unclear is whether exercise adherence (e.g., gym attendance) can be predicted by individuals' dispositional competencies for self-control (predisposition model) or whether stronger self-control competencies might develop as a consequence of better exercise adherence (socialization model). Recent research has proposed and tested the relationship between volition and participation in sport and exercise based either on the predisposition (Bertrams & Englert, 2013; Englert, 2016; Gillebaart & Adriaanse, 2017; Martin Ginis & Bray, 2010; Toering & Jordet, 2015) or the socialization model (Muraven, 2010; Oaten & Cheng, 2006).

*Predisposition model.* The predisposition model suggests that people with strong volitional competencies are naturally attracted to sport and exercise and more likely to adhere to exercise plans than those with weaker volitional competencies (cf. Kopp et al., 2020). In line with this assumption, Bertrams and Englert (2013) found that sport students high in their dispositional availability of self-control adhered to their individual exercise plans more than those low in self-control. Similarly, Toering and Jordet (2015) investigated the concept of self-control and its relationship with performance sampling professional male soccer players. Their

research revealed that soccer players with strong self-control spent more time in training facilities. More recently, Gillebaart and Adriaanse (2017) highlighted the relevance of self-control in the domain of sport and exercise. The results demonstrated that gym members' self-control correlated with self-reported exercise behavior. Martin Ginis and Bray (2010) recruited university students who claimed to exercise regularly. First, participants completed an exercise program. Then, their self-control was depleted with a laboratory task (Stroop color word task) and then the participants' exercise adherence over a subsequent 8-week period was tested. The magnitude of self-control depletion predicted exercise adherence over the 8-week period; participants who were less vulnerable to depletion (indicative of high self-control) showed higher adherence rates.

*Socialization model.* In contrast to the predisposition model, the socialization model proposes that volitional competencies change over time as a result of (regular) exercise behavior. This approach has been adopted by Oaten and Cheng (2006) who showed that regular participation in physical exercise over a two-month period led to better self-control performance in a demanding visual tracking task. Similarly, Muraven (2010) demonstrated that participants who squeezed a handgrip for as long as possible twice a day over a 2-week period improved in the stop signal task, a self-control task in which participants suppress automatized responses when presented with auditory stop signals, which required participants to overcome physical discomfort and the urge to release. Hence, this task required exerting self-control, resulting in stronger self-control capability over time. Some degree of discomfort and exertion is unavoidable in many types of sport and exercise, which can also be expected for regular participation in many physical exercise programs.

As previously mentioned, the above findings indicated initial connections between volition and exercise adherence in sport and exercise (Hagger, 2014; O'Donnell, 2005). However, although promising, these results are largely restricted to controlled laboratory settings and retrospective exercise behavior merely using single self-reported frequency items (one-dimensional continuous variables) on daily sports activities (cf. Cox et al., 2003; Rhodes et al., 2009). The self reporting, in turn, could also be biased by social desirability (cf. Dyrstad et al., 2014) or open to presentational and consistency biases (Kaushal & Rhodes, 2015). In particular, a variety of (exercise) behavioral patterns might have resulted in the same single number, but not the same relationships with volitional competencies. To shed more light on the relationship between volition and exercise adherence, a reliable assessment of (actual) exercise behavior (e.g., electronic tracking system) is required, as is the reflection of the complex multi-dimensional nature of exercise behavior to identify distinct patterns of exercise participation.

In addition, previous research measured volition only as a global trait (e.g., Brief Self-Control Scale; Tangney et al., 2004) or resource, but a more focused testing of single volitional subcomponents or competencies would be preferable to enable more validated statements and empirical evidence (Kuhl et al., 2006). Moreover, the relationship between volition and exercise participation has not yet been established through longitudinal research (and not verified using a prospective design). Empirical evidence is indeed scarce since few studies have included two measurements (Muraven, 2010; Oaten & Cheng, 2006) that would allow testing both the predisposition and socialization models at the same time. Another gap is the investigation of both models and their bidirectional association in a single study-design to test whether volitional skills are an antecedent to, or consequence of, regular exercise behavior. Since previous research was primarily conducted under controlled conditions in a lab setup, longitudinal research under daily-life conditions is still lacking. The present research follows the assumption of the predisposition and socialization models and addresses how they are related and connected to (actual) exercise adherence (i.e., gym attendance).

## 1.5 Research Potential

As described above, research on motivational (i.e., achievement motives, exercise motivation) and volitional determinants (e.g., self-control, self-regulation, or volitional competencies) on PA reveals certain limitations and research gaps addressed by the present studies.

First, even though recent research has indicated connections between motivational determinants and exercise adherence, the results are not generalizable. This is because they are mainly based on retrospective data and/or methodological constraints, such as operationalization of exercise behavior (Kaushal & Rhodes, 2015). In addition, longitudinal research and approaches to examining the reasons behind initial exercise adoption and exercise adherence are scarce (Miquelon & Castonguay, 2017). Hence, it is still unclear whether and how the achievement motive contributes to or predicts *new* exercise behavior over time (Gröpel et al., 2016). Furthermore, the attempt to capture and therefore measure changes in motivation in PA behavior is still lacking but absolutely necessary to predict PA adherence (Teixeira et al., 2012). Therefore, additional research is needed to examine the relative importance of different types of autonomous or controlled forms of motivation on gym attendance over longer periods of time such as six months (Miquelon & Castonguay, 2017; Rand et al., 2020).

Second, although self-control has been studied within the larger discipline of psychology, questions arise regarding the relationship between volitional competencies and exercise adherence. It is still unclear whether volitional skills are an antecedent to, or consequence of, regular exercise behavior due to the lack of evidence of both predisposition and socialization models (cf. Buckley et al., 2014; Englert et al., 2020; Friese et al., 2017). Previous research mainly involved laboratory settings, employed retrospective study designs, waived objective indicators of exercise adherence, or operationalized exercise participation as a continuous variable using one-dimensional measures like participation frequency (e.g., time per week) to analyze whether the volitional competencies change in response to different patterns of exercise participation. This indicates a lack of studies that investigate the actual relation between volitional competencies and exercise adherence in naturalistic settings; research on self-control within sport and exercise psychology is still in its infancy (Englert et al., 2020). Therefore, knowledge about the actual relation between volitional competencies and exercise adherence is needed to strengthen the transferability of previous findings to the PA field.

## 1.6 Aims of the Present Research

This section presents the central research aims derived from the theoretical outline above. These goals rest upon the critiques and limitations of the existing research and consider the guidelines of the collaborative project.

**Aims of publication 1.** The first scientific contribution aimed at providing a greater understanding of the motivational factors that drive exercise participation. Therefore, the aim of the first publication was twofold. First, the predictive validity of both the implicit and explicit achievement motive and its congruence with gym attendance were evaluated in a sample of new gym members. Whether and/or how the achievement motive facilitates a new exercise behavior over time has not yet been tested. Previous research on achievement motive and exercise behavior is primarily based on retrospective data and therefore limits implications derived from the research on achievement motive and exercise behavior (Gröpel et al., 2016). In addition, only a few longitudinal studies examined the maintenance of PA behavior beyond six months of adoption of this behavior and little research exists with more than two measurement occasions. To narrow these gaps, a longitudinal prospective study (see Figure 8) was designed to cover 30 consecutive weeks including repeated measurements in four waves ( $T_{\text{week1}}$ ,  $T_{\text{week4}}$ ,  $T_{\text{week15}}$ , and  $T_{\text{week30}}$ ) to address the research questions.

The second aim was to capture changes in psychosocial constructs from SDT (i.e., exercise motivation) at different points in time in order to analyze changes in gym attendance. In particular, as the quality of motivation (e.g., autonomous or controlled motivation) may change in response to the exercise program along a continuum—ranging from amotivation to controlled to autonomous motivation—the study aimed to quantitatively test whether the autonomous and controlled forms of motivation proposed by SDT at different measurements (i.e.,  $T_{\text{week4}}$  and  $T_{\text{week15}}$ ) predict exercise behavior. In this way, the current work was intended to help understand the role motivation plays in different phases of PA and its impact on perseverance with exercise. Since estimates of gym attendance are typically restricted to self-reports depending on accurate recall and reporting likely to be biased by social desirability (Dyrstad et al., 2014; Kaushal & Rhodes, 2015), a further goal was to determine how well participants' self-reported gym attendance matched their actual gym visits. To overcome the methodological limitations of previous research, a magnetic card system, as a more direct behavioral measure, was employed to shed light on the relationship between exercise motivation and actual exercise behavior. From a practical perspective, the challenge was to address how to use the knowledge gained in this study to better promote exercise/physical



activity engagement. Therefore, a further goal was to provide suggestions on (a) which form of exercise motivation is most relevant at the start of a new exercise behavior, and (b) which form of exercise motivation should be strengthened during the course of gym membership or while working out in order to maintain that exercise behavior over time.

**Aims of publication 2.** Publication 2 aimed at focusing on volitional (i.e., self-control) traits in relation to PA through a bidirectional lens to determine if these dispositional characteristics of new gym members foster, or are fostered by, gym attendance. So this publication quantitatively investigated the relationship between volitional competencies and long-term gym attendance over 15 consecutive weeks in a sample of new gym patrons by applying two competing models: the predisposition model and the socialization model. Specifically, publication 2 aimed at testing whether volitional competencies predict gym attendance (predisposition model) over time or if these personality traits change as a result of behavior (socialization model). Growing evidence indicates a relationship between volitional competencies and exercise adherence (Hagger, 2014; O'Donnell, 2005); however, these associations have not yet been clearly established through longitudinal research. To overcome these limitations of previous studies, journal paper 2 examined the relationship between exercise participation and volition using the prospective longitudinal design (see Figure 7) and including two measurement occasions ( $T_{\text{week1}}$  and  $T_{\text{week15}}$ ) that allow testing both the predisposition and socialization model at the same time. Moreover, since previous studies measured volition only as a global trait or function, publication 2 further aimed at decomposing volition into several volitional competencies in order to assess individual functions and volitional competencies. In particular, the study intended to explore which volitional competencies promote frequent gym attendance and which are further strengthened by this attendance. Finally, as previous research on exercise behavior and volitional strength drew conclusions on exercise behavior using self-reports, this scientific contribution also makes use of the electronic attendance data as an objective indicator to account for participants' actual gym attendance.

Based on the aims outlined above, Figure 6 shows a structural overview to the research objectives including the underlying theoretical approach outlined in Chapter 1, a summary of the dependent and independent variables utilized for each publication/sub-study, and, most importantly, the (main) statistical procedures employed (see also Chapter 2) to answer the research aims optimally.

Influencing Factors				Independent Variables	Dependant Variables	
				Motivational Variables	Achievement Motive Theory (McClelland, 1987) Self-Determination Theory (Deci & Ryan, 1985)	Journal Paper/ Sub-Study 1
Motivational Variables	Achievement Motive Theory (McClelland, 1987) Self-Determination Theory (Deci & Ryan, 1985)	Journal Paper/ Sub-Study 1	Linear Multilevel (2-Level) Growth Models	Model 2	Equals Model 1	Self-reported Gym Attendance (T <sub>week4</sub> -T <sub>week30</sub> )
				Model 3	Impl. Ach. Motive Expl. Ach. Motive Congruence (Impl. x Expl.) Change scores Exercise Motivation (T <sub>week15</sub> -T <sub>week4</sub> )	Actual Gym Attendance (T <sub>week4</sub> -T <sub>week30</sub> )
				Model 4	Equals Model 3	Self-reported Gym Attendance (T <sub>week4</sub> -T <sub>week30</sub> )
Volitional Competencies	Theory of Volition (Kuhl, 2000)	Journal Paper/ Sub-Study 2	2-Level Growth Model	Predisposition Model	Volitional Competencies (T <sub>week1</sub> )	Actual Gym Attendance (T <sub>week1</sub> -T <sub>week15</sub> )
			NOCLEP 4 X 2 ANOVA	Socialization Model	Actual Gym Attendance (T <sub>week1</sub> -T <sub>week15</sub> )	Volitional Competencies (T <sub>week15</sub> )

**Figure 6.** Structural overview of both journal papers/(sub-)studies including (main) statistical procedures as well as independent and dependent variables for each scientific contribution. Note. Impl.=Implicit Motive; Expl.=Explicit Motive; Ach.=Achievement Motive; x=Interaction between implicit and explicit achievement motive. Exercise Motivation is the general term used for autonomous (i.e., intrinsic motivation, identified regulation), and controlled (i.e., external regulation, introjected regulation) forms of motivation.

## **1.7 Outline of the Present Dissertation**

The remainder of this dissertation is organized into four additional chapters and structured as follows: Chapter 2 provides a detailed overview of the underlying longitudinal study design from which both journal publications emerged. In addition, this chapter builds on a brief overview of the research methods and data analyses employed for each article. Chapter 3 introduces both journal papers including a short summary of each study which highlights the contribution to the extant literature. Next, Chapter 4 discusses the findings beyond the existing limitations of both articles, provides suggestions for future research, and outlines practical recommendations for practitioners, athletes, and gym owners. Finally, Chapter 5 provides a brief conclusion.

## 2 Methods

This section primarily outlines the gym study from which both journal publications emerged. The overarching study design was used as a conceptual framework and common data source for both publications, and it included all measures necessary to address the research questions and scope of each manuscript presented above. Second, since the present gym study was conducted in a quantitative fashion, and different research approaches and mixed methodologies were implemented. Although also addressed in each article, this chapter provides a brief overview of the measures used and main statistical analyses conducted.

### 2.1 Gym Study Design

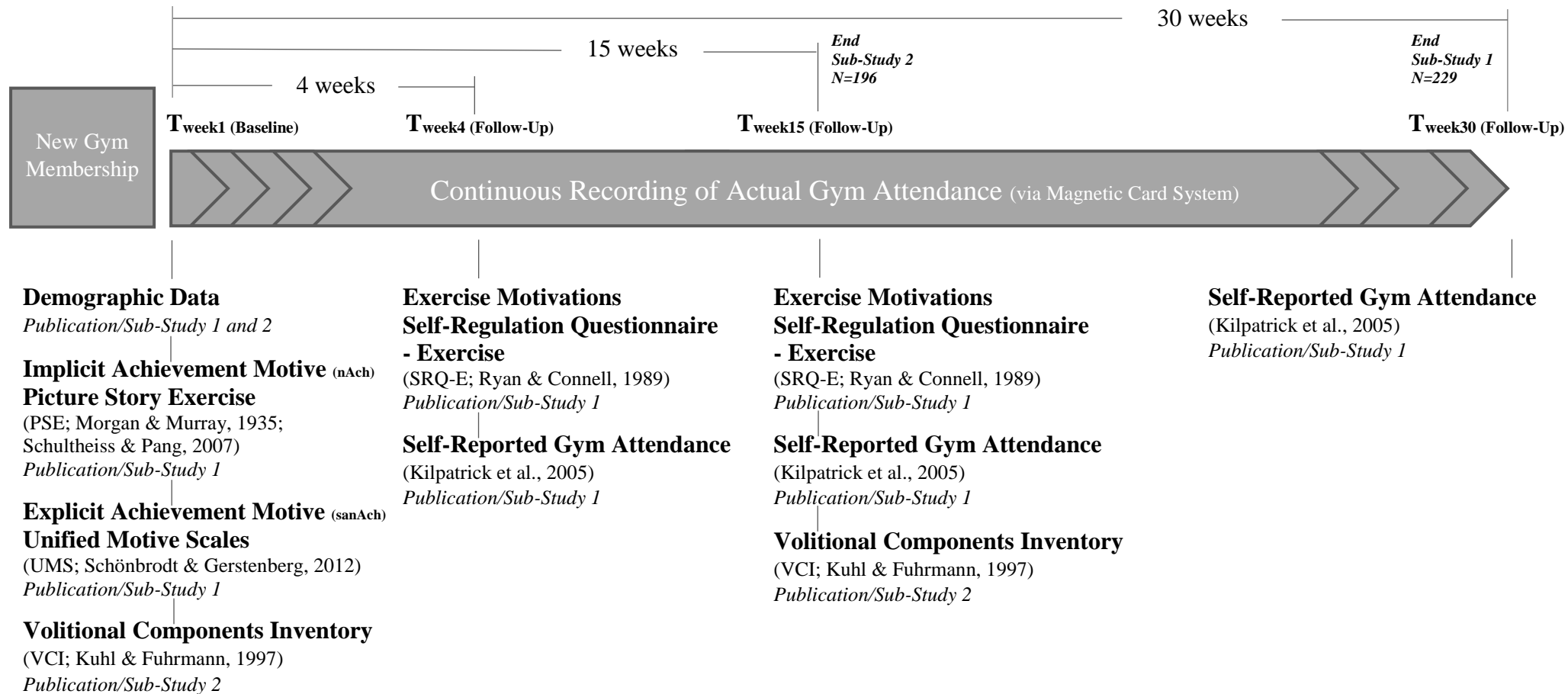
#### 2.1.1 Longitudinal Prospective Study Design

The present study was a longitudinal multicenter study, allowing for the assessment of changes in exercise motivation, volitional skills, and behavior. Therefore, a 30-week prospective study design with four distinct measurement occasions (Time:  $T_{\text{week1}}$ ,  $T_{\text{week4}}$ ,  $T_{\text{week15}}$ , and  $T_{\text{week30}}$ ) under real-life conditions was employed. New gym members were followed over the first 30 weeks of their recently commenced gym membership.

The 30-week period was chosen in line with the systematic review by Teixeira et al. (2012), wherein prospective studies on exercise participation and SDT range from four weeks to one year, with most studies having a posttest either after four or 10-13 weeks. Based on that, the first posttest was set four weeks after the baseline measurement, the second posttest after another 11 weeks, and the follow-up after the sum of the previous weeks (i.e., after 30 weeks).

#### 2.1.2 Online Study

The study was conducted online in order to assure business as usual for both participants and gym owners. Hence, baseline measures providing online questionnaires on socio-demographic and motivational variables were distributed by email in the first week after the start of the gym membership. Follow-up questionnaires were sent out four ( $T_{\text{week4}}$ ), 15 ( $T_{\text{week15}}$ ), and 30 weeks ( $T_{\text{week30}}$ ) thereafter while continuously recording gym attendance (see Figure 7). Applying this approach, gym-internal processes, workflows and workouts were not interfered with and participants could complete the questionnaires from home.



**Figure 7.** Gym study procedure: Sequence of online measurements (i.e., baseline and follow-up) on timeline for common data collection differentiated by measures used for publication 1 and 2. Note. nAch = Need for achievement; sanAch = Self-attributed need for achievement.

## 2.2 Participants

### 2.2.1 New Gym Members

This study focused on new gym members as this sample enables the understanding of initial exercise adoption and exercise adherence at gym. In the following, the characteristics of consented participants used for both publications are presented. During the course of the gym study, a total of 255 individuals were approached to participate in the study. Of them, 229 persons aged 18 to 60 years volunteered to participate and completed the baseline (T1) survey. Table 1 displays socio-demographic baseline characteristics of consenting participants.

**Table 1**

*Socio-demographic baseline characteristics of consenting participants (N=229)*

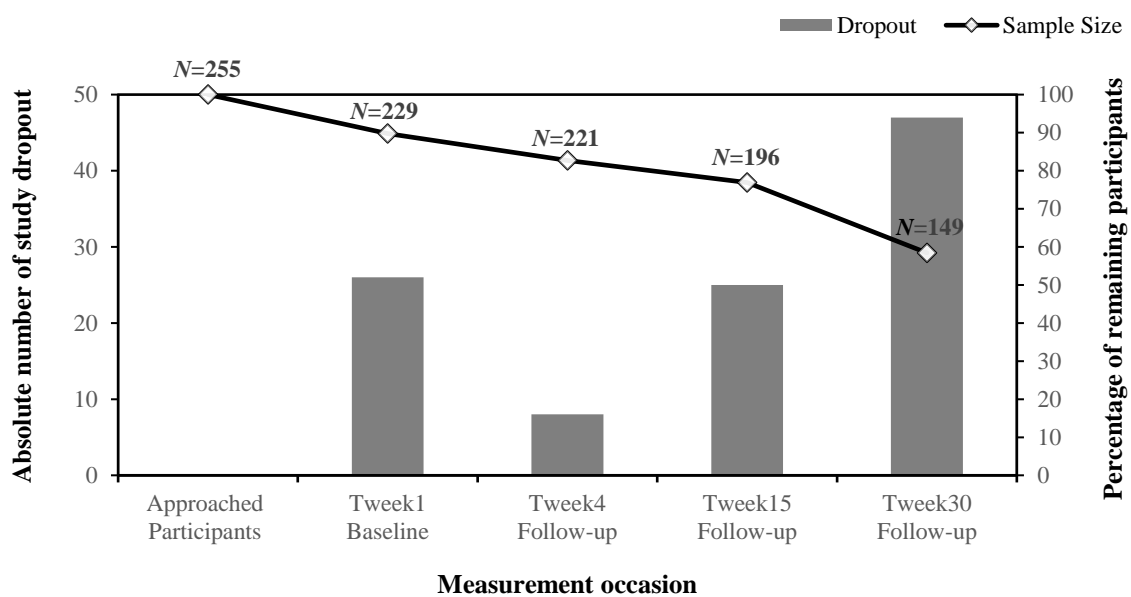
	Female (N=138)	Male (N=91)	Total (N=229)
Age [years; M (SD)]	31.52 (12.06)	33.08 (12.69)	32.14 (12.36)
Employment status [n; (% of group)]			
Employed (Full-time/ Part-time work)	72 (52.17%)	57 (62.64%)	139 (60.69%)
Self-employed	4 (2.89%)	6 (6.59%)	10 (4.36%)
Student	31 (22.46%)	21 (23.08%)	52 (22.71%)
Retired	3 (2.17%)	4 (4.39%)	7 (3.06%)
Currently unemployed	1 (0.72%)	1 (1.09%)	2 (0.87%)
Not reported	17 (12.31%)	2 (2.19%)	19 (8.29%)
Physically active before [n; (% of group)]			
Yes	85 (61.59%)	70 (76.92%)	155 (67.69%)
No	53 (38.41%)	21 (23.08%)	74 (32.31%)
Actual visits/week [hours per week; M (SD)]	1.77 (0.53)	1.99 (0.71)	1.86 (0.62)

*Note.* Actual visits per week are non-filtered and display average attendance over the observation period of 30 weeks.

### 2.2.2 Study Attrition/Dropout

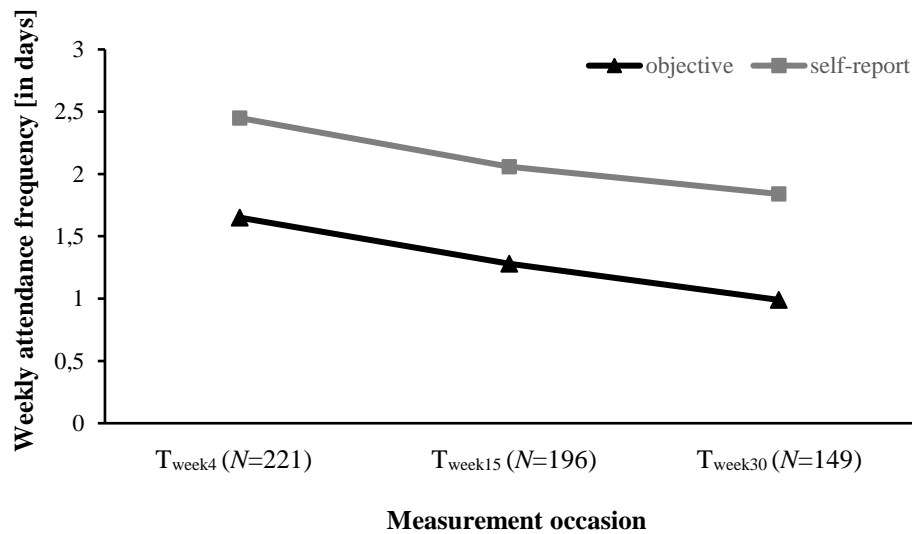
Participants' behavior in the online study varied as some did not choose to continue the survey over all measurement occasions. At follow-ups (T<sub>week4</sub>-T<sub>week30</sub>), the dropout rates due to unwillingness to go through retesting were 8 (T<sub>week4</sub>), 25 (T<sub>week15</sub>), and 47 (T<sub>week30</sub>). The descriptive statistics in Figure 8 shows the dropouts and the remaining sample size over the

course of the online study. In total, 149 participants (87 women, 62 men) went through all four measurements and followed the link to complete the various online surveys. Their age varied between 19 and 55 with a mean age of 27.4 years ( $SD = 7.7$ ). Twenty-five subjects had completed their studies or vocational training and had a job at the time of the study, while 39 of the subjects were students. While publication/study 1 included all four measurement waves ( $T_{\text{week1}}-T_{\text{week30}}$ ) publication/(sub-)study 2 considered only two measurement occasions ( $T_{\text{week1}}$  and  $T_{\text{week15}}$ ). Consequently, publication 1 included 229 participants in the final sample whereas publication 2/(sub-)study 2 included 196 only participants.



**Figure 8.** Dropout and sample size for online study tracked over 30 consecutive weeks (cf. Bernecker & Job, 2011).

*Note.* Because mixed effects models (statistical procedure applied in both journal papers) can be estimated in the presence of partially missing data (Hayes, 2006), all participants (also those who dropped out in later phases) were included in the analyses. Based on study attrition, Figure 9 shows the evolution of both subjective and objective gym attendance during the study period.



**Figure 9.** Evolution of gym attendance. Note. Data not clustered according to distinct patterns of exercise participation.

### 2.3 Featured Gyms and Inclusion Criteria

Data was collected simultaneously from a large network of gyms spread across Germany (e.g., Munich, Berlin, Stuttgart, Cologne, Dusseldorf, and Hamburg). Using contacts provided by the DHfPG, this study focused on 16 gyms with a similar offering, including endurance and resistance exercise training, group-based fitness classes (e.g., aerobic, indoor cycling, Pilates, Zumba<sup>®</sup>, Body Pump<sup>®</sup>, body forming) as well as wellness areas and salons (cf. DIN 33961-1:2015-11; DSSV, 2019; Paoli & Bianco, 2015). Pricing and contract menus were comparable among gyms offering annual memberships with an average cost of 49 EUR (*SD* 5 EUR) per month. A magnetic registration system was required for inclusion in this study to record participants' actual gym attendance during the observation period (Seelig & Fuchs, 2011). The magnetic system was activated when participants swiped a magnetic membership card when entering and leaving the gym. The automatic recording of attendance was saved in a database and used for the analyses.

### 2.4 Recruiting Executive Investigators

Since data were collected on a large network of gyms distributed around Germany, it was not possible for the experimenter to be on-site in every participating gym. Instead, certified gym trainers supported and supervised data collection as executive investigators. Therefore, to



enable data collection at gyms, undergraduate DHfPG students who were in the final stage of their studies were recruited to join the project. They were completing a dual, cooperative study program, including both mandatory attendance periods at the university and a full-time engagement at a gym in addition to the curriculum. Motivational and volitional aspects were curricular components of all Bachelor courses. Moreover, after completing three semesters, the DHfPG-permitted students to provide instructions to the participants on the use of exercise equipment at gyms. Hence, advanced DHfPG students were well-suited to support data collection at gyms employing standardized procedures. Because gyms equipped with an electronic check-in/check-out system were selected, suitable students were also required to work in a gym using an electronic system. The students were also required to complete a Bachelor's thesis as part of the research project. Inclusion criteria also consisted of a willingness to recruit and supervise participants, implementation of (pre-)specified guidelines, and six months of involvement in the study. Suitable undergraduates who consented were directed over the course of the project and during the writing of their Bachelor theses.

## **2.5 Standardisation and Trainer Instructions**

Even though selected DHfPG students had the appropriate education to supervise participants, they were still required to attend a comprehensive briefing prior to the study to help them develop a clear sense of direction early on. This approach standardized testing procedures, data assessment and client treatment among participating gyms to help prevent bias caused by unequally distributed knowledge, so it focused on the preparation for supervision. For this purpose, the experimenter held oral presentations on the study and also visited the gyms. In doing so, it was ensured that trainers were adequately and equally skilled: they had comparable information, background knowledge, and competencies on psychological variables to supervise clients and gather the data in their respective gym.

*Note.* Alongside these instructions, all written information materials, protocol templates, and measures (e.g., rating scales, questionnaires) used in the online study were prepared and provided centrally by the experimenter to ensure standardized testing procedures for each participant across gyms. Trainers were advised that deliberate deviation from the defined specifications would compromise consistency in the treatment of the participants, meaning the affected subjects would have to be excluded from the final analyses. For ease of comprehension, students are now referred to as (gym) trainers. In particular, trainers were instructed as described in the following section.

***Pre-screening target group.*** As a pre-selection criterion, trainers were requested to target individuals who had just signed up as new gym members and entered into a contract for the first time and not to include contract renewals, current members, pregnant women, and individuals who reported potential health problems. Relevant participants were to be recruited when signing the membership contract but before using the gym for the first time.

***Incentivization to attend exercise sessions.*** To assure real-life conditions at a gym, real costs for participation (e.g., membership fee) were mandatory (cf. Wanjek et al., 2016) in order to prevent motivation by financial incentives. However, gyms could provide a free tryout lesson. Moreover, no retention strategies were to be applied by the trainers if gym dropout, hence study dropout, appeared imminent.

***Briefing of volunteers.*** Recruitment information also indicated that prior to study commencement, each participant was to be advised on the study procedures and an appropriate gym workout. This included scheduling a mandatory pre-study workout session, fitness tests, and a guided tour (see below for more information) to familiarize each participant with the respective gym (e.g., gym policies, training options) and an introduction to the questionnaires they would fill in at home at certain points during the 30-week period. It was particularly important that participants were familiarized with the “Picture Story Exercise” (see Methods, publication 1) process, as this measure required them to write down short imaginative stories in response to a set of picture cues they were presented with. The rationale given was that people often write about something unrelated to the pictures, write stories that are unusable or omit stories altogether which would complicate the evaluation process (cf. Bernecker & Job, 2011; Smith et al., 1992). In addition, participants were to be informed that they had to create an individual code when entering the online study for the first time and to also use this code for all future log-ins. Otherwise, the system would disallow further participation. Even though an introduction to the online-surveys was necessary, students were advised to avoid discussing the actual aim of the study and to provide a different rationale for the study. As the aim was to compare both self-reported and actual visits to the gym, trainers were requested to not inform participants that their actual gym attendance was being recorded using the check-in/out systems. Moreover, they were asked not to give any indication that could have suggested a comparison of individual (i.e., self-reported) with actual gym attendance. Trainers were merely permitted to tell participants they should use their magnetic card when entering and leaving the gym without any reference to a research question. Finally, trainers were asked to instruct participants to respond to all questions honestly.

**Debriefing form.** As participants were unaware that their actual gym attendance was recorded as part of the study, they were debriefed at the end of the study, providing an opportunity for them to withdraw the initial consent to analyze their data. Hence, trainers provided a mandatory debriefing form on whether or not the participants would like to have their data included in this study. Employing this approach offered an opportunity to withdraw data as well as to legally secure using and processing this (attendance) data in accordance with TUM regulations.

**Reminders.** In order to minimize attrition (cf. Graham, 2009) and guarantee compliance with the study procedures, trainers were required to follow up with participants occasionally through email, telephone or in person to obtain the follow-up questionnaires on time. The experimenter accepted a waiting period of one week because the online questionnaires were also delivered over holidays, a period of time in which participants were temporarily unavailable. Participants were also asked not to work on questionnaires from different observation periods (e.g.,  $T_{\text{week1}}$ ,  $T_{\text{week4}}$ ,  $T_{\text{week15}}$ ,  $T_{\text{week30}}$ ) at the same time.

**Registering objective gym attendance data.** As the study made use of administrative attendance data, trainers had to collect a complete record on actual gym attendance for each participant over the respective observation period obtained by the magnetic registration system. This was possible as all participants were required to register at their gym using their magnetic cards. The valid membership records were then transmitted to a separate data file and provided to the experimenter after study completion.

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## 2.6 Measures and Data Analysis

The prospective longitudinal gym study was conducted in a quantitative fashion. Since this dissertation is based on two journal publications, different research approaches and a mixed methodology were implemented to address the research questions and scopes of each publication/(sub-)study. However, all measures employed (i.e., questionnaires, items, and scales) and data analyses of each (sub-)study are thoroughly described in the journal papers (see Chapter 3). Therefore, this section merely provides a brief overview of these approaches.

Since the Picture Story Exercise (PSE; Schultheiss & Pang, 2007) was only briefly mentioned in journal paper 1, Section 2.6.1 also aims at providing further insight into this psychological measure.

### 2.6.1 Publication 1

The first publication was conducted in a quantitative fashion to evaluate the predictive validity of the achievement motive (implicit, explicit, and its congruence) and exercise motivation on (self-reported and actual) gym attendance.

To assess the *implicit* achievement motive ( $T_{\text{week1}}$ ), the computer-based version of the Picture Story Exercise (PSE; Schultheiss & Pang, 2007) was employed. Since this measure is only briefly outlined in journal paper 1, a more detailed description is provided in the following. As implicit motives are largely inaccessible to self-report (Sokolowski et al., 2000; Winter, 1994), the use of a projective measure was required. Therefore, to assess the implicit need for achievement ( $n\text{Ach}$ ) at  $T_{\text{week1}}$ , participants filled in the Picture Story Exercise (PSE; Schultheiss & Pang, 2007), a projective and standard story-writing exercise with roots in the Thematic Apperception Test (TAT; Morgan, 1935). In particular, using the PSE also enabled the assessment of the implicit power  $n\text{Pow}$  and affiliation motive  $n\text{Aff}$ . Since implicit motives are aroused by, and therefore sensitive to, incentives in the surrounding environment, a standardized and neutral testing situation outside the gym was required to assess implicit motives accurately (Klinger, 1968; Schultheiss & Pang, 2007; Smith, 1992). Therefore, Pang and Schultheiss's (2005) computer-based version was used to enable processing from home prior to the first workout session. To fire their imagination, participants were shown a randomized set of picture cues (photographs), typically depicting multiple actors in ambiguous interpersonal situations (Pang, 2010). Participants were instructed to write stories in response to the set of picture cues according to the German standard instructions adapted from Langens

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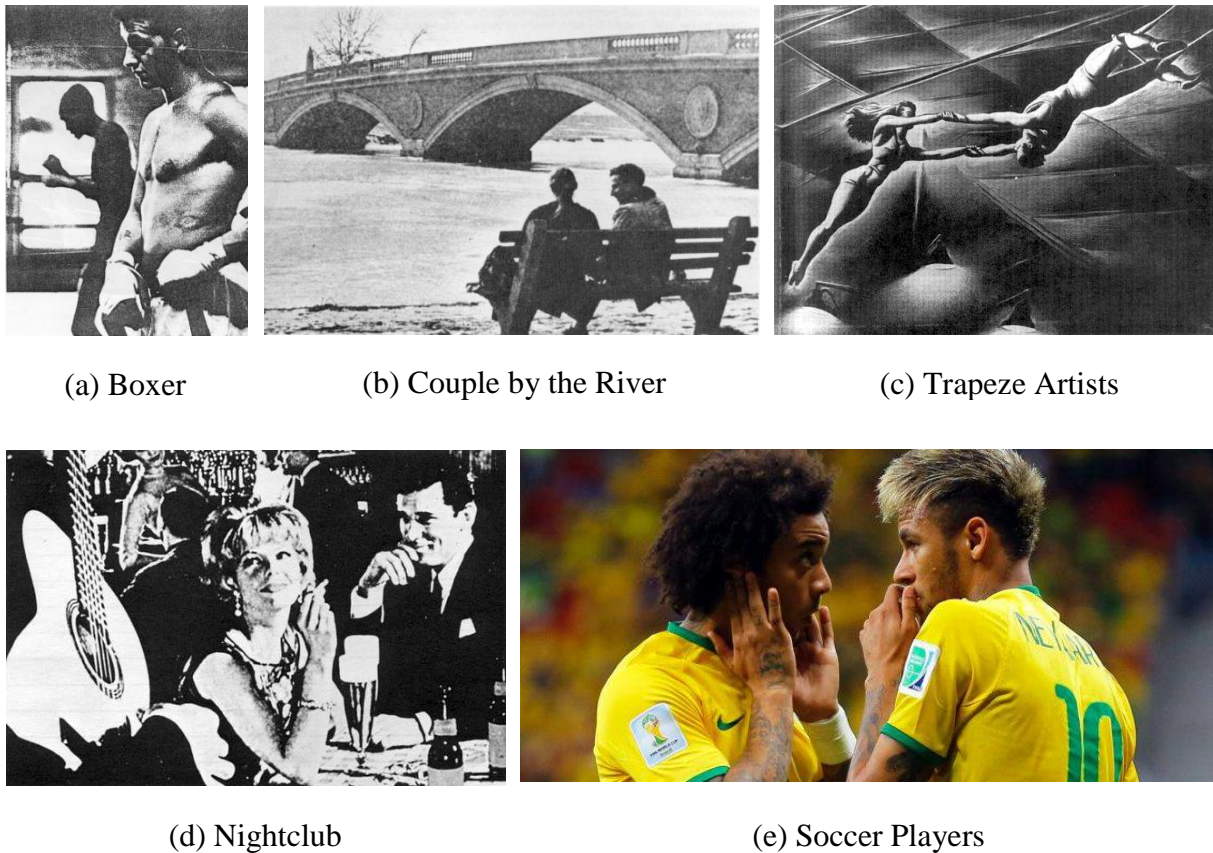
and Schüler (2003). They viewed each picture for 10s in advance and then had five minutes to write a story about that picture in a text box on the computer following four reminders (standard instructions) about what to include in the story. Reminders were conveyed as suggestions, not as commands and included cues as follows (cf. Bernecker & Job, 2011):

- 1) “What is happening?”, “Who are the people?”
- 2) “What happened before?”, “What has led up to this situation?”
- 3) “What do they want?”
- 4) “What will happen next?”

Once participants started writing texts, they were not allowed to view the picture again. Participants could paste long stories into the survey as the text field was not limited, and they were allowed to move on to the next picture whenever they were ready. Otherwise, the program automatically turned to the next picture after the expiry of five minutes. The PSE took a maximum of 25 minutes for each participant. Table 3 shows some exemplary sentences from the dataset available (note that grammatical errors are from the original texts provided by study participants and were not corrected).

**Choice of picture cues.** The selection of picture cues is generally based on the principle that the presentation of evocative images triggers motive-relevant emotions and cognitions among the participants. In a multi-motive picture set, scientists recommend that PSE should include at least five pictures in a study aiming at the measurement of several motives at once. This approach is necessary in order to prevent less valid scores for later stories due to participants’ fatigue, to motivate them to cooperate in producing stories as well as to guarantee variance of scores (Brunstein et al., 1998; Grant & Langan-Fox, 2006; Schultheiss & Brunstein, 2001). Hence, the 5-picture set consisted of four classic images, such as *Boxer*, *Couple by the River*, *Nightclub*, *Trapeze Artists*, and a novel image (*Soccer Players*) showing two football players in discussion (see Figure 10). With the exception of the last picture, all were taken from Smith (1992) and have been frequently used. *Soccer Players* was added to the picture set according to the guidelines introduced by Pang (2010a). The picture selection was intended to increase the sensitivity for all motive domains (achievement, affiliation, and power) especially in sport situations (Pang, 2010a) and therefore were supposed to be motivationally relevant in the context of interest – in this case, gym exercising (cf. Pang, 2010). Three pictures (*Boxer*, *Soccer Players*, and *Trapeze Artists*) depict people in athletic or exercise surroundings. Consequently, they qualified as high-pull pictures (Figure 11) for the measurement of

*n*Achievement, as this was the motive mainly focused on in the gym context, as well as for *n*Power. *Couple by the River* and *Nightclub* were picture cues intended to inspire *n*Affiliation.



**Figure 10.** Picture cues used in the PSE for arousal of *n*Achievement, *n*Affiliation, and *n*Power: Note. Pictures (a), (b), (c), and (d) were first introduced by McClelland and Steele (1972). Reprinted from “*Motivation and Personality: Handbook of Thematic Content Analysis*”, by Smith (Ed.), 1992, New York, NY: Cambridge University Press, p. 637. Pictures are not individually copyrighted and thus have an open license. Picture (e) was obtained from private collection according to the guidelines introduced by Pang (2010). All rights reserved. The picture is available at URL: <https://osf.io/ay9ns/>

**Analyzing PSE.** To derive motive scores from the stories, the PSE protocols were later content coded for motive-specific content using Winter's (1994) *Manual for Scoring Motive Imagery in Running Text*, a coding system widely used on implicit motives and repeatedly demonstrated to be applicable (Schultheiss & Pang, 2007). The manual defines rules for when to code a motive image for each category (Affiliation, achievement, and power). According to the manual, four to six content categories are defined for each motive (see Table 2). For example, *n*Achievement (*n*Ach) was coded for story content expressing concern for a standard of excellence for achievement (e.g., unique accomplishment or doing task well), power (e.g.,

impressing others), and affiliation (e.g., dialog or expression of friendly feelings towards others) imagery.

**Table 2**

*Categories of coding motive imagery (Winter, 1994). Adapted from Schönbrodt et al. (2020)*

Motive	Categories
<b>Affiliation/Intimacy</b>	aff1: Positive, friendly, or intimate feelings towards others
	aff2: Negative feeling about separation
	aff3: Affiliative, companionate activities
	aff4: Friendly nurturant acts
<b>Achievement</b>	ach1: Adjectives that positively evaluate performance/outcomes
	ach2: Descriptions of performances/goals that suggest positive evaluation
	ach3: Winning or competing with others
	ach4: Negative feelings about failure, doing badly, lack of consequence
	ach5: Unique accomplishment
<b>Power</b>	pow1: Strong, forceful actions which inherently have an impact on other people
	pow2: Control or regulation
	pow3: Attempts to convince, persuade, influence, argue, make a point, etc.
	pow4: Giving help, support, or advice that is not explicitly solicited
	pow5: Impressing others, concern about fame, prestige, reputation
	pow6: Strong emotional reactions in one person to intentional actions of another person

*Note.* aff=affiliation; ach=achievement; pow=power

In addition to some exemplary sentences from the dataset, Table 3 shows how sentences were coded.

**Table 3***Exemplary story (divided in sentences) and its codes for the “Boxer” motive imagery*

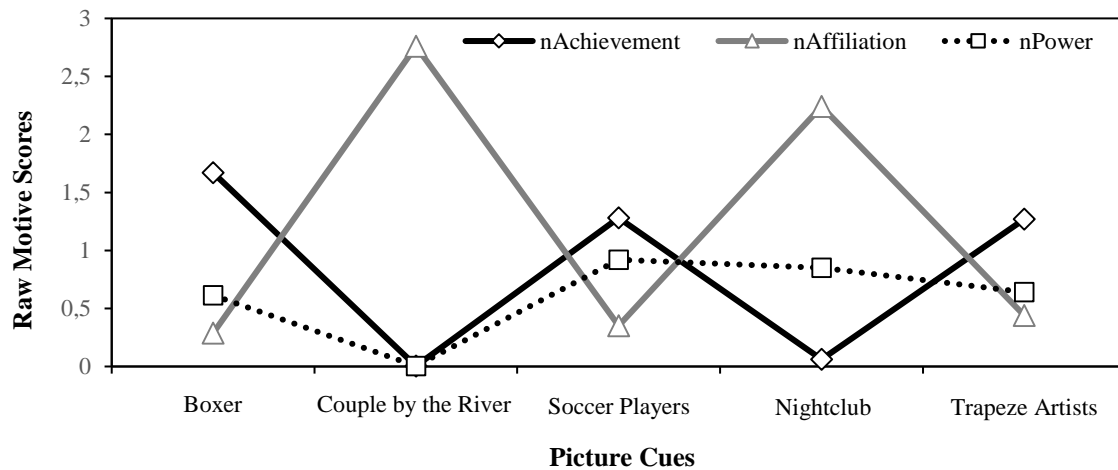
Text (original)	Text (translation)	aff	ach	pow	motclassfull
Holger, angehender Profi	Holger, budding	0	1	0	ach
Boxer, trainiert für seinen ersten Profikampf.	professional boxer, training for his first professional fight.				
Er ist in sich bedrückt, da er mit seinem Trainingslevel unzufrieden ist und er permanent an seinen Gegner denkt.	He is depressed, because he is dissatisfied with his training level and he is constantly thinking of his opponent.	0	1	0	ach
Der Kampf ist in zwei Wochen er trainiert härter in dieser Zeit.	The fight is in two weeks he trains harder in this time.	0	1	0	ach
Er verliert trotzdem.	He still loses.	0	0	0	null

*Note.* Grammatical errors are from the original texts provided by study participants and were not corrected.

The coding unit for all stories is the sentence. The coding convention prescribes that a motive of a certain category cannot be coded in two consecutive sentences; however, omitting codings in such a way likely leads to a loss of relevant diagnostic information. Hence, in deviation from Winter (1994), the “second sentence-rule”-convention was not applied, and every sentence was scored independently regardless of the previous sentence (Schönbrodt et al., 2020). A trained coder (provided by the Ludwig Maximilian University of Munich), who had previously exceeded 85% ( $ICC(2,1) > .85$ ) of inter-scorer agreement on German expert-scored calibration materials in the Winter (1994) Manual, coded all PSEs. The coder had thoroughly mastered the scoring system and had extensive experience ( $>> 1000$  stories coded) in using the system in addition to the training materials completed in advance (Smith et al., 1992). Using similar picture cues as trained by the coder and following the recommendations of Schultheiss and Pang (2007), it was sufficient to have only one coder scoring all PSE stories. This procedure of employing only one trained coder is in line with previous research (Schönbrodt et al., 2020; Schultheiss & Pang, 2007; Roch et al., 2017). As recommended by previous research, PSE stories for one cue were scored before going on to those for another cue (Schultheiss & Pang, 2007). In addition, stories were randomized for each participant. This



procedure was necessary to score each story independently of the others to avoid remembering subjects' scores on other stories to reduce the *Halo* effect. Moreover, the coder was blind to participants' scores on other measures as well as the study context. Figure 11 shows motive profiles for the individual picture cues implemented in the online study for raw motive scores based on participants who completed  $T_{week1}$  ( $N=229$ ). Raw motive score data are presented as means.



**Figure 11.** Picture profiles for raw motive scores (cf. Bernecker & Job, 2011). Note. Motive profiles for Boxer, Soccer Players, and Trapeze Artists show the highest “pull” for the implicit *nAchievement*, the respective motive this reasearch focused on in the gym context. Motive profiles developed as expected by the picture cues.

In addition, Table 4 provides description of the PSE measurements at  $T_{week1}$  (Busch & Hofer, 2012).

**Table 4**

*Descriptive statistics for motive scores and word count based on  $N=229$*

Achievement		<i>nAffiliation</i>		<i>nPower</i>		Word count	
<i>M (SD)</i>	<i>range</i>	<i>M (SD)</i>	<i>range</i>	<i>M (SD)</i>	<i>range</i>	<i>M (SD)</i>	<i>range</i>
4.25 (2.33)	0-11	6.01 (3.16)	0-18	3.27 (2.77)	0-15	330.63 (122.96)	110-818

Note. M=Mean; SD=Standard Deviation; n=need for.

As commonly found in implicit motive research, PSE protocol lengths ( $M = 331, SD = 123$ ) significantly correlated with participants' overall scores for *nPow* ( $r = .48$ ), *nAch* ( $r = .37$ ), and

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$n_{\text{Aff}}$  ( $r = .64$ ), all  $ps < .001$ . Raw motive scores were corrected for story/protocol length by using regression analysis (Smith et al., 1992; Winter, 1989).

The *explicit* achievement motive ( $T_{\text{week1}}$ ) was measured using the Unified Motive Scales (UMS; Schönbrodt & Gerstenberg, 2012) motives. *Autonomous and controlled forms of motivation* proposed by SDT ( $T_{\text{week4}}$  and  $T_{\text{week15}}$ ) were measured with the Exercise Self-Regulation Questionnaire (SRQ-E; Ryan & Connell, 1989; Thomas & Müller, 2016). All questionnaires are commonly used measures to test AMT and SDT in the exercise context (cf. Gröpel et al., 2016, Kehr, 2004a; Teixeira et al., 2012). Self-reported gym attendance ( $T_{\text{week1}}$ ,  $T_{\text{week4}}$ ,  $T_{\text{week15}}$ , and  $T_{\text{week30}}$ ), was measured using a single frequency item, “Please indicate how many days per week you have worked out at the gym since the last survey” (Kilpatrick et al., 2005). Actual gym attendance was measured electronically with a magnetic card for the check-in system implemented in each participating gym (Jekauc et al., 2015; Rand et al., 2020).

**Data analysis.** Paired t-tests were used to assess differences between actual and self-reported gym attendance. Due to the hierarchical (i.e., nested) structure of the gym data, linear multilevel growth models (i.e., mixed effects growth models) (Level 2 = participants; Level 1 = measurement occasions) were used as the main analysis method to test the hypotheses. Growth modeling is increasingly seen as the method of choice for the analysis of data from longitudinal or repeated measures designs, as it has all of the advantages of multilevel analysis while overcoming many of the shortcomings of repeated measures ANOVA. For instance, there is no requirement that measurement begins and ends at the same time for every individual in the study, the measurement periods do not have to be equally spaced, the number of measurements can vary between individuals (and thus participants need not be dropped because of missing data), and models of change can be estimated that do not presume that change is linear over time (Field, 2013; Hayes, 2006). Consequently, to test the predictive effect of motivational variables on gym attendance, four separate conditional growth models (two for self-reported gym attendance as dependent variable and the other two for actual gym attendance) were computed, in which (a) the implicit and explicit achievement motives (and their interaction) and the SRQ-E constructs at  $T_{\text{week4}}$  are included as predictors, and (b) the implicit and explicit achievement motives (and their congruence) as well as change scores of the SRQ-E construct are included as predictors (see also Figure 6). The change scores are used as additional predictors reflecting the evolution of autonomous and controlled forms of motivation from  $T_{\text{week4}}$  to  $T_{\text{week15}}$ , as the quality of exercise motivation is likely to change in response to an exercise program (Ryan & Deci, 2000). This approach enabled the gathering of

information on which form of exercise motivation is most relevant at the start of a new behavior, and which form of exercise motivation should be strengthened in the course of action in order to maintain that behavior over time. To explain the different pattern of relationships between the SRQ-E constructs and gym attendance that emerged at  $T_{\text{week4}}$  and  $T_{\text{week15}}$  that could not be explained by sample mean-level changes, an exploratory cluster analysis as an additional analysis method was conducted. The main advantage of change scores is that extraneous error variance from individual variations in trait is reduced. As reported by Zumbo (1999), a series of research projects have demonstrated that the inclusion of behavioral regulations as change/difference scores is an acceptable index of change.

Indeed, cluster analysis has been previously used to identify sport participants with different motivation profiles within the SDT framework (Ullrich-French & Cox, 2009; Vlachopoulos et al., 2000). In particular, some of the identified motivation profiles have been found more adaptive for exercise behavior than others. Thus, the cluster analysis approach was helpful in explaining the different pattern of relationships (i.e., individual level changes).

### **2.6.2 Publication 2**

The second publication was conducted in a quantitative fashion to analyse the (bidirectional) associations between volitional competencies and gym attendance. To assess volitional competencies ( $T_{\text{week1}}$  and  $T_{\text{week15}}$ ), the Volitional Components Inventory (VCI; Kuhl & Fuhrmann, 1998) was applied. This questionnaire is frequently used and a common measure in self-control research (e.g., Kehr, 2004a). Actual gym attendance was recorded electronically using the magnetic check-in/out system implemented in each participating gym (Jekauc et al., 2015).

**Data analysis.** The database of the longitudinal gym study was analysed for a reduced 15-week period ( $T_{\text{week1}}$  -  $T_{\text{week15}}$ ). Again, multi-level growth modelling was employed as the main statistical procedure. The growth modelling approach was built on the assumption that (1) the data was clustered hierarchically and (2) variables change over time. In this study, some variables were nested within other variables, such as observation period (e.g., weeks 1 to 15) for participants. An unstructured covariance structure was used. This type of variance fits all variances and covariances between random effects (and thus results in the best possible model fit) and represents a common choice for models with random intercepts and slopes (Heck et al. 2013). Autoregressive (AR1) and autoregressive heterogeneous (ARH1) variance types, which

are often assumed in time course data when measurements are taken over a period of time, such as in growth models, resulted in worsened model fit or yielded very similar results to the unstructured type of variance. This structure implies that covariances are assumed to be completely unpredictable and, therefore do not conform to a systematic pattern (Field, 2013).

***Predisposition model.*** In order to accurately test the predisposition model, the initial volitional competencies ( $T_{\text{week1}}$ ) were used to predict changes in gym attendance and, more importantly, stability or adherence. To analyse the data, two-level growth models (Level 2 = participants, Level 1 = weeks) were conducted to test the predictive effect of volitional competencies on gym attendance over the observation period of 15 weeks. In addition, two-level growth models (Level 2 = participants, Level 1 = weeks 1 to 15) were computed to test whether gym attendance changed over time.

***Socialization model.*** To test whether the volitional competencies changed in response to different patterns of exercise participation, the Normative Classification of Exercise Participation system (NOCLEP; Seelig & Fuchs, 2011) was applied to cluster participants into four participation patterns (i.e., maintenance, fluctuation, late dropout, and early dropout). Then, a  $4 \times 2$  (Group  $\times$  Phase) repeated measures ANOVA for each volitional competence was conducted to examine whether (initial) volitional competencies changed (from  $T_{\text{week1}}$  to  $T_{\text{week15}}$ ) in response to these patterns of exercise participation. NOCLEP-clusters were defined as follows: The maintenance group (called *maintainers*) encompasses participants that exercise almost every week during the observation period. Fluctuation participants (called *fluctuators*) maintain their participation until study end, however on an irregular basis. *Late dropouts* show similar attendance patterns as the fluctuators; however weekly gym attendance decreases to a large extent in the final stages of the observation period. *Early dropouts* show a steady decline in engagement and then remain at the lowest level.

***Rationale of NOCLEP (justification of usage).*** Since the longitudinal study recorded participants' gym attendance electronically for 15 consecutive weeks ( $T_{\text{week1}} - T_{\text{week15}}$ ), only a one-dimensional continuous variable (e.g., single number of attendance frequency) was available, representing all of the gym attendance averaged over the weeks. However, projecting exercise participation (i.e., gym attendance) onto only one dimension could not adequately reflect the complex multi-dimensional nature of involvement and would not provide any information regarding people's ability to adhere to a gym schedule. In particular, a variety of behavioral patterns might have resulted in the same single number, but not the same relationships with volitional competencies. Since participants were new gym members,

presumably some had made new resolutions to exercise. It was expected that the gym attendance data would display multiple growth curves; for example, some participants could have started out attending frequently and maintained that rate while others may have started off with frequent visits only to decrease their attendance at varying rates. Others still might have started out with low to moderate attendance, later increasing, decreasing, staying stable, and so forth. Thus, to better test the socialization model under investigation, analyzing these latent growth curves and how the time-varying self-regulation covariates related to the curves was the most optimal method. Consequently, a categorical conceptualization of gym attendance using both attendance frequency (e.g., weekly attendance frequency) and temporal distribution of gym attendance were considered to identify discrete gym attendance patterns using the NOCLEP (cf. Seelig & Fuchs, 2011).

## **2.7 Common Data Collection - General Procedure**

The gym study included a longitudinal component consisting of four measurements for each participant over a 30-week period beginning with his or her respective date of gym enrollment. The inclusion of eligible participants with new contracts ran from August 2016 to September 2017. During this period, participants completed baseline and follow-up questionnaire packages on socio-demographic and motivational variables and also exercised at a gym. After the end of the study, participants attended a post-study session and were debriefed. Baseline and follow-up measurements ran an entire year to avoid seasonal effects (O'Connell et al., 2014; Rich et al., 2012) as some months (e.g., January) are busier than others (e.g., July) (cf. Garon et al., 2015). Accordingly, measurement occasions varied for each participant due to temporally distinct gym registration. A general overview of the procedure prior to study start and each measurement during the actual study period is described below (see also Figure 12).

***Briefing of executive investigators (DHfPG-students).*** Prior to the start of the study, gym trainers (DHfPG students) as executive investigators were briefed by the experimenter on the guidelines above to standardize study procedures and supervision for all gym patrons.

***Recruiting of participants.*** Once the criteria were defined, individuals who had just signed a new contract were approached by a gym trainer (DHfPG-student) directly at the check-in counters or salons, were informed of the online study (e.g., purpose, duration), and were asked if they were willing to take part in a research project.

***Incentivation.*** As participants were to develop their own motivations to exercise and not be prompted to maintain an exercise program, they were not compensated for study engagement in order to prevent motivation by incentives. The only exception was the typical “tryout lesson” (Body Life, 2007, 2008, 2010) offered by each participating gym prior to membership.

***Volunteer information on the research project.*** Those who expressed willingness to participate were then orally briefed in more detail on the study procedures and were provided instructions and written subscriber information (handout) outlining the study procedures and requirements during the 30-week period. Participants were informed that their data would be treated confidentially in accordance with the General Data Protection Regulation (2016/679) of the European Parliament and the Council of 27 April 2016 and its Corrigendum of 23 May 2018. They were also informed that the study would not involve any invasive or potentially dangerous methods and therefore, in accordance with the German Research Foundation and the guidelines of the Technical University of Munich, did not require formal ethical approval. Finally, participants were reminded that their participation was voluntary, and they were assured they had the right to withdraw from participation at any time without consequences.

***Ethics statement and written informed consent.*** Those who then agreed to participate provided written informed consent in accordance with the Declaration of Helsinki (“World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects,” 2013).

***Pre-study workout session (instructions and introduction).*** Prior to the first individual workout, participants were scheduled to attend a pre-study workout session run by a trainer (cf. (Body Life, 2007, 2008, 2010; DIN 33961-1:2015-11)). At this workout, participants were provided with a tour of the gym, which typically took about 30-45 minutes, depending on the size of the gym and the knowledge and ability level of the participant. The tour included instructions on facility policies, safety, and demonstrations on the use of gym equipment such as cardiovascular machines (e.g., rowers, treadmills, ergometers, and cross trainers), strength training machines, and free weights. As participants were fairly inactive at the onset of the study, the guidance also included an initial interview and anamnesis, in which they were asked about past experience in sports and exercise to assess individual health risks. Trainers then performed fitness tests and prepared individualized exercise plans (including weight loading parameters) according to the individual exercise motives. This approach ensured that participants would be physically able to manage their workouts (e.g., intensity and quantity of PA), to handle fitness machines (e.g., proper execution of exercises), and for safety (e.g.,

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guarantee of a sufficient level of fitness and avoidance of overloading in weightlifting) (cf. DIN 33961-1:2015-11). To control for proper execution of exercises, participants were encouraged to try the machines during the gym tour, especially those that were on their individualized exercise plans. Since training evaluations, such as progression or success in workout, have to be done at least after three months of workout, participants were able to adapt their training plans and exercises according to the instructions given by the trainers at regular intervals (cf. DIN 33961-1:2015-11). Trainers were allowed to create individualized diet plans to meet individual needs if requested. Upon receiving the instructions and after the pre-study workout session, participants were able to perform body-weight exercises, weightlifting, and cardiovascular exercises safely without supervision and exercised on their own for the remainder of the study. However, a trainer was always present during workouts to answer any questions (cf. Boyd, 2013). Each pre-study workout was scheduled at mutually convenient times. Subsequent individual workout sessions were performed at each gym between 6:00 and 22:00 Monday to Sunday.

***Data on workout sessions during study period and gym attendance.*** Between measurement occasions ( $T_{\text{week1}}-T_{\text{week30}}$ ), participants followed their usual workout routines and used the services offered by their respective gym without interference. Every time they entered or left the gym, participants registered via their magnetic customer cards. Although participants were obliged to use their membership cards, they were unaware that this procedure was directly associated with recording their actual gym attendance. Therefore, participants received a mandatory debriefing form at the end of the study (see below) in order to make a decision on whether or not they would like to have their data included in the study. Attendance data authorized for use was later transferred to a separate file and provided to the experimenter for further analyses.

***Online data collection.*** The study and online data collection covering four measurement occasions ( $T_{\text{week1}}-T_{\text{week30}}$ ) began with the individual pre-study workout session. Participants were scheduled to fill in baseline measures within several days of attending the pre-study workout (see below) but prior to the first individual workout session. As a computerized survey was employed that participants had to take part in, rating scales and all questionnaires administered at each measurement occasion were provided online (i.e., with a link to a website) to ensure that workout sessions were uninterrupted. Each time participants accessed the survey, they logged in with a unique code and then completed the questionnaires. The coding enabled the merging of the dataset for each participant with all measurement occasions. The time required to fill out the questionnaires for each measurement occasion varied.  $T_{\text{week1}}$  required

roughly 40 minutes,  $T_{\text{week4}}$  took approximately 10 minutes,  $T_{\text{week15}}$  25 minutes, and  $T_{\text{week30}}$  could be conducted in about two minutes. A brief description of all measures administered at each point in time is presented below, followed by a more detailed description including the psychometric properties in the methods section.

**Baseline measures.** In the first week ( $T_{\text{week1}}$ ) after taking out the gym membership but prior to the first regular workout, trainers sent baseline measures to the participants who then filled them out. They were requested to complete a questionnaire package at home assessing baseline status, which included socio-demographic variables (e.g., age, gender, occupation, and previous experience in sports and exercise), as well as measures (described below) on motivational variables such as the implicit achievement motive (PSE; Schultheiss and Pang, 2005) and the explicit achievement motive (UMS; Schönbrodt & Gerstenberg, 2012). In addition, the Volitional Components Inventory (VCI; Kuhl & Fuhrmann, 1998) was administered at this session to determine volitional competencies (e.g., self-control, self-regulation, goal-enactment, and self-access) at an early stage of gym attendance. At the end, participants were provided with the availability (e.g., the date of the next survey) of their next questionnaire (follow-up). *Note.* To reduce study drop-out, the questionnaires were ordered according to a warm-up technique proposed by previous research (cf. Musch & Klauer, 2002; Bernecker & Job, 2011). Main measures, such as the PSE, UMS, and VCI were placed several pages into the survey. Consequently, participants had already answered questions on socio-demographic information before filling in more demanding questions.

**Reminders.** To make sure that participants completed the surveys in a timely manner, trainers provided separate reminders occasionally via email, telephone, or in person informing them that a new online survey would be available soon. A waiting period of one week was accepted because online questionnaires were also provided over holidays, a period of time in which participants are temporarily unavailable. In addition, participants were informed not to work on temporally separate questionnaires at the same time. Participants received reminders for all future measurements ( $T_{\text{week4}}$ ;  $T_{\text{week15}}$ ;  $T_{\text{week30}}$ ).

**Week four ( $T_{\text{week4}}$ ) and week 15 ( $T_{\text{week15}}$ ) follow-up.** In order to assess maintenance or changes in exercise motivation and exercise behavior after weeks four ( $T_{\text{week4}}$ ) and 15 ( $T_{\text{week15}}$ ) of gym exercise, participants were requested to fill in follow-up questionnaire packages. Every time, participants completed a questionnaire measuring exercise motivation (intrinsic, identified, introjected, and extrinsic motivation) proposed by SDT (SRQ-E; Ryan & Connell, 1989). They also indicated a single frequency item (exercise frequency) measuring the mean number of days per week in which they had visited the gym since their last survey at  $T_{\text{week1}}$  or

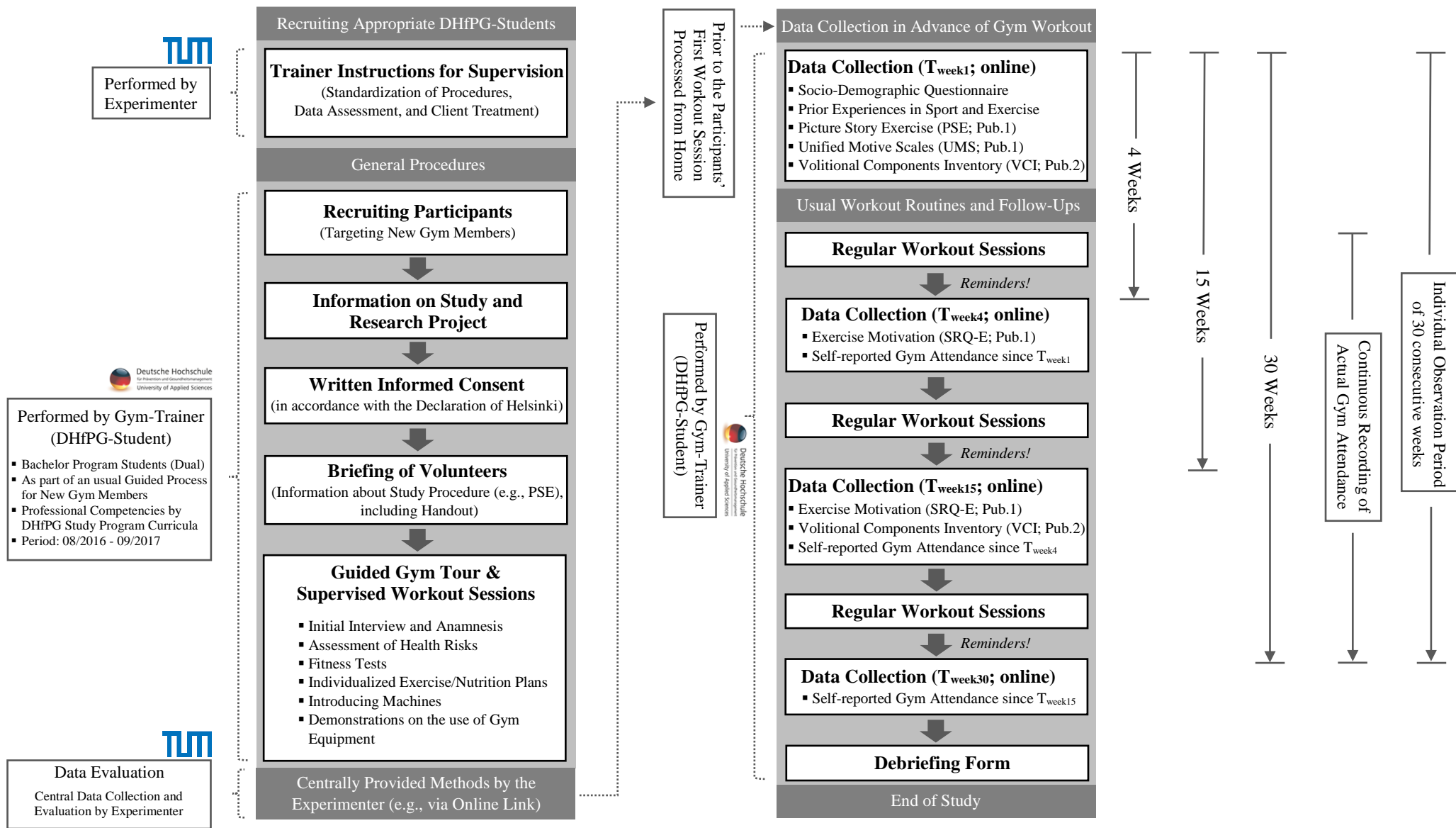


T<sub>week4</sub>. The two surveys were nearly identical in content; however, in contrast to T<sub>week4</sub>, T<sub>week15</sub> also included the VCI (Kuhl & Fuhrmann, 1998), which was re-administered and participants had to repeat. Once each questionnaire package was made available, participants were again provided with the availability of the next follow-up questionnaire (e.g., date specification) on T<sub>week15</sub> or T<sub>week30</sub> and also received the reminders in a timely manner.

**30-week follow-up.** At T<sub>week30</sub>, participants once again completed a brief series of questions on exercise behavior measuring self-reported gym attendance per week since their last survey (i.e., T<sub>week15</sub>).

**Post-study session.** As participants were unaware that their (actual) gym attendance had been recorded via the magnetic check-in/out system, they were scheduled to attend a post-study session shortly after completing T<sub>week30</sub>. At this session, participants received a debriefing form which gave them the opportunity to withdraw their data from further analysis. However, no participant withdrew consent, so all data could be included in the final analyses. In addition, subjects were provided with details on the actual aim of the study and why it was important to refrain from explaining the intent at the beginning of the study. Finally, the trainers thanked participants for their willingness to participate in the study.

The flow chart below (see Figure 12) summarizes all relevant procedures.



**Figure 12.** A flow chart of gym study including the sequence of measurements. Note. The flow chart covers all measurements used in either publication 1 or 2. Objective Gym-Attendance was used for statistical computations for both publications. Self-reported Gym Attendance was applied for publication 1 only. Pub. = Publication.

### 3 Original Publications

This chapter is comprised of both international peer-reviewed Q1 journal publications and includes their scientific contribution based on the aims defined in the introduction. The articles focus on the connection between psychological variables and exercise participation (i.e., gym attendance) and, therefore lead to a better understanding of the dispositional characteristics of individuals that may promote, or be promoted by, regular gym attendance (i.e., exercise maintenance). While publication 1 (i.e., sub-study 1) explores the impact of motivational variables on exercise adherence, publication 2 (i.e., sub-study 2) investigates the (bidirectional) association between volitional competencies and gym attendance. Both publications employ data from the prospective longitudinal multicenter study design. Consequently, parts of the dataset were used for both publications. However, each publication addresses a different research question, and all analyses presented for each journal paper are new. The original versions of each publication are provided below. The journals provided reprint permissions for a publication-based dissertation in advance, and these permissions are attached as a supplement to each publication to avoid plagiarism or dual publication of any kind.

#### 3.1 Publication 1 - Achievement Motive, Autonomous Motivation, and Attendance at Fitness Center: A Longitudinal Prospective Study

**Authors:** Philipp Moritz Kopp, Veit Senner, Hugo M. Kehr & Peter Gröpel

**Title:** Achievement Motive, Autonomous Motivation, and Attendance at Fitness Center: A Longitudinal Prospective Study

**Journal:** Psychology of Sport and Exercise (PSE)

**Doi:** <https://doi.org/10.1016/j.psychsport.2020.101758>

**Citation:** Kopp, P. M., Senner, V., Kehr, H. M., & Gröpel, P. (2020). Achievement motive, autonomous motivation, and attendance at fitness center: A longitudinal prospective study. *Psychology of Sport and Exercise*, Volume 51, 2020, 101758, ISSN 1469-0292. <https://doi.org/10.1016/j.psychsport.2020.101758>.

### 3.1.1 Summary

Since a great number of participants who attempt to engage in exercise programs experience a relapse to an inactive lifestyle and drop out, the main motivation of this quantitative study under daily life conditions was to provide a better understanding of motivational characteristics of new gym members that may affect regular (i.e., long-term) exercise engagement. Specifically, it is still unclear from the extant literature what role motivation plays in different phases of PA and examining the variables predicting exercise maintenance is crucial for effective health promotion. Therefore, the purpose of this study was to examine the extent to which the achievement motive (implicit, explicit, and the congruence of these), autonomous motivation or regulations (i.e., intrinsic motivation, identified regulation), and controlled forms of motivation (i.e., introjected regulation, external regulation) predicted actual and self-reported gym attendance over 30 consecutive weeks. Furthermore, the study sought to capture changes in exercise motivation in order to analyze the evolution of gym attendance or drop-out since the quality of motivation may change in response to the exercise program. An additional goal was to determine how well the participants' self-reported gym attendance matched their actual behavior, as both self-reported and behavioral data on gym attendance were recorded. Two theoretical frameworks for understanding the impact of motivation on exercise adherence were applied: The Achievement Motive Theory (AMT; McClelland, 1987) and the Self-Determination Theory (SDT; Deci & Ryan, 1985). The quantitative research involved a longitudinal prospective multicenter ( $N=16$  gyms) study design covering 30 consecutive weeks and included four distinct measurements ( $T_{\text{week1}}$ ,  $T_{\text{week4}}$ ,  $T_{\text{week15}}$ , and  $T_{\text{week30}}$ ). New gym members ( $N=229$ ), were asked to join the study and completed baseline ( $T_{\text{week1}}$ ) measurements on implicit and explicit motive dispositions as well as follow-up questionnaires on exercise motivation and exercise behavior after four ( $T_{\text{week4}}$ ), 15 ( $T_{\text{week15}}$ ), and 30 weeks ( $T_{\text{week30}}$ ), respectively. The implicit achievement motive was measured using the Picture Story Exercise (PSE; Morgan, 1935; Schultheiss & Pang, 2007). The explicit achievement motive was quantified using the Unified Motive Scales (UMS, Schönbrodt & Gerstenberg, 2012) whereas exercise motivations were assessed using the Self-Regulation Questionnaire - Exercise (SRQ-E; Ryan & Connell, 1989) to determine the role played by motivation in different phases of PA. During the study, data on actual gym attendance was recorded continuously using a magnetic card system implemented in each gym.

To test the predictive effect of motivational variables, four separate conditional (i.e., multilevel) growth models were conducted as the main analytical procedure (see Figure 6), two

each for self-reported and actual gym attendance as dependent variables, in which (a) the implicit and explicit achievement motives (and their interaction) and the SRQ-E constructs at  $T_{\text{week}4}$  were included as predictors, and (b) the implicit and explicit achievement motives (and their interaction) and change scores of the SRQ-E construct were included as predictors. The change scores were used as additional predictors reflecting the evolution of autonomous and controlled forms of motivation from  $T_{\text{week}4}$  to  $T_{\text{week}15}$ , as the quality of exercise motivation is likely to change in response to an exercise program (Ryan & Deci, 2000).

Results revealed that participants significantly overestimated their gym attendance. In addition, the achievement motive did not predict the participants' gym attendance, neither for self-reported nor for actual attendance. Moreover, the effect of autonomous motivation was mixed. While intrinsic motivation (i.e., enjoyment) predicted self-reported, but not actual, gym attendance over the 30-week period, the evolution of intrinsic motivation was unrelated to gym attendance. Identified regulation was unrelated to gym attendance, but the evolution of identified motivation (i.e., considering the exercise personally important) predicted both self-reported and actual gym attendance. Controlled motivation was unrelated to gym attendance. Therefore, continuous and regular participation in an exercise program is more likely when individuals enjoy the program and consider it personally important. Helping people to maintain or even increase their autonomous motivation in the first weeks of an exercise program is likely to be a good way to promote continuous and regular participation in PA. Overall, the journal paper provides understanding of motivational variables predicting objective behavior (i.e., attendance) and also provides suggestions for future research.

This was the first longitudinal prospective study design that tested two motivational theories – the AMT and SDT – at the same time in a single set-up under naturalistic conditions. The study therefore makes a significant contribution to the field about predicting actual PA behavior (i.e., attendance). Also for the first time, the impact and change of motivation were captured to provide key insights into what role motivation plays in different phases of PA, especially in a real-life environment. Finally, this study was the first to consider the discrepancy between objective and self-reported attendance data.

### **3.1.2 Organ of Publication**

The original manuscript was submitted in October 2019, accepted in July 2020, and published in July 2020 in *Psychology of Sport and Exercise (PSE)*, an international peer-reviewed ELSEVIER B.V journal. In particular, *PSE* is an official journal of the European Federation of Sport Psychology (FEPSAC) and, therefore an international forum for scholarly reports in the psychology of sport and exercise. *PSE* is committed to publishing results from high quality empirical research and is one of the leading journals in the field of sport, exercise and performance psychology. The current Impact Factor (IF) of *PSE* is 2.872, whereas the 5-Year Impact Factor is 3.878 (Elsevier B.V., n.d.). *PSE* is listed as a Q1 journal in all categories/sections (SCImago Journal & Country Ranking [SJR], n.d.).

### **3.1.3 Authors' Contribution**

Philipp M. Kopp was the principal investigator and first author of the accepted article. He developed the idea for the longitudinal gym study design, and chose the methods utilized while receiving feedback from his co-authors. In particular, he conducted formal analyses, wrote the original draft and then reviewed and revised the present article, accepted and published in *Psychology of Sport and Exercise*. Peter Gröpel assisted with statistical computations and interpretation of the data. All co-authors (Veit Senner, Hugo M. Kehr, and Peter Gröpel) contributed to the present publication, consented to their names being included on the manuscript, and gave final approval of the manuscript to be published. The individual contributions of the authors were as follows:

Philipp M. Kopp: Writing – original draft, Writing – review & editing, Formal Analysis  
Veit Senner: Writing – review & editing  
Hugo M. Kehr: Writing – review & editing  
Peter Gröpel: Formal Analysis, Writing – original draft, Writing – review & editing

### 3.1.4 Reprint Permission



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**Achievement motive, autonomous motivation, and attendance at fitness center: A longitudinal prospective study**

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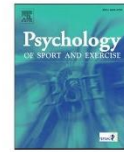
## 3.1.5 Original Publication

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## Achievement motive, autonomous motivation, and attendance at fitness center: A longitudinal prospective study

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## ABSTRACT

**Objectives:** The aim of this study was to test whether achievement motive, autonomous forms of exercise motivation (intrinsic motivation, identified regulation), and controlled forms of exercise motivation (introjected regulation, external regulation) would predict gym attendance over 30 consecutive weeks in a sample of new gym members.

**Design:** A longitudinal prospective study with four distinct measurement occasions was employed. Psychological variables and gym attendance were assessed in the first, fourth, 15th, and 30th week after starting the membership.

**Method:** Participants were 229 new gym members. The implicit achievement motive was measured using the Picture Story Exercise. The explicit achievement motive and exercise motivations were measured with questionnaires. Gym attendance was obtained via self-reports and also recorded electronically. Multilevel growth modeling was used as the main analysis method.

**Results:** Participants overestimated their self-reported gym attendance; the overall gap between self-reported and actual attendance was 39%. The achievement motive did not predict participants' gym attendance over the 30-week period, neither for self-reported nor for actual. The effect of autonomous motivation was mixed. Intrinsic motivation predicted self-reported, but not actual, gym attendance over the 30-week period, whereas the evolution of intrinsic motivation was unrelated to gym attendance. Identified regulation was unrelated to gym attendance, but the increase in identified motivation over time positively predicted both self-reported and actual gym attendance. Controlled motivation was unrelated to gym attendance.

**Conclusions:** Continuous and regular participation in an exercise program is more likely when individuals enjoy the program and consider it personally important.

Physical activity and exercise are important for health, but the benefits cannot be maintained if the physical activity is not regular (Biddle & Mutrie, 2008; Mujika & Padilla, 2000). Contemporary approaches to promoting physical activity emphasize the importance of motivation (Hagger & Chatzisarantis, 2016; Ntoumanis, Thøgersen-Ntoumani, Quested, & Chatzisarantis, 2018). The role of motivation in facilitating (or hindering) physical activity engagement is unquestionable, but its relative impact may vary over time. Evidence shows that about 45% of the participants in exercise programs drop out during the first six months (Dishman & Buckworth, 1996; FIA, 2001; James et al.,

2008), with the sharpest dropout rate in the first three months after starting a program (FIA, 2001). Such findings indicate that many people have trouble maintaining, rather than starting to participate in physical activity and exercise. Understanding why people adhere to physical activity is thus crucial to effective health promotion. However, it is still unclear from the literature what role motivation plays in different phases of physical activity.

This research explores the impact of motivation on exercise adherence. Exercise has been defined as a type of physical activity which is planned, structured, and repetitive for the purpose of

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improving fitness and health (Caspersen, Powell, & Christenson, 1985). We studied attendance in a sample of individuals who had just joined fitness centers. Cognitive processes such as weighing the pros and cons of exercising are arguably most relevant for developing the intention to exercise (e.g., considering gym membership), whereas motivational and behavioral processes become increasingly important after having joined a gym (Marcus & Forsyth, 2003). We thus applied two well-established motivational theories – the Achievement Motive Theory (McClelland, 1987) and the Self-Determination Theory (Deci & Ryan, 1985a) – as a theoretical framework to predict the individuals' gym attendance. The Achievement Motive Theory emphasizes a dispositional need that, once aroused, should make some people more inclined to exercise behavior than others, while the self-determination theory adds the importance of the quality of motivation to strengthen exercise participation. Both theories have been widely used in the sport and exercise context.

### 1. Achievement Motive Theory

The Achievement Motive Theory (McClelland, 1987; McClelland, Atkinson, Clark, & Lowell, 1953) proposes that people have a natural need to attain high levels of success in various pursuits, such as when striving for improvement in physical exercise settings. According to McClelland et al., the achievement motive is a relatively stable individual characteristic that influences people's motivation to master challenging tasks, surpass standards of excellence, and to do their best. People with a high achievement motive strive to test and improve their competence (e.g., stamina in a fitness course), and seek out challenges in order to succeed and feel proud. Consequently, the level of achievement motive may significantly contribute to exercise adherence, as challenges and improvements of competencies are features in many exercise programs. Indeed, people typically report challenges and improvement of fitness or health as their primary motivation for sport and exercise participation (Kilpatrick, Hebert, & Bartholomew, 2005).

In the achievement motive literature, researchers distinguish between implicit and explicit achievement motives (Brunstein & Heckhausen, 2008; McClelland, Koestner, & Weinberger, 1989). The *implicit* achievement motive operates largely outside of a person's awareness and represents an enduring motivational disposition to do things well, which is based on rewarding affective experience, such as enjoyment and pride upon mastering a challenging task. On the other hand, the *explicit* achievement motive is part of the individual's self-concept and includes conscious perceptions of whether achievement is important to the individual or valued by the individual's social environment. Consequently, the implicit achievement motive affects an activity because of the pleasure derived from the activity itself, whereas the explicit achievement motive drives behavior because of the perceived value of that activity. McClelland et al. further propose that the implicit achievement motive primarily predicts long-term trends in behavior while the explicit achievement motive primarily predicts immediate responses or choice behavior, and that the congruence between the two achievement motives has the highest motivational potential to drive behaviors (Kehr, 2004b).

Because sport and exercise provide ample achievement incentives, a stronger achievement motive may be associated with higher participation in sport and exercise (Gabler, 2002; Gröpel, Wegner, & Schüler, 2016; Halvari, 1991). In line with this, Gabler observed a more frequent participation in training activities in swimmers with a strong implicit achievement motive. Gröpel et al. tested different samples, recreational, amateur, and elite athletes respectively, and found that the implicit achievement motive consistently predicted regular

engagement in sport and exercise activities, but the explicit achievement motive did not. Halvari found an indirect impact of the explicit achievement motive on maximal aerobic power through perceived intrinsic instrumentality. Hence, the affective experience (attributable to the implicit achievement motive) seems to be particularly relevant for exercise behavior. Indeed, Woolley and Fishbach (2016) reported that gym-goers who focused on enjoyable, task-intrinsic rewards persisted more in a workout than gym-goers who focused on valuable, health-related benefits. Regarding the congruence between the implicit and explicit achievement motives, researchers have not found evidence for the effect of motive congruence on participation in sport and exercise (Gröpel et al., 2016).

### 2. Self-determination theory (SDT)

SDT (Deci & Ryan, 1985a; Ryan & Deci, 2000) emphasizes the importance of quality of motivation to participate in behaviors such as physical activity and exercise. The theory distinguishes between two broad types of motivation – autonomous and controlled – and amotivation. *Autonomous* motivation encompasses intrinsic reasons that reflect feelings of enjoyment or personal accomplishment while doing an activity (termed “intrinsic motivation”) as well as extrinsic reasons that reflect a conscious valuing of the activity, such that the action is congruent with the self (integrated regulation) or accepted as personally important (identified regulation). *Controlled* motivation encompasses extrinsic reasons that reflect a low degree of valuing of an activity, such that the action is performed to avoid guilt or internal pressure (introjected regulation) or to satisfy an external demand or reward contingency (external regulation). *Amotivation* reflects a lack of intention to act. Researchers have typically tested these types of motivation separately as well as in the form of a composite score, the Relative Autonomy Index (RAI), by which individual regulations are weighted and summed to provide an index of the extent to which a person's behavior is more or less autonomously regulated (Teixeira, Carraga, Markland, Silva, & Ryan, 2012; Vallerand, Pelletier, & Koestner, 2008).

A central tenet of SDT is that people can change the quality of their motivation and progress (or regress) on the continuum between amotivation and intrinsic motivation (Ryan & Deci, 2000). Autonomous motivation is more likely when individuals experience the feelings of competence, relatedness, and autonomy while doing an activity, whereas more controlled forms of motivation, or a complete loss of motivation, are likely to develop when such needs are frustrated. Hence, unlike the achievement motive which is rather stable, autonomous motivation can increase (or decrease) over time.

Teixeira et al. (2012) conducted a systematic review of the literature that tested SDT predictions in the context of physical activity and exercise. The review provided supportive evidence for the role of autonomous motivation in promoting exercise behavior. They found a positive relationship between more autonomous forms of motivation and exercise, with a trend towards identified regulation predicting short-term adoption of a new exercise program more strongly than intrinsic motivation. Intrinsic motivation, however, was more predictive of long-term exercise adherence. Furthermore, Teixeira et al. (2012) found that autonomous motivation increased across stages of exercise adoption, reaching the highest level in the action and maintenance stage. The evidence for controlled forms of motivation was mixed; introjected regulation was either unrelated or positively related to exercise behavior, whereas external regulation was primarily unrelated to physical activity and exercise. Amotivation was either unrelated or negatively related to exercise. Although these results were largely based on cross-sectional designs, experimental studies that have emerged since

then provided comparable results (e.g., Abula et al., 2018; Cheon & Reeve, 2013; Ntoumanis, Thøgersen-Ntoumani, Quested, & Hancox, 2017).

### 3. Limitations of prior research

Teixeira et al. (2012) suggested that identified regulation might be more relevant for initiating a new exercise behavior whereas intrinsic motivation might be more important for long-term adherence. However, no strong empirical evidence base exists for this hypothesis, as this conclusion was primarily based on retrospective data. Retrospective designs also limit implications derived from the research on achievement motive and exercise behavior (Gröpel et al., 2016). Whether and how achievement motive facilitates a new exercise behavior over time has not yet been tested. In addition, past work is limited by methodological problems. There are only a few longitudinal studies with more than two measurement occasions and the majority of previous studies are restricted to self-reported data of physical activity and exercise. For example, in the systematic review of Teixeira et al. (2012), only four studies (5.6%) employed behavioral measurements such as pedometry and only two studies (2.8%) included follow-ups. A notable exception is the recent study by Jekauc et al. (2015) who recorded attendance at a fitness center with a magnetic card over six months. However, they did not analyze achievement motive or autonomous motivation in their research.

### 4. The present research

The aim of this study is twofold. First, we evaluate the predictive validity of the implicit and explicit achievement motives on gym attendance over 30 consecutive weeks in a sample of individuals whose gym memberships have just started. Because the achievement motive is considered relatively stable (McClelland et al., 1953; 1989), it is measured only once at the beginning of the study. Second, we test whether the autonomous and controlled forms of motivation (and the evolution of these) predict exercise behavior over time. Autonomous and controlled motivations are measured twice, four and 15 weeks after the start of the study, as the quality of motivation may change in response to the exercise program (Ryan & Deci, 2000). We do not measure autonomous and controlled forms of motivation at the study start because the items are related to an existing workout experience at the gym, which had not yet been established at the beginning of the study. An additional goal is to check how well the participants' self-reported gym attendance match their actual behavior, as both self-reported and behavioral data on gym attendance are recorded.

Based on the Achievement Motive Theory (Brunstein & Heckhausen, 2008; McClelland et al., 1953; 1989), we expect that both the implicit and explicit achievement motive, and the congruence of these, predict gym attendance over the 30-week period. In particular, we hypothesize that stronger achievement motives will be associated with more frequent gym attendance. Based on the SDT (Ryan & Deci, 2000), we expect that the autonomous forms of motivation (intrinsic motivation, identified regulation) will positively predict gym attendance. Furthermore, we hypothesize that the evolution of the autonomous forms of motivation will be positively related to gym attendance, as autonomous motivation tends to increase across stages of exercise adoption (Teixeira et al., 2012). We do not formulate specific hypotheses regarding the controlled forms of motivation (introjected regulation, external regulation) because prior evidence for these forms of motivation is inconsistent.

### 5. Method

#### 5.1. Participants and design

The study was a longitudinal multicenter study conducted in 16

different fitness centers distributed across Germany.<sup>1</sup> We employed prospective study design with four distinct measurement occasions. Participants were individuals who had just signed up as a new gym member. A total of 255 individuals were approached. Of them, 229 persons (91 men and 138 women) aged 18–60 years ( $M = 32.14$ ,  $SD = 12.36$ ) completed the baseline survey (see [Supplementary Table S1](#) for baseline characteristics of the sample). The dropout rates due to not completing follow-up surveys were 8, 25, and 47, at the second, third, and fourth follow-ups, respectively. In total, 149 participants went through all four measurements. The inclusion of participants ran from August 2016 to September 2017. Baseline and follow-up measurements were running all year to avoid seasonal effects.

#### 5.2. Procedure

Individuals who just signed up as a new member were approached by a gym trainer and informed about the study. Those who were willing to participate were then briefed in more detail on the study procedure by the trainer and asked to provide written informed consent. A link to an online questionnaire measuring demographic and psychological variables was distributed by E-mail in the first week after starting the gym membership ( $T_{\text{week}1}$ ). Further questionnaires were sent out four ( $T_{\text{week}4}$ ), 15 ( $T_{\text{week}15}$ ), and 30 weeks ( $T_{\text{week}30}$ ) thereafter (see [Supplementary Figure S2](#)). Each time, participants logged-in with their unique individual code. To minimize attrition, an email was sent to participants few days before each follow-up to remind them to look out for the questionnaire in next email, and another reminder email was sent a week later to those who had not completed their questionnaires. The implicit and explicit achievement motives were assessed at  $T_{\text{week}1}$ , autonomous motivation at  $T_{\text{week}4}$  and  $T_{\text{week}15}$ , and self-reported gym attendance at  $T_{\text{week}4}$ ,  $T_{\text{week}15}$ , and  $T_{\text{week}30}$ . The questionnaires were programmed in Inquisit 4.0 (Millisecond Software, Seattle, WA, USA). Actual gym attendance was registered electronically for 30 consecutive weeks. Participants were unaware that their actual gym attendance was part of the study. We informed them about this at the end of the study. Therefore, during debriefing, we asked participants whether they wish to withdraw their initial consent to analyze their data. No participant withdrew his or her consent. Ethical approval for the study was provided by the first author's university. Participants were not compensated for their participation except the typical "one-week free trial" prior to the membership.

<sup>1</sup> The data were collected as part of a broader research project on longitudinal gym attendance, and the data set used in this study was also used by Kopp, Senner, and Gröpel (2020). In particular, Kopp et al. tested whether volitional competencies (self-regulation, self-control, goal enactment, self-access) predict gym attendance over 15 weeks or change in response to that attendance. Their analysis revealed that volitional competencies were unrelated to gym attendance, but the gym attendance predicted positive changes in the self-control competence. Before conducting analyses in the present study, we investigated whether volitional competencies interacted with motivational variables in predicting gym attendance. Only two interactions were observed. First, identified regulation at  $T_{\text{week}4}$  predicted self-reported gym attendance over the 30-week period only when the self-regulation competence was high,  $b = 0.36$ ,  $SE = 0.17$ ,  $p = .042$ , 95% CI [0.01, 0.70]. Second, lower intrinsic motivation at  $T_{\text{week}4}$  was associated with lower actual gym attendance for participants with a weak goal enactment competence, whereas a high goal enactment competence compensated for low levels of intrinsic motivation,  $b = -0.16$ ,  $SE = 0.07$ ,  $p = .028$ , 95% CI [-0.31, -0.02]. The other forms of exercise motivation and the implicit and explicit achievement motives did not interact with volitional competencies to predict self-reported or actual gym attendance in the present dataset.



### 5.3. Measures<sup>2</sup>

**Demographic variables.** Participants indicated their age, gender, occupation, and prior experience in exercise and sports. Experience in exercise and sports was measured by asking subjects whether they had participated in any organized exercise courses or played any organized sports previously.

**Achievement motive.** The *implicit achievement motive* was measured with Pang and Schultheiss's (2005) computer-based version of the Picture Story Exercise (PSE; Schultheiss & Pang, 2007), which has its roots in the Thematic Apperception Test (Morgan & Murray, 1935). Participants were shown five commonly used pictures to arouse implicit motives (Schönbrodt et al., 2020). Each picture depicted a social situation with several characters involved. The pictures used were: boxer, couple by river, trapeze artists, nightclub scene, and Neymar & Marcelo. Participants were presented with each picture for 10 s in a random order. After each picture, participants had 5 min to write an imaginative story about the scene depicted according to the standard instructions used in research on implicit motives (Smith, 1992). The stories were content coded by a trained coder using Winter's (1994) *Manual for Scoring Motive Imagery in Running Text* without applying the "2nd-sentence-rule" (Schönbrodt et al., 2020). The coder had several hours of scoring practice (>1000 stories) and has established at least 85% of inter-rater agreement on expert-coded calibration materials. Because raw motive scores were significantly correlated with protocol length ( $r = 0.37, p = .001$ ), the scores were corrected for protocol length by using regression (Smith, Feld, & Franz, 1992). Prior research supported adequate validity and test-retest reliability of the PSE (cf. Schultheiss & Pang, 2007).

The *explicit achievement motive* was measured using the Unified Motive Scales (UMS; Schönbrodt & Gerstenberg, 2012). Participants rated six achievement and goal related items (e.g. "Continuously improve myself") on a scale from 1 (not important to me) to 6 (extremely important to me). An explicit achievement motive score was computed by averaging the items' responses. Cronbach's Alpha in the present study was  $\alpha = 0.84$ . The achievement UMS subscale captures, at the level of self-reported motivational needs, the same achievement-related motivational themes as Winter's (1994) system and is commonly used as a contrast measure to the implicit achievement motive (Schönbrodt & Gerstenberg, 2012). The UMS was developed based on content coverage of multiple existing motive scales and the item-response theory approach, with the final set of items demonstrating incremental validity over existing motive scales (Schönbrodt & Gerstenberg, 2012).

**Exercise motivations.** Autonomous and controlled forms of motivation were measured with the Exercise Self-Regulation Questionnaire (SRQ-E; Ryan & Connell, 1989). Participants were asked "Why do you work out?" followed by 12 items that measured intrinsic motivation (e.g., "Because I simply enjoy working out"), identified regulation ("Because it is personally important to me to work out"), introjected regulation ("Because I'd be afraid of falling too far out of shape"), and external regulation ("Because others like me better when I am in shape"). Amotivation was not considered, as participants did not lack the intention to exercise as demonstrated by the gym membership. Responses were measured on 7-point Likert-type scales ranging from 1 (not at all true) to 7 (very true). Subscale scores for each of the four subscales were computed by averaging the responses to each of the subscale's items. Prior research confirmed the reliability and validity of the SRQ-E (Ryan & Connell, 1989).

**Gym attendance.** *Self-reported* gym attendance was measured employing a single frequency item, "Please indicate how many days per week you have worked out at the gym since the last survey" (cf. Kilpatrick et al., 2005). Participants reported the mean number of days per week in which they visited the gym in the particular measurement

period. *Actual* gym attendance was measured electronically with a magnetic card for the check-in system in the participating gyms. The mean number of days per week were calculated for each measurement period and paired with the respective period the self-reported gym attendance referred to.

### 5.4. Data analysis

Paired *t*-tests were used to assess differences between self-reported and actual gym attendance at each measurement occasion, whereas linear multilevel growth models were used as the main analysis method to test our hypotheses. The growth modeling was employed because of the hierarchical structure of our data, in which each time measurement is nested within each participant (Level 2 = participants, Level 1 = measurement occasions). Multilevel growth models take into account this nested data structure by calculating separate, but related equations at the within- and between-person levels. We did not include Level 3 (= gyms) in the growth modeling because preliminary intercept-only models revealed that gym affiliation did not explain a significant portion of variance in either self-reported or actual gym attendance.

To explore the degree of variance in the two dependent variables (self-reported and actual gym attendance) attributable to the between- and within-person levels, intercept-only models were first estimated for each variable. Second, we computed unconditional linear growth models for the two dependent variables, containing only a "time" variable as a predictor, to examine their change patterns over time. In an additional model, we also added a quadratic trend of time to check for non-linear evolution of gym attendance. In each model (and subsequent models), gym attendance was centered at initial status (i.e.,  $T_{\text{week}4}$ ). Third, we tested conditional growth models to control whether demographic variables had an effect on gym attendance; predictor (fixed) variables consisted of intercept, time, and the four demographic variables (gender, age, occupation, past exercise behavior), and random effects included a random intercept and a random slope for "time". The variance type "unstructured", which fits all variances and covariances between random effects, was selected. Fourth, to test the predictive effect of motivational variables on gym attendance, we computed separate conditional growth models in which (a) the implicit and explicit achievement motives (and their interaction) and the SRQ-E constructs at  $T_{\text{week}4}$  were included as predictors, and (b) the implicit and explicit achievement motives (and their interaction) and change scores of the SRQ-E construct were included as predictors. The change scores were used as additional predictors reflecting the evolution of autonomous and controlled forms of motivation from  $T_{\text{week}4}$  to  $T_{\text{week}15}$ , as the quality of exercise motivation were likely to change in response to an exercise program (Ryan & Deci, 2000).<sup>3</sup> We computed the change scores for each SRQ-E construct by subtracting its value at  $T_{\text{week}4}$  from the value at  $T_{\text{week}15}$ ; positive change scores thus represent an increase in the respective form of exercise motivation. Factorial invariance of the SRQ-E constructs across the two measurements was verified with SPSS Amos 25 (IBM Corp.; Armonk, NY). In all above growth models, the raw score predictors were used. We controlled for gender in the motivational models because men and women significantly differed in gym

<sup>2</sup> Participants also completed items on volitional competencies and well-being that were not relevant for this paper.

<sup>3</sup> Change scores have long been controversial, primarily because multiple measurements (and therefore multiple measurement errors) are incorporated into a single score and because using change scores as independent variables introduces constraints that reduces the explained variance (Edwards, 2001). The main advantage of change scores, meanwhile, is that each person can serve as control for himself or herself, and so extraneous error variance from individual variations in trait is reduced. Researchers have demonstrated that change score is an acceptable index of change (Zumbo, 1999).

attendance.<sup>4</sup>

Finally, a number of additional analyses were performed. For each motivational variable, we computed conditional growth models that included an interaction with "time" to test whether the respective motivational variable can explain the evolution of gym attendance over time. Partial correlation coefficients (controlled for gender) were calculated to examine single relationships between achievement motive, autonomous and controlled forms of exercise motivation, and gym attendance. Independent sample *t*-tests were used to analyze differences between participants who went through all four measurements and participants who dropped out. Except for factorial invariance, all other analyses were performed using SPSS 24.0 (IBM Corp.; Armonk, NY). The level of significance was set at  $p \leq .05$  (two-tailed). The statistical assumptions associated with mixed effects (growth) models were met. Normal probability plots of the standardized residual and scatterplots of residuals were generated to test normality, linearity, and homoscedasticity. The non-autocorrelation assumption was also met (Durbin-Watson-test;  $1.5 < d < 2.5$  for all models). No serious multicollinearity problems among the predictor variables of the models were found (all variance inflation factor statistics  $< 4.0$ ). Because mixed effects models can be estimated in the presence of partially missing data (Hayes, 2006), all participants (including those who dropped out in later phases) were included in the analyses. Researchers have shown that a sample of 50 or more participants is required at Level 2 to avoid biased estimates (Barr, Levy, Scheepers, & Tily, 2013); our sample at Level 2 included 229 participants.

## 6. Results

Means and standard deviations of exercise motivations, achievement motive, and gym attendance are presented in Table 1. Model parameters for the growth models examining the effect of achievement motive and exercise motivations on gym attendance are depicted in Table 2. Model parameters for the growth models examining whether the evolution of exercise motivations from  $T_{\text{week}4}$  to  $T_{\text{week}15}$  had an effect on gym attendance are depicted in Table 3. Correlation coefficients between the motivational variables and gym attendance are shown in Supplementary

**Table 1**  
Psychological characteristics and gym attendance.

	$T_{\text{week}1}$ ( $n = 229$ )	$T_{\text{week}4}$ ( $n = 221$ )	$T_{\text{week}15}$ ( $n = 196$ )	$T_{\text{week}30}$ ( $n = 149$ )
Achievement motive				
Implicit	4.26 ± 2.34			
Explicit	4.16 ± 0.90			
Exercise motivations				
Intrinsic motivation		5.22 ± 1.26	5.13 ± 1.37	
Identified regulation		5.94 ± 0.95	5.95 ± 1.05	
Introjected regulation		4.13 ± 1.25	4.22 ± 1.32	
External regulation		3.56 ± 1.63	3.58 ± 1.73	
Gym attendance (days/week)				
Self-reported		2.44 ± 1.04	2.06 ± 1.12	1.84 ± 1.26
Actual		1.65 ± 0.87	1.28 ± 1.05	0.99 ± 1.02

Note. Data are presented as mean ± SD. For the implicit achievement motive, raw motive score (uncorrected) is presented.

<sup>4</sup> Following recommendations by Becker et al. (2016), we also computed the models without including "gender" as the control variable. The exclusion of gender did not substantially change the results.

Table S3. Internal consistencies, intercorrelations among the motivational variables, and correlation coefficients between the motivational variables and age are presented in Supplementary Table S4.

### 6.1. Actual versus self-reported gym attendance

Participants systematically overestimated their self-reported gym attendance (Table 1). At  $T_{\text{week}4}$ , they claimed to attend the gym 0.80 days/week more often than their actual attendance,  $t(217) = 12.53, p < .001, 95\% \text{ CI } [0.67, 0.93], d_z = 0.85$ . Similar differences were observed at  $T_{\text{week}15}$ ,  $t(192) = 10.46, p < .001, 95\% \text{ CI } [0.63, 0.93], d_z = 0.75$ , and  $T_{\text{week}30}$ ,  $t(144) = 9.05, p < .001, 95\% \text{ CI } [0.67, 1.05], d_z = 0.75$ . The correlation between self-reported and actual attendance was 0.52, 0.59, and 0.52 (all  $p$ s  $< .001$ ) at  $T_{\text{week}4}$ ,  $T_{\text{week}15}$ , and  $T_{\text{week}30}$ , respectively.

### 6.2. The effect of time and demographic variables

Both self-reported and actual gym attendances declined over time (Table 1). For self-reported gym attendance, the linear effect of time was significant,  $F(1, 174.47) = 54.88, p < .001$ , indicating a drop in gym attendance with each subsequent measurement,  $b = -0.34, SE = 0.05, p < .001, 95\% \text{ CI } [-0.43, -0.25]$ . There was also a significant effect of gender,  $F(1, 206.06) = 9.06, p = .003$ , indicating that male participants went to the gym more often than female participants,  $b = 0.42, SE = 0.14, p = .003, 95\% \text{ CI } [0.14, 0.69]$ . The analysis further revealed a significant variance in intercepts across participants,  $\text{Var}(u_{0j}) = 0.61, SE = 0.11, Z = 5.41, p < .001, 95\% \text{ CI } [0.43, 0.88]$ , whereas the slopes did not vary across participants. The covariance between intercept and slope was not significant.

For actual gym attendance, again, the linear effect of time,  $F(1, 186.50) = 93.03, p < .001$ , and gender were significant,  $F(1, 209.48) = 12.70, p < .001$ . Gym attendance decreased with each subsequent measurement,  $b = -0.37, SE = 0.04, p < .001, 95\% \text{ CI } [-0.45, -0.30]$ , with male participants attending the gym more often than female participants,  $b = 0.40, SE = 0.11, p < .001, 95\% \text{ CI } [0.18, 0.62]$ . There was a significant variance in intercepts across participants,  $\text{Var}(u_{0j}) = 0.32, SE = 0.08, Z = 4.03, p < .001, 95\% \text{ CI } [0.20, 0.52]$ , whereas the variance in slopes and the covariance between intercept and slope were not significant. Participants' age, occupation, and past exercise behavior failed to predict gym attendance, neither self-reported nor actual.

### 6.3. Motivational variables and gym attendance

Multilevel growth modeling did not reveal any significant predictor effect of the achievement motive on gym attendance over the 30-weeks period. The interaction between the implicit and explicit motives was also not significant (Table 2). There were only a few single positive correlations between both achievement motives and self-reported gym attendance at  $T_{\text{week}30}$ , and between the implicit achievement motive and actual gym attendance at  $T_{\text{week}15}$  (see Supplementary Table S3).<sup>5</sup>

Regarding autonomous and controlled forms of motivation, only intrinsic motivation measured at  $T_{\text{week}4}$  prospectively predicted self-reported gym attendance over the 30-weeks period, with more intrinsically motivated participants claiming to visit the gym more frequently. Actual gym attendance was not predicted by any of the SRQ-E constructs (Table 2). Analyzing the evolution of autonomous and controlled forms of motivation from  $T_{\text{week}4}$  to  $T_{\text{week}15}$ , we found that changes in identified regulation positively predicted both self-reported and actual gym

<sup>5</sup> We also analyzed the implicit and explicit affiliation and power motives in the present study. There were no significant correlations between the motives and gym attendance at either measurement occasion. Furthermore, the interaction between the implicit and the explicit affiliation motives did not predict gym attendance. Similarly, we did not find any interaction effect of the implicit and explicit power motives on gym attendance.



**Table 2**  
Parameter estimates (unstandardized) for the growth models examining the relationship between achievement motive, exercise motivations, and gym attendance.

	Self-reported gym attendance				Actual gym attendance			
	Estimate	SE	p	95% CI	Estimate	SE	p	95% CI
<b>Fixed effects</b>								
Intercept	1.30	.53	.015	[0.25, 2.34]	1.18	.44	.008	[0.32, 2.04]
Time	-0.33	.05	<.001	[0.42, -0.24]	-0.37	.04	<.001	[-0.45, -0.30]
Gender	0.29	.14	.039	[0.01, 0.56]	0.40	.12	.001	[0.17, 0.63]
Implicit achievement	0.01	.14	.942	[0.26, 0.28]	0.07	.11	.531	[0.15, 0.30]
Explicit achievement	0.07	.09	.486	[0.12, 0.25]	-0.02	.08	.776	[-0.18, 0.13]
Implicit × Explicit achievement	0.00	.03	.941	[-0.06, 0.07]	-0.01	.03	.739	[-0.06, 0.05]
Intrinsic motivation	0.16	.08	.037	[0.01, 0.31]	0.00	.06	.981	[-0.13, 0.12]
Identified regulation	-0.04	.10	.684	[0.24, 0.16]	0.06	.09	.465	[0.11, 0.23]
Introjected regulation	-0.02	.06	.752	[-0.14, 0.10]	-0.01	.05	.845	[-0.11, 0.09]
External regulation	0.06	.05	.243	[-0.04, 0.15]	0.01	.04	.890	[-0.07, 0.08]
<b>Random effects</b>								
Residual	0.51	.06	<.001	[0.41, 0.64]	0.45	.05	<.001	[0.37, 0.55]
Intercept	0.60	.11	<.001	[0.42, 0.87]	0.35	.08	<.001	[0.22, 0.56]
Time	0.08	.06	.102	[0.02, 0.27]	0.02	.04	.548	[0.00, 0.57]
Cov (Intercept, Time)	0.02	.05	.662	[-0.09, 0.13]	0.06	.04	.173	[-0.03, 0.14]
<b>Model Test</b>								
Deviance (-2LL)	1594				1462			
Pseudo-R <sup>2</sup>	.261				.246			

Note. The dependent variables were self-reported and actual gym attendance from T<sub>week4</sub> to T<sub>week30</sub>. The implicit and explicit achievement motives were measured at T<sub>week1</sub>. The SRQ-E constructs were measured at T<sub>week4</sub>. Gender: 0 = female, 1 = male.

**Table 3**  
Parameter estimates (unstandardized) for the growth models examining the relationship between achievement motive, change in exercise motivations, and gym attendance.

	Self-reported gym attendance				Actual gym attendance			
	Estimate	SE	p	95% CI	Estimate	SE	p	95% CI
<b>Fixed effects</b>								
Intercept	1.62	.39	<.001	[0.84, 2.40]	1.34	.33	<.001	[0.69, 1.99]
Time	-0.33	.05	<.001	[0.42, -0.24]	-0.38	.04	<.001	[-0.46, -0.30]
Gender	0.19	.14	.177	[0.09, 0.47]	0.28	.12	.019	[0.05, 0.51]
Implicit achievement	-0.03	.14	.839	[0.30, 0.24]	0.04	.11	.730	[-0.19, 0.26]
Explicit achievement	0.18	.10	.071	[-0.02, 0.37]	0.05	.08	.573	[-0.11, 0.20]
Implicit × Explicit achievement	0.01	.03	.787	[0.06, 0.07]	-0.01	.02	.850	[-0.06, 0.05]
Intrinsic motivation (difference)	0.03	.08	.671	[0.12, 0.18]	-0.02	.06	.747	[0.14, 0.10]
Identified regulation (difference)	0.25	.08	.003	[0.09, 0.42]	0.22	.07	.002	[0.08, 0.36]
Introjected regulation (difference)	0.06	.06	.310	[-0.06, 0.18]	0.08	.05	.123	[-0.02, 0.18]
External regulation (difference)	0.07	.05	.199	[-0.04, 0.17]	0.04	.04	.319	[-0.04, 0.13]
<b>Random effects</b>								
Residual	0.51	.06	<.001	[0.41, 0.64]	0.45	.05	<.001	[0.37, 0.56]
Intercept	0.62	.12	<.001	[0.43, 0.91]	0.34	.09	<.001	[0.21, 0.56]
Time	0.08	.05	.095	[0.03, 0.27]	0.02	.04	.534	[0.00, 0.53]
Cov (Intercept, Time)	-0.02	.06	.784	[-0.13, 0.10]	0.04	.04	.405	[-0.05, 0.12]
<b>Model Test</b>								
Deviance (-2LL)	1516				1388			
Pseudo-R <sup>2</sup>	.261				.242			

Note. The dependent variables were self-reported and actual gym attendance from T<sub>week4</sub> to T<sub>week30</sub>. The implicit and explicit achievement motives were measured at T<sub>week1</sub>. Difference scores in exercise motivations represent the within-person changes in the SRQ-E constructs from T<sub>week4</sub> to T<sub>week15</sub>; positive difference scores indicate an increase in exercise motivations. Gender: 0 = female, 1 = male.

attendance over the 30-weeks period, with increase in identified regulation predicting more frequent attendance. Changes in intrinsic motivation, introjected regulation, and external regulation were unrelated to gym attendance (Table 3).<sup>6</sup> Supplementary Figure S5 shows four different clusters of participants based on how they changed their exercise motivations and Supplementary Table S6 provides details on gym attendance for the four clusters. In particular, participants who reduced autonomous motivation (especially identified regulation) reported less

frequent gym attendance from week five onwards than participants whose autonomous motivation remained the same or increased.

#### 6.4. Additional analyses

A number of additional analyses were conducted. First, we tested a non-linear evolution of gym attendance over study time by including a quadratic trend of time into the time analysis, but did not find a significant effect, neither for self-reported nor actual gym attendance. Second, we tested an interaction between gender and time to determine whether men and women differed in the reduction of gym attendance, but the interaction was not significant. We also tested separate interactions of the implicit and explicit achievement motives and the SRQ-E constructs with time to determine whether the motivational variables can explain the evolution of gym attendance across time. We found no

<sup>6</sup> In addition to the SRQ-E subscales, the relative autonomy index (RAI) was calculated from the subscales by weighting intrinsic motivation (+2), identified regulation (+1), introjected regulation (-1), and external regulation (-2) scores. Multilevel growth modeling found no effect of RAI on gym attendance over the 30-weeks period, either self-reported or actual. Similarly, the changes in RAI from T<sub>week4</sub> to T<sub>week15</sub> were unrelated to gym attendance.

significant interaction of time with any of the motivational variables. Finally, we tested whether participants who went through all four measurements differed in the study variables from participants who dropped out. Two significant differences were observed: first, participants who went through all four measurements had higher actual gym attendance at  $T_{\text{week}4}$  than participants who dropped out (1.74 vs. 1.46 days/week),  $t(219) = 2.21$ ,  $p = .03$ , 95% CI [0.03, 0.52],  $d = 0.33$ ; second, the former participants had higher implicit achievement motives than the latter participants (2.14 vs. 1.39),  $t(223) = 2.47$ ,  $p = .01$ , 95% CI [0.15, 1.34],  $d = 0.35$ . Differences in self-reported gym attendance, exercise motivations, and the explicit achievement motive were not significant.

## 7. Discussion

The aim of this study was to test whether achievement motive and autonomous and controlled forms of exercise motivation would predict gym attendance over 30 consecutive weeks in a sample of new gym members. We found no evidence of an association between participants' achievement motive and their attendance at the gym, either self-reported or actual. The effect of autonomous motivation was mixed: The level of intrinsic motivation measured four weeks after the study start ( $T_{\text{week}4}$ ) positively predicted self-reported, but not actual, gym attendance over the 30-weeks period, whereas identified regulation was unrelated to gym attendance. The evolution of intrinsic motivation from week five onwards ( $T_{\text{week}4}$  to  $T_{\text{week}15}$ ) was unrelated to gym attendance, but changes in identified regulation were predictive for both self-reported and actual gym attendance. The more participants started to identify the workout as personally important, the higher was their attendance at the gym over time. Controlled forms of exercise motivation (introjected regulation, external regulation) did not predict gym attendance.

The finding that the achievement motive did not predict gym attendance is at odds with previous findings that the implicit achievement motive is in particular related to regular engagement in sports and exercise (Gabler, 2002; Gröpel et al., 2016). In our study, using growth models as the main analysis method, neither the implicit nor the explicit achievement motive predicted participants' gym attendance over the entire 30-weeks period. We merely found a few single correlations between the implicit and explicit achievement motives and self-reported gym attendance at  $T_{\text{week}30}$  (30 weeks after the study start) and between the implicit achievement motive and actual gym attendance at  $T_{\text{week}15}$ . These correlations can be explained by the significantly stronger implicit achievement motives of the participants who remained in the study, as compared to those who dropped out, and thus stronger effects emerged towards the study end. Alternatively, the achievement motive may also become particularly relevant in the later phases of establishing a new exercise behavior. People choose to exercise for many reasons such as to get in shape, lose weight, keep New Year's resolutions, and meet new people, anyone of which may predominantly drive their behavior in the first few weeks. As time goes by, however, the initial reasons may become weaker (or habituated; Hagger, 2019) and inherent personal characteristics, such as the implicit achievement motive, may become increasingly important. In addition, exercise-related incentives (e.g., having fun, feeling better in shape) tend to change from the initiation to the maintenance of exercise behavior (Schüler & Brunner, 2012), which may arouse the implicit achievement motive more often and thus strengthen its role over time. Indeed, the implicit achievement motive has been found to predict long-term rather than short-term or immediate behaviors (McClelland et al., 1989; Spangler, 1992).

The lower dropout rate of participants with stronger implicit achievement motive might also indicate that the motive promotes long-term membership in a gym, without having much impact on the frequency of attendance. This could, for example, reflect a stronger willingness to maintain an achievement goal (here: visit the gym regularly) despite typical barriers to exercise, such as little time and high

workload. However, this conclusion is limited and necessitates further research as we have no data on whether participants who dropped out of the study also quit the gym. We also hypothesized that the congruence between the implicit and explicit achievement motives would predict gym attendance over time, but did not find evidence for this either. This hypothesis was based on McClelland et al.'s (1989) theory that the congruence between the two achievement motives has a cumulative motivational impact and recent researchers have supported this theory for well-being (Baumann, Kaschel, & Kuhl, 2005; Kehr, 2004a), flow experience (Rheinberg, 2008; Schüler, 2010), and immediate behavior (Brunstein & Maier, 2005). However, in line with the present results, prior research on sport participation documented no effects of the congruence between the implicit and explicit achievement motives (Gröpel et al., 2016). Hence, the congruence seems to be beneficial for positive affect states and immediate behavior, but its predictive role in long-term behavior (here: gym attendance) cannot be supported.

We further hypothesized that the autonomous forms of motivation (intrinsic motivation, identified regulation) would predict gym attendance. Unlike the achievement motive, which is considered relatively stable (McClelland et al., 1953), autonomous motivation can change over time (Ryan & Deci, 2000) and was therefore measured four and 15 weeks after the study start. We found a mixed effect of autonomous motivation on gym attendance. Intrinsic motivation measured at  $T_{\text{week}4}$  positively predicted self-reported, but not actual, gym attendance, whereas the evolution of intrinsic motivation from  $T_{\text{week}4}$  to  $T_{\text{week}15}$  was unrelated to gym attendance. Identified regulation at  $T_{\text{week}4}$  was unrelated to gym attendance, but the evolution of identified motivation from  $T_{\text{week}4}$  to  $T_{\text{week}15}$  was the strongest motivational predictor of both self-reported and actual gym attendance over time. Participants who increased their initial level of identified motivation showed the highest attendance at the gym over the study period. Thus, high intrinsic motivation seems to be a good predictor of gym attendance at the start of the gym membership, whereas attempts to strengthen identified regulation may increasingly become important in the first weeks of the membership in order to maintain regular gym attendance over time. These results are in line with previous evidence that continued participation in an exercise program is more likely when individuals find the program enjoyable and personally important (Teixeira et al., 2012).

However, our findings do not support the proposition that identified regulation is more relevant for initiating a new exercise behavior and intrinsic motivation is more important for long-term adherence (Teixeira et al., 2012). We found that intrinsic motivation measured early in the study was positively related to gym attendance, whereas the increase in intrinsic motivation in the later stages was not. In contrast, identified regulation measured early in the study was unrelated to gym attendance, but the evolution of identified regulation became predictive for how frequently participants visited the gym. This is in accordance with Mullan, Markland, and Ingledew (1997) who suggest that it is unlikely that people will long-term engage in regular exercise, with all the organization and commitment it entails, purely for the intrinsic reasons of fun and enjoyment. Moreover, Edmunds, Ntoumanis, and Duda (2006) reported that regulation by identification was even more important than intrinsic motivation for regular exercise behavior.

In addition to autonomous motivation, we also measured the controlled forms of motivation (introjected regulation, external regulation), but did not formulate specific hypotheses because prior evidence for these forms of motivation was inconsistent. A correlational analysis revealed no relationship between controlled motivation at  $T_{\text{week}4}$  and gym attendance, whereas both forms of controlled motivation at  $T_{\text{week}15}$  showed single correlations with gym attendance (see Supplementary Table S3). However, when all forms of autonomous and controlled motivations were simultaneously analyzed within growth models, neither introjected regulation nor external regulation predicted gym attendance. These inconsistencies between single correlations and overall growth models indicate that controlled forms of motivation may have an effect on maintained gym attendance, but this effect is much



weaker than that of autonomous motivation. Previous research supported the role of introjected regulation, especially in strenuous exercise behavior (Edmunds et al., 2006).

A substantial strength of this study is that we measured both self-reported and actual gym attendance. We found that participants systematically overestimated their gym attendance; an overall gap of 39% existed between self-reported and actual attendance. This indicates that people tend to make considerable errors when asked to report their past behavior, which may have important implications for research based solely on physical activity surveys. For example, the most recent survey on worldwide trends in insufficient physical activity found that 42% of people in high-income Western countries did not meet the WHO physical activity guidelines (Guthold, Stevens, Riley, & Bull, 2018). Based on our results, the observed prevalence of insufficient physical activity could have been as high as 58% if behavioral data had been available for analysis. Future research on physical activity behavior should include both behavioral and self-report measures to obtain a more realistic picture of the actual situation.

In addition, we found that gym attendance gradually declined from  $T_{\text{week4}}$  to  $T_{\text{week30}}$  and that men visited the gym more frequently than women. The drop in gym attendance presumably reflects the overall trend that about half of new gym members reduce their attendance at the gym in the first six months (FIA, 2001). Similarly, the observed difference between men and women is not surprising given that multiple population-based surveys have shown that men are, on average, more physically active than women (e.g., Guthold et al., 2018).

The present study has several limitations. First, we did not control for individual differences in the planned gym sessions. Information about participants' attendance plans would enable testing participants' intention-action fit (or gap) as an additional index of exercise engagement. For example, planning as well as attending the gym twice a week, which constitutes a "full" attendance (100% attendance), would represent a better exercise engagement than planning to attend the gym four times a week but actually attending only twice (50% attendance), even though the frequency remains the same. Researchers might thus benefit from measuring people's plans to attend a gym in future studies on motivation and exercise. Second, only 65% of participants went through all four measurements, whereas 35% dropped out of the study. Even though the reduced sample size was still sufficient to ensure enough power, the study attrition might potentially impact the ability to detect effects in this study (e.g., because of dropout of participants with low implicit achievement motive). Third, we did not control for baseline autonomous and controlled motivations. It could be beneficial to know whether participants had started exercising for more autonomous or more controlled reasons. Also, we did not control for participants' causality orientations, that is, participants' dispositional tendencies toward autonomous or controlled motivation (Deci & Ryan, 1985b). Some people may be more inclined to follow their internal indicators of preference in engaging in sport and exercise, while others may more naturally tend to align with external directives and norms, which might moderate how autonomous and controlled motivations changed over time in response to gym attendance. Finally, although we recorded actual gym attendance, we did not measure actual exercise behavior. Mere gym attendance does not necessarily indicate that participants actually engaged in exercising; they may also have attended the gym to visit salons and wellness areas. Future studies should therefore include objective exercise measures, such as pedometry or apps that record the effective "time on task" while exercising.

## 8. Conclusion

Many people have difficulty maintaining, rather than starting, participation in physical activity and exercise. In this study, we tested whether a strong achievement motive and high autonomous motivation would help new gym members attend the gym regularly over 30 consecutive weeks. We found no evidence of an impact from

achievement motive, but a partial beneficial effect of autonomous motivation. The more participants identified the workout as enjoyable and personally important, the higher was their attendance at the gym. Helping people to maintain or even increase their autonomous motivation in the first weeks of gym membership seems to be a good way to promote continuous and regular participation in physical activity and exercise.

## CRedit authorship contribution statement

**Philipp M. Kopp:** Writing - original draft, Writing - review & editing, Formal analysis. **Veit Senner:** Writing - review & editing. **Hugo M. Kehr:** Writing - review & editing. **Peter Gröpel:** Formal analysis, Writing - original draft, Writing - review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. In addition, the authors declare that the research was conducted in absence of any commercial relationships that could be conducted as a potential conflict of interest.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.psychsport.2020.101758>.

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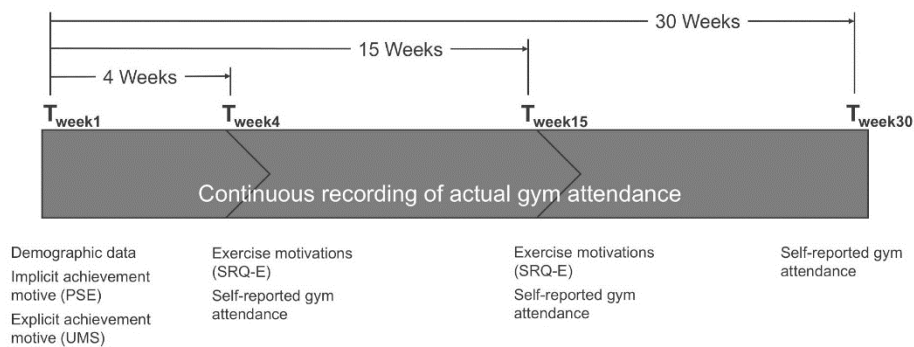
## Appendix A. Supplementary Data

(Supplementary data can be found online at <https://doi.org/10.1016/j.psychsport.2020.101758>)

**Supplementary Table S1.** Baseline characteristics of the study sample

	<i>N</i>	<i>Mean</i>	<i>SD</i>
Gender			
Men	91		
Women	138		
Age		32.14	12.36
Occupation			
Employed	139		
Self-employed	10		
Student	52		
Retired	7		
Unemployed	2		
Not reported	19		
Past sport/exercise behavior			
Yes	155		
No	74		

**Supplementary Figure S2.** Study procedure: Sequence of measurements on timeline.



**Supplementary Table S3.** Partial correlations between motivational variables and gym attendance (controlled for gender)

	Self-reported attendance			Actual attendance		
	T <sub>week4</sub>	T <sub>week15</sub>	T <sub>week30</sub>	T <sub>week4</sub>	T <sub>week15</sub>	T <sub>week30</sub>
Achievement motive						
Implicit	.01	.07	.18*	.02	.16*	.08
Explicit	.08	.08	.21*	-.03	.02	-.02
Exercise motivations T <sub>week4</sub>						
Intrinsic motivation	.19**	.15*	.28**	.02	.08	.10
Identified regulation	.14*	.08	.17*	.07	.04	.05
Introjected regulation	.01	.03	.06	-.03	.03	.11
External regulation	.10	.09	.13	-.02	.07	.08
Exercise motivations T <sub>week15</sub>						
Intrinsic motivation		.34**	.41**		.16*	.18*
Identified regulation		.32**	.41**		.29**	.22**
Introjected regulation		.19*	.21*		.22**	.28**
External regulation		.23**	.27**		.15*	.27**

Note. RAI = Relative Autonomy Index.

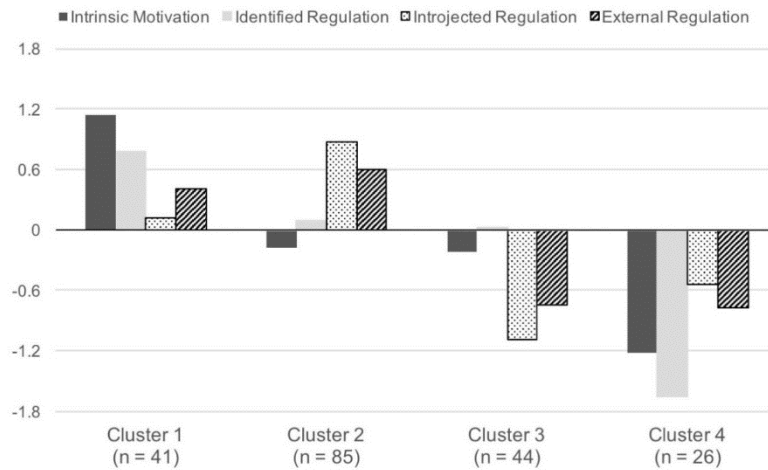
\* $p \leq .05$ ; \*\* $p \leq .01$

**Supplementary Table S4.** Pearson correlations (below the diagonal) and internal consistencies (on the diagonal) of the tested motivational variables and age

	1	2	3	4	5	6	7	8	9	10	11
1 Age	NA										
2 Implicit achievement motive	-.06	NA									
3 Explicit achievement motive	-.23**	.09	.84								
4 Intrinsic motivation T <sub>week4</sub>	-.04	.05	.24**	.81							
5 Identified regulation T <sub>week4</sub>	.01	.01	.29**	.72**	.80						
6 Introjected regulation T <sub>week4</sub>	-.12	.04	.07	.04	.17*	.58					
7 External regulation T <sub>week4</sub>	-.27**	.09	.16*	.22**	.22**	.52**	.80				
8 Intrinsic motivation T <sub>week15</sub>	-.07	.10	.22**	.71**	.51**	.07	.16*	.83			
9 Identified regulation T <sub>week15</sub>	-.09	.07	.23**	.55**	.58**	.13	.15*	.68**	.82		
10 Introjected regulation T <sub>week15</sub>	-.16*	.10	-.05	.04	.10	.55**	.46**	.18*	.25**	.62	
11 External regulation T <sub>week15</sub>	-.20**	.09	.05	.18*	.17*	.44**	.67**	.30**	.24**	.66**	.86

Note. \* $p \leq .05$ ; \*\* $p \leq .01$

**Supplementary Figure S5.** Clusters of participants based on how they changed their exercise motivations from  $T_{\text{week4}}$  to  $T_{\text{week15}}$ .



**Supplementary Table S6.** Clusters of participants and gym attendance at different measurement occasions

	Cluster 1 (n = 41)	Cluster 2 (n = 85)	Cluster 3 (n = 44)	Cluster 4 (n = 26)
<b>Self-reported gym attendance</b>				
$T_{\text{week4}}$	2.46 ± 1.23	2.46 ± 0.87	2.70 ± 1.17	2.12 ± 0.91
$T_{\text{week15}}$ **	2.43 ± 1.11	2.19 ± 1.09	2.00 ± 1.41	1.15 ± 1.01
$T_{\text{week30}}$ **	2.38 ± 1.24	1.77 ± 1.27	1.94 ± 1.21	1.05 ± 0.95
<b>Actual gym attendance</b>				
$T_{\text{week4}}$	1.77 ± 0.92	1.78 ± 0.87	1.66 ± 0.94	1.34 ± 0.76
$T_{\text{week15}}$ **	1.38 ± 0.97	1.46 ± 1.16	1.25 ± 0.94	0.60 ± 0.63
$T_{\text{week30}}$	1.14 ± 0.72	1.07 ± 1.05	0.91 ± 0.95	0.63 ± 1.37

*Note.* Data are presented as mean ± SD. Cluster 1 = participants with increased autonomous motivation; Cluster 2 = participants with stable autonomous and increased controlled motivations; Cluster 3 = participants with stable autonomous and reduced controlled motivations; Cluster 4 = participants with reduced autonomous motivation.

\* $p \leq .05$ ; \*\* $p \leq .01$

#### Information to Figure S5 and Table S6

For each of the SRQ-E constructs, we calculated participants' change scores from  $T_{\text{week4}}$  to  $T_{\text{week15}}$  and subsequently conducted an exploratory cluster analysis, which revealed four clusters: (1) participants with increased autonomous motivation, (2) participants with stable autonomous and increased controlled motivations, (3) participants with stable autonomous and reduced controlled motivations, and (4) participants with reduced autonomous motivation (Figure S5). The clusters of participants did not differ in either self-reported or actual gym attendance at  $T_{\text{week4}}$ , but differences emerged at  $T_{\text{week15}}$  and  $T_{\text{week30}}$  (Table S6). At  $T_{\text{week15}}$ , the

clusters differed significantly in both self-reported,  $F(4, 188) = 6.43, p < .001, \eta_p^2 = .09$ , and actual gym attendances,  $F(4, 191) = 4.52, p = .004, \eta_p^2 = .07$ , with participants who reduced their autonomous motivation showing the lowest attendance. At  $T_{\text{week30}}$ , only self-reported gym attendance differed significantly among the clusters,  $F(4, 142) = 4.47, p = .005, \eta_p^2 = .09$ . Again, participants who reduced autonomous motivation reported less frequent gym attendance than participants whose autonomous motivation remained the same or increased.

### 3.2 Publication 2 - Regular Exercise Participation and Volitional Competencies

**Authors:** Philipp Moritz Kopp, Veit Senner, & Peter Gröpel

**Title:** Regular exercise participation and volitional competencies

**Journal:** Sport, Exercise, and Performance Psychology (SEPP)

**Doi:** <https://doi.org/10.1037/spy0000197>

**Citation:** Kopp, P. M., Senner, V., & Gröpel, P. (2020). Regular exercise participation and volitional competencies. *Sport, Exercise, and Performance Psychology*, 9(2), 232-243. <https://doi.org/10.1037/spy0000197>

#### 3.2.1 Summary

The main motivation for this quantitative study under daily life conditions was to provide a better understanding of volitional characteristics of new gym members that may foster, or be fostered by, regular PA. In particular, the article focused on self-control traits in relation to PA to address the research gap whether good volitional skills are an antecedent to, or consequence of, regular exercise behavior. Therefore, two competing hypotheses were tested to determine if certain volitional traits predict behavior (predisposition model), or if these personality traits change over time as a result of behavior (socialization model). The research reported here involved a longitudinal prospective multicenter study design covering 15 consecutive weeks and includes two distinct measurements ( $T_{\text{week1}}$  and  $T_{\text{week15}}$ ) to narrow the research question. New gym members ( $N=196$ ) who had just taken out a membership at gym were asked to participate in a study and those willing completed a pretest measurement of various self-regulation and self-control competencies (VCI, Kuhl & Fuhrmann, 1998) and a follow-up 15 weeks later. During the study, a rich database of card swipe data was recorded using a magnetic registration system to record the actual gym attendance of each participant (i.e., frequency). For the predisposition model, two-level growth models were conducted to test the predictive effect of volitional competences on gym attendance over the 15-week observation period. To test the socialization model, multiple patterns of gym attendance were investigated using the Normative Classification system (NOCLEP; Seelig & Fuchs, 2011), which clustered participants in four groups of exercise participation: maintenance, fluctuation, late dropout, and early dropout. Then, it was examined whether volitional competencies changed in response to these patterns of exercise participation.

The analysis revealed that volitional competencies in the pretest ( $T_{\text{week1}}$ ) were unrelated to gym attendance, but gym attendance did predict positive changes in the self-control competence measured at the follow-up ( $T_{\text{week15}}$ ). Participants who more frequently attended the gym showed greater improvement in self-control. These findings provide empirical support for the socialization model rather than the predisposition model, indicating that exercise participation is less dependent on concrete volitional skills, though they may strengthen volitional competencies as a consequence. This study therefore highlights the importance of regular exercise participation to promote the capacity for self-control. The results are applicable in the sense that the motivation to regularly attend the gym does not have to be embraced initially, but the simple behavior of attending the gym may subsequently impact the related motivational factors (i.e., volitional competencies). Therefore, exercise participation results not only in better fitness levels and health, but also strengthens willpower.

This publication extends previous research by identifying volitional competencies (i.e., self-control, self-regulation, arousal control, coping with failure, and positive and negative self-motivation) that could benefit most from regular participation in sport and exercise. But as volitional competencies were only measured at two points in time, further research might include multiple measurements to test more complex mediational models, such as whether initial improvement in self-control results in better planning skills and in more frequent exercise participation over time. This was the first longitudinal study design that tested both models (the predisposition and socialization model) at the same time in a single set-up, therefore making a significant contribution to the field. Also for the first time, volition was assessed as a function and competence. Finally, this study was the first to involve objective attendance data to shed more light on the actual relationship between volition and exercise participation.

### ***3.2.2 Organ of Publication***

The original manuscript was submitted in February 2019, accepted in September 2019, and published (online first) in October 2019 in the special section *Self-Control in Sport and Exercise Psychology* of the *Sport, Exercise, and Performance Psychology (SEPP)* journal, an international peer-reviewed journal of Division 47 (Society of Sport, Exercise, and Performance Psychology) of the American Psychological Association (APA). The journal is committed to publishing evidence that supports the application of psychological principles to facilitate peak sport performance, enhance physical activity participation, and achieve optimal human

performance. The journal is one of the leading journals in the field of sport, exercise and performance psychology. The low acceptance rate places it near the top of most categories of its competitor journals in this field of research (cf. Kavussanu, 2017). The current Impact Factor (IF) of *SEPP* is 2.647, whereas the 5-Year Impact Factor is 2.744 (American Psychological Association [APA], n.d.). *SEPP* is listed as a quartile 1 (Q1) journal in all categories/sections (cf. SJR, n.d.).

### **3.2.3 Authors' Contribution**

Philipp M. Kopp was the principal investigator and first author of the accepted article. He developed the idea for the longitudinal gym study design, and chose the methods utilized, while receiving feedback from his co-authors. In particular, he conducted formal analyses, wrote the original draft and then reviewed and revised the present article, accepted and published in *Sport Exercise, and Performance Psychology*. Peter Gröpel assisted with statistical computations and interpretation of the data. All co-authors (Veit Senner and Peter Gröpel) contributed to the present publication, consented to their names being included on the manuscript, and gave final approval of the manuscript to be published. The individual contributions of the authors were as follows:

Philipp M. Kopp: Writing – original draft, Writing – review & editing, Formal Analysis

Veit Senner: Writing – review & editing

Peter Gröpel: Formal Analysis, Writing – original draft, Writing – review & editing

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### 3.2.5 Original Publication

## **Sport, Exercise, and Performance Psychology**

### **Regular Exercise Participation and Volitional Competencies**

Philipp M. Kopp, Veit Senner, and Peter Gröpel

Online First Publication, October 28, 2019. <http://dx.doi.org/10.1037/spy0000197>

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## Regular Exercise Participation and Volitional Competencies

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This study investigated the relationship between exercise participation and volition. In particular, we tested whether volitional competencies predict gym attendance (predisposition model) or change in response to attendance (socialization model). A prospective longitudinal study was employed. Individuals ( $N = 196$ ) who had just signed up as a new gym member completed a pretest measurement of various self-regulation and self-control competencies and a follow-up 15 weeks later. Participants' gym attendance was registered electronically using a magnetic card. The analysis revealed that volitional competencies at the pretest were unrelated to gym attendance, but the gym attendance predicted positive changes in the self-control competence measured at the follow-up. Participants who more frequently attended the gym showed greater improvement in self-control. These findings support the socialization model rather than the predisposition model, indicating that exercise participation is less dependent on concrete volitional skills, but it may strengthen volitional competencies as a consequence.

*Keywords:* exercise, sport, self-regulation, self-control, volition

Regular participation in physical activity and exercise is generally promoted for its benefits to physical and mental health (Harber et al., 2017; Sallis et al., 2016; Schulz, Meyer, & Langguth, 2012). Understanding factors that foster long-term exercise behavior is thus crucial to effective health promotion. Contemporary approaches include suggestions about the relationship between volitional competencies and exercise adherence (Hagger, 2014; O'Donnell, 2005), but these links have not yet

been clearly established through longitudinal research and evidence is scarce. It is also unclear whether good volitional skills are an antecedent or consequence of regular exercise behavior. In other words, it is unclear whether people with a stronger will adhere more to exercise programs or regular exercise behavior strengthens volitional skills. This study therefore examines the relationship between exercise participation and volition using a prospective longitudinal design with repeated measurements.

Volition has been characterized as a set of conscious and unconscious processes that support goal-related cognitions and emotions against competing action tendencies (Kuhl, 2000). The concept of volition is closely related to similar constructs, such as willpower (Metcalfe & Mischel, 1999), self-regulation (Carver & Scheier, 1998), or self-control (Muraven & Baumeister, 2000), and involves overriding or inhibiting competing urges, behaviors, or desires. Self-control researchers have provided initial evidence that self-control strength may foster exercise adherence (Bertrams & Englert, 2013; Gillebaart & Adriaanse, 2017; Martin Ginis & Bray, 2010). This evidence is promising

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but also limited, as exercise behavior in these studies has primarily been inferred from self-report data, and self-control has been tested in terms of a general skill rather than specific self-control competencies. In the present research, we contribute to the existing evidence by recording participants' frequency of gym attendance with a magnetic card and linking the attendance frequency to specific volitional competencies. To do this, we use Kuhl's (2000) theory of volition as a theoretical framework.

### Kuhl's Theory of Volition

Kuhl (2000; see also Kuhl & Fuhrmann, 1998) postulated that the two most important tasks of volition are maintaining both one's goals and the integrity of one's "self." Unlike researchers who have used the terms self-regulation and self-control synonymously (Kehr, 2004; Muraven & Baumeister, 2000), Kuhl described volition as a superordinate concept with self-control and self-regulation differentiated into two basic modes of volition that help accomplish the volitional tasks. *Self-control* is the self-disciplining mode of volition that supports the maintenance of an active goal, whereas *self-regulation* is the self-integrating mode of volition that supports the task of maintaining one's action in line with one's self. People typically use both self-regulation and self-control simultaneously by directing their behavior. However, in situations when important goals are not (yet) compatible with, or supported by, intrinsic aspects of the self, self-regulation and self-control can alternate serially. If, for example, the goal to exercise regularly has been introjected (e.g., through a doctor's advice; Ryan & Deci, 2000), the person might pursue this goal effectively, as long as it can help reach other self-concordant goals (i.e., maintaining good health). In such a case, self-control may temporarily suppress the self to accomplish the important but unpleasant goal to exercise regularly, for example, by imagining negative outcomes if not exercising. Self-regulation will take over after the goal to exercise regularly has become integrated into the person's self.

To measure subcomponents of volition, Kuhl and Fuhrmann (1998) have decomposed volition into several volitional competencies that can be described as either consciously deploy-

able strategies or unconsciously represented mechanisms (see Table 1, for overview of volitional competencies and respective sample items). Self-control comprises competencies that support goal maintenance, such as planning, monitoring, and negative anticipations or motivations. Self-regulation comprises competencies that support self-maintenance, for instance self-determination, positive self-motivation, and arousal control. In addition, Kuhl and Fuhrmann included scales that access various forms of volitional inhibition, which can hinder goal enactment and self-maintenance. The scales related to the hindered goal enactment measure deficiencies in initiating and completing actions and concentrating on the task at hand, whereas the scales related to the hindered self-maintenance capture symptoms of reduced access to the self, for example, low levels of integration, reduced emotional self-awareness, and unsuccessful coping with failure.

### Volition and Participation in Sport and Exercise

Recently, researchers have proposed and tested the association between volition and participation in sport and exercise based either on a predisposition (Bertrams & Englert, 2013; Englert, 2016; Gillebaart & Adriaanse, 2017; Martin Ginis & Bray, 2010; Toering & Jordet, 2015) or a socialization model (Muraven, 2010; Oaten & Cheng, 2006). According to the predisposition model, people with strong volitional competencies are naturally attracted to sport and exercise and able to adhere to exercise plans. In line with this, Bertrams and Englert (2013) found that sport students high in self-control adhered to their individual exercise plans more than students low in self-control. Similarly, Gillebaart and Adriaanse (2017) reported that self-control correlated with self-reported exercise behavior, and Toering and Jordet (2015) observed that professional male soccer players with strong self-control spent more time at training facilities. In a more direct test, Martin Ginis and Bray (2010) sampled university students who claimed to exercise regularly, depleted their self-control with a laboratory task (Stroop color word task), and then tested the participants' exercise adherence over a subsequent 8-week period. The magnitude of self-control depletion predicted exercise adherence

Table 1  
*Overview of Volitional Competencies (Including Sample Items) as Differentiated by Kuhl and Fuhrmann (1998)*

Competencies	Description	Sample item
Self-regulation		
Self-determination	Choosing and attaining self-concordant goals	In doing what I do, I feel it was me who chose to do it
Positive self-motivation	Considering positive incentives to energize behavior	If an activity gets boring, I can usually find a way to make it fun again
Arousal control	Being able to calm down if this will help	I can reduce my tension level, if it becomes disturbing
Self-control		
Planning	Thinking out details of the matter	Before starting on something new, I usually make a plan
Negative self-motivation	Considering negative incentives in case of failure	I often get myself to act by imagining how bad I would feel if I didn't complete the task
Goal enactment		
Initiative	Being able to get started easily	If a task has to be done, I prefer to start it immediately
Activity	Being able to complete actions	I often finish unpleasant tasks only at the last minute <sup>a</sup>
Concentration	Being able to focus at the task at hand and resist temptation	I often find myself thinking of things which have nothing to do with my current activity <sup>a</sup>
Self-access		
Coping with failure	Getting rid of negative thoughts after a failure	After unpleasant experiences, I cannot get rid of thoughts which take away my energy <sup>a</sup>
Emotional self-awareness	Being able to maintain awareness of own feelings	If I fail in a goal, I lose access to my feelings <sup>a</sup>
Integration	Demonstrating behavioral consistency and a coherent sense of self	My behavior often appears contradictory <sup>a</sup>

<sup>a</sup> Reverse scored item. The sample items are taken from the Volitional Components Inventory (Kuhl & Fuhrmann, 1998).

over this period; participants who were less vulnerable to depletion (indicative of high self-control) showed higher adherence.

The socialization model proposes that volitional competencies change over time as a consequence of exercise behavior. This proposition has been supported by Oaten and Cheng (2006) who demonstrated that regular participation in physical exercise over a 2-month period led to better self-control performance in a demanding visual tracking task. Similarly, Muraven (2010) found that participants who squeezed a handgrip for as long as possible twice a day over a 2-week period improved in the stop signal task, which is a self-control task where participants suppress automatized responses when presented with auditory stop signals. Muraven argued that doing the physical handgrip exercise required participants to overcome physical discomfort and the urge to release, for which self-control

exertion is needed, and thus resulted in stronger self-control over time. Given that some degree of discomfort and exertion is unavoidable in many types of sport and exercise, similar effects can be expected for regular participation in many physical exercise programs.

The above findings provide support for associations between volition and regular participation in sport and exercise. However, although promising, these results are largely restricted to questionnaire data, because exercise behavior was not measured objectively but only inferred from participants' self-report, which in turn could be biased by social desirability (cf. Dyrstad, Hansen, Holme, & Anderssen, 2014). A more direct measurement, for example, by using electronic tracking systems, is necessary to shed more light into the relationship between volition and exercise behavior and replicate the results. Furthermore, only a few longitudinal



studies have been conducted with at least two measurement occasions that would allow testing both the predisposition and socialization models at the same time. Finally, the above studies tested volition as a global trait or resource, by using either the Brief Self-Control Scale (Tangney, Baumeister, & Boone, 2004) or behavioral tasks (e.g., the visual tracking task, the stop signal task), which was necessary to explore the association between exercise behavior and volitional strength in general. Because the results support this association, research could now benefit from more focused testing of single volitional subcomponents or competencies. Compared with the measurement of global traits or functions, the assessment of individual functions and competencies enable practitioners and health promoters more efficient consulting, coaching, and training (Kuhl, Kazén, & Koole, 2006). For example, the knowledge of relevant volitional competencies could permit coaches at gyms to quickly zoom in on critical issues for their clients to strengthen motivation, increase participation, and gain higher levels of satisfaction and fewer personal complaints.

### The Present Research

The aim of this study is to test which volitional competencies promote frequent gym attendance and which are further strengthened by this attendance. We sample new gym members and test their volitional competencies twice, at the start of their gym membership and 15 weeks later, and continuously record their gym attendance. If volitional competencies promote exercise participation, then high scores on these competencies at the start of the membership should correlate with more frequent gym attendance during the following 15 weeks. If exercise participation strengthens volitional competencies, then more frequent gym attendance should predict higher scores in these competencies after the 15-week period when compared with baseline.

### Method

#### Participants

The study was a multicenter study conducted in 16 different gyms distributed across Germany. Participants were individuals who had

just signed up as a new gym member. A total of 255 individuals were approached, 229 individuals volunteered to participate and completed the initial, pretest survey. Of them, 196 persons completed a follow-up 15 weeks later and were thus included in the final sample (see Table 2, for characteristics of the participants). The inclusion of participants ran from August 2016 to September 2017; pretest measures and follow-up were running all year to avoid seasonal effects. For the predisposition model, an a priori sample-size calculation with G\*Power (Faul, Erdfelder, Buchner, & Lang, 2009) for a linear regression with one tested predictor variable (volitional competence) and two control predictors (time, gender), based on middle effect size ( $f^2 = 0.15$ ), power = 0.95, and  $\alpha = .05$ , resulted in a minimal sample size of 89 participants. For the socialization model, an a priori sample-size calculation for a repeated measures analysis of variance (ANOVA) with four normatively classified groups (Seelig & Fuchs, 2011) and two measurement occasions (pretest, follow-up), based on middle effect size ( $f = 0.25$ ), power = 0.95, and  $\alpha = .05$ , resulted in a minimal sample size of 76 participants.

#### Design and Procedure

We employed a 15-weeks prospective study design with two distinct measurement occasions: a pretest (baseline) and a posttest. Persons who just signed up as a new gym members were approached by a gym trainer and informed

Table 2  
*Characteristics of the Study Sample (N = 196)*

Socio-demographic characteristics	N	M	SD	Range
Gender				
Men	79			
Women	117			
Age (years)		31.97	12.27	18–60
Occupation				
Employed	122			
Self-employed	5			
Student	45			
Retired	6			
Unemployed	2			
Not reported	16			
Past sport/exercise behavior				
Yes	137			
No	59			

about the study. Those who showed interest to participate were then briefed on the study procedure and asked to provide written informed consent. In the pretest, a link to an online questionnaire measuring demographic variables and self-regulation was distributed by e-mail in the first week after starting the gym membership. The same self-regulation questionnaire was sent out in the posttest 15 weeks later. The questionnaires were programmed in Inquisit 4.0 (Millisecond Software, Seattle, WA). Each time, participants logged-in with their unique individual code and completed the survey. Participants' gym attendance was registered electronically for 15 consecutive weeks. Prior to study participation, participants were briefed on the study and gave written informed consent in accordance with the Declaration of Helsinki. The study did not involve any invasive or potentially dangerous methods and therefore, in accordance with the German Research Foundation and the guidelines of Philipp M. Kopp's institution, did not require formal ethical approval. Participants were not compensated for their participation except the typical "one-week free trial" prior to the membership to prevent motivation by incentives.

## Measures

**Demographic variables.** Participants were asked to indicate their age, gender, occupation, and prior experience in exercise and sports. Experience in exercise and sports was assessed by asking subjects whether they had participated in any organized exercise courses or played any organized sports previously.

**Volition.** Volitional competencies were measured with the short form of the Volitional Components Inventory (VCI; Kuhl & Fuhrmann, 1998). The inventory consists of four volitional macro scales (Self-Regulation, Self-Control, Goal Enactment, and Self-Access) and 11 subscales including four items each (Self-Determination, Positive Self-Motivation, Arousal Control, Planning, Negative Self-Motivation, Initiative, Activity, Concentration, Coping With Failure, Emotional Self-Awareness, and Integration; Table 1). In addition to the volitional subscales, the inventory includes two life stress subscales: Demands (item example: "My current life circumstances are very tough") and Threats ("I have many painful ex-

periences to cope with"). Participants responded to all items using a 4-point scale from 1 (*completely disagree*) to 4 (*completely agree*). Good validity and adequate internal consistencies of the VCI have been reported previously (Kuhl & Fuhrmann, 1998; Kuhl et al., 2006). In the present study, internal consistencies for the VCI subscales were all in line with psychometric standards ( $\alpha s > .70$ ). Subscale scores for each of the 13 subscales were computed by averaging the responses to each of the subscale's items.

**Gym attendance.** Gym attendance was registered electronically with a magnetic card for the check-in/check-out system in the participating gyms (cf. Jekauc et al., 2015). The data were summarized as the frequency of the weekly attendance. The score for 1 week could range from 0 (*when a participant did not even visit the gym once during the week*) to 7 (*when a participant visited the gym every single day of the week*).

## Results

### Predisposition Model

Figure 1 shows the average gym attendance during the observed 15 weeks. Two-level growth models (Level 2 = participants, Level 1 = weeks) with intercept, measurement time (Week 1 to 15), and demographic variables (gender, age, and prior experience in exercise and sports) were computed to test whether gym attendance changed over time. Random effects included a random intercept and a random slope for "time." The analysis revealed a significant linear effect of time,  $b = -.05$ ,  $t(181) = -7.62$ ,  $p < .001$ , indicating a drop in gym attendance over the 15 weeks. There was a significant variance in intercepts across participants,  $\text{Var}(u_{0j}) = 0.60$ ,  $Z = 7.21$ ,  $p < .001$ , and in the slopes across participants,  $\text{Var}(u_{1j}) = 0.004$ ,  $Z = 5.03$ ,  $p < .001$ . The covariance between the random components was also significant,  $\text{Cov}(u_{0j}, u_{1j}) = -0.02$ ,  $Z = -2.78$ ,  $p = .005$ , indicating that there was between-participants variation in how frequently participants attended the gym over time. The analysis further revealed a significant effect of gender,  $b = .40$ ,  $t(190) = 3.53$ ,  $p = .001$ , showing that male participants visited the gym more often than female participants. We thus controlled for gender when testing the predisposition model. Par-



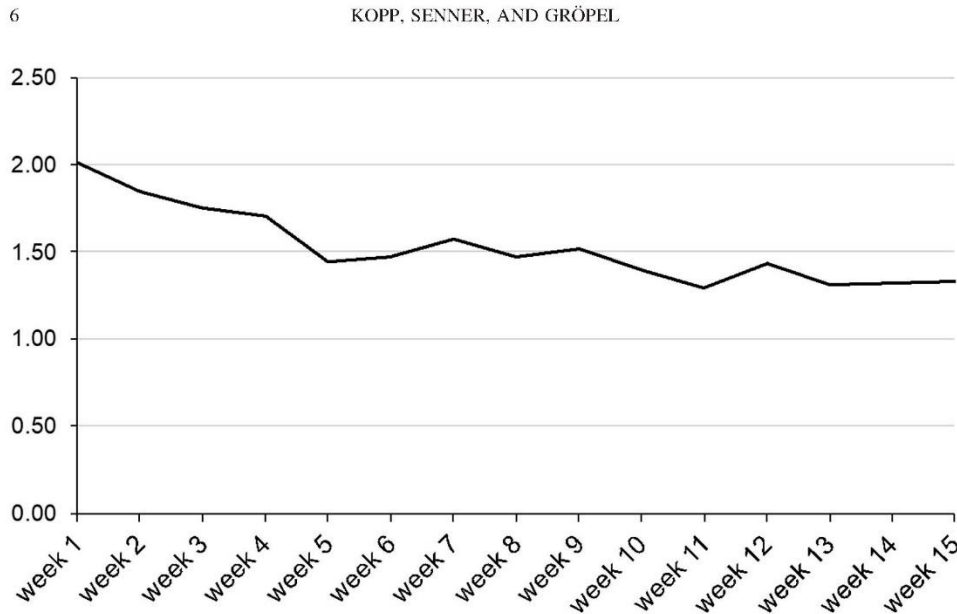


Figure 1. Average gym attendance across 15 weeks.

participants' age and prior experience in exercise and sports did not predict gym attendance.

Two-level growth models (Level 2 = participants, Level 1 = weeks) were computed to test the predictive effect of volitional competencies on gym attendance over the 15 weeks. Predictor (fixed) variables consisted of intercept, measurement time (Week 1 to 15), gender (0 = female, 1 = male), and the respective volitional competence, and random effects included a random intercept and a random slope for "time." Parameter estimates for the macro scales are summarized in Table 3. Volitional competencies at the pretest were largely unrelated to gym attendance. Similarly, volitional competencies did not predict how participants changed their gym attendance over time, as indicated by non-significant Competence  $\times$  Time interactions. At the subscale level, emotional self-awareness was the only competence showing a main effect on gym attendance,  $b = .17$ ,  $t(191) = 2.14$ ,  $p = .034$ , but no interaction. In sum, these results indicated that the predisposition model could not be supported by the present data.

#### Socialization Model

Scores of self-regulation and self-control increased significantly from pretest to posttest

(see Table 4). Regarding single subscales, participants reported higher scores in self-determination, positive self-motivation, arousal control, negative self-motivation, and coping with failure 15 weeks after starting the gym membership. Participants' gender, age, and prior experience in exercise and sports did not predict changes in volitional competencies, except that older participants were higher than younger participants in emotional self-awareness at the posttest when compared with the pretest,  $F(1, 194) = 4.07$ ,  $p = .045$ ,  $\eta_p^2 = .02$ , and women were higher than men in coping with failure,  $F(1, 194) = 5.32$ ,  $p = .02$ ,  $\eta_p^2 = .03$ . However, controlling for gender and age did not substantially change the results.

We further analyzed whether the volitional competencies changed in response to different patterns of exercise participation. Because there was a significant covariance between random intercepts and slopes across participants (see above), indicating a between-participants variation in gym attendance over the 15 weeks, we first applied the Normative Classification of Exercise Participation system (Seelig & Fuchs, 2011) to cluster participants into four participation patterns (groups): maintenance, fluctuation, late dropout, and early dropout (see Seelig &

Table 3  
*Parameter Estimates (Unstandardized) for the Growth Models Examining the Relationship Between Volitional Competencies and Gym Attendance*

Model parameters	Self-regulation	Self-control	Goal enactment	Self-access
<b>Model 1</b>				
Fixed effects				
Intercept	1.55**	1.93**	1.66**	1.25**
Gender	.41**	.42**	.42**	.41**
Time	-.05**	-.05**	-.05**	-.05**
Variable	.05	-.11	-.001	.14
Random effects				
Residual	.84**	.84**	.84**	.84**
Intercept	.61**	.61**	.61**	.60**
Time	.004**	.004**	.004**	.004**
Cov (Intercept, Time)	-.02**	-.02**	-.02**	-.02**
Deviance (-2LL)	7.804	7.803	7.805	7.803
<b>Model 2</b>				
Fixed effects				
Intercept	1.41**	1.86**	1.59**	1.28**
Gender	.41**	.42**	.42**	.41**
Time	-.02	-.04	-.03	-.05
Variable	.10	-.08	.02	.13
Time × Variable	-.01	-.005	-.005	.002
Random effects				
Residual	.84**	.84**	.84**	.84**
Intercept	.61**	.61**	.61**	.60**
Time	.004**	.004**	.004**	.004**
Cov (Intercept, Time)	-.02**	-.02**	-.02**	-.02**
Deviance (-2LL)	7.810	7.811	7.812	7.810

*Note.* Cov = covariance; -2 LL = -2 log likelihood. The dependent variable was gym attendance during the 15 weeks. In Model 1, the effect of the respective volitional variable (self-regulation, self-control, goal enactment, and self-access) was evaluated. In Model 2, the interaction between the volitional variable and time was added. Gender: 0 = female, 1 = male. \*  $p < .05$ . \*\*  $p < .01$ .

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Fuchs, 2011, for calculation of classification parameters). Figure 2 shows the average gym attendance during the 15 weeks for the four groups. We then conducted a  $4 \times 2$  (Group  $\times$  Phase) repeated measures ANOVA for each volitional competence. The analysis revealed no Group  $\times$  Phase interaction for self-regulation, goal enactment, and self-access, and only a marginal interaction for self-control,  $F(3, 191) = 2.37, p = .072, \eta_p^2 = .04$ , with maintainers showing the highest increase of self-control followed by fluctuators and late dropouts, whereas early dropouts showed a slight decline of self-control. At the subscale level, we found no significant interaction.

In sum, these results only partially support the socialization model. Although the scores of self-regulation and self-control significantly increased over the 15 weeks of gym membership, only the increase of self-control was directly,

but marginally, related to regular (maintained) participation.

#### Additional Analyses

Because the VCI included two stress-related scales (demands and threats), we also analyzed whether gym attendance affected a change in perceived life stress. Life stress did not change significantly from pretest to posttest (see Table 4). However, a  $4 \times 2$  (Group  $\times$  Phase) repeated measures ANOVA revealed a main effect of Group,  $F(3, 191) = 6.28, p < .001, \eta_p^2 = .09$ . Post hoc analysis revealed that early dropouts had significantly higher average stress scores ( $M = 2.34$ ) than late dropouts ( $M = 1.95$ ), fluctuators ( $M = 1.93$ ), and maintainers ( $M = 1.63$ ),  $ps < .037$  (Bonferroni corrected). This held for both demands,  $F(3, 191) = 5.25, p = .002, \eta_p^2 = .08$ , and threats,  $F(3, 191) = 5.74,$

Table 4  
*Volitional Competencies and Stress at the Pretest and the Posttest*

Volitional competencies	Pretest	Posttest	<i>t</i> test ( <i>df</i> = 195)	<i>p</i> value
Self-regulation	2.49 ± .45	2.63 ± .45	5.61	<b>.000</b>
Self-determination	2.69 ± .48	2.79 ± .48	3.11	<b>.002</b>
Positive self-motivation	2.49 ± .54	2.64 ± .51	4.26	<b>.000</b>
Arousal control	2.27 ± .59	2.46 ± .62	5.26	<b>.000</b>
Self-control	2.46 ± .54	2.54 ± .52	2.66	<b>.008</b>
Planning	2.64 ± .70	2.71 ± .68	1.66	.098
Negative self-motivation	2.27 ± .71	2.38 ± .66	2.54	<b>.012</b>
Goal enactment	2.76 ± .53	2.80 ± .53	1.31	.192
Initiative	2.59 ± .63	2.64 ± .61	1.27	.206
Activity	2.85 ± .63	2.84 ± .62	.22	.830
Concentration	2.84 ± .71	2.91 ± .69	1.60	.112
Self-access	3.01 ± .60	3.03 ± .61	.90	.371
Coping with failure	2.70 ± .72	2.81 ± .68	2.85	<b>.005</b>
Emotional self-awareness	3.06 ± .69	3.06 ± .71	.18	.857
Integration	3.26 ± .66	3.23 ± .71	.85	.395
Life stress	1.95 ± .66	1.93 ± .66	.30	.765
Demands	1.88 ± .67	1.92 ± .67	1.04	.300
Threats	2.02 ± .75	1.94 ± .76	1.45	.149

Note. Data are presented as  $M \pm SD$ . Boldface values indicate significant changes ( $p < .05$ ) in volitional competencies (scales and subscales) from pretest to posttest.

$p = .001$ ,  $\eta_p^2 = .08$ . The Group  $\times$  Phase interaction was not significant for any stress variable.

### Discussion

This study tested the relationship between exercise participation and volition. We sampled new gym members, operationalized exercise participation as participants' gym attendance per week over a 15-week period, and tested whether volitional competencies would predict gym attendance (predisposition model) or change in response to the gym attendance (socialization model). We found no evidence for the predisposition model, but partial support for the socialization model. This indicates that the exercise participation may be less dependent on concrete volitional skills, but it likely strengthens volitional competencies as a consequence.

Our results are consistent with previous findings suggesting that exercise participation results in better volitional regulation (Oaten & Cheng, 2006). Moreover, our study extends this line of research by identifying volitional competencies that could benefit most from exercise participation. On the macroscale level, we found that participants improved in both self-

regulation and self-control during the first 15 weeks of gym membership. Regarding the sub-components, the improvement was especially visible in self-determination and both positive and negative self-motivation. According to Kuhl (2000), both forms of self-motivation are adaptive, positive self-motivation for self-concordant goals and negative self-motivation for goals that are not (yet) fully integrated. In addition, arousal control and coping with failure improved as well.

Although the scores of both self-regulation and self-control significantly increased during the 15 weeks of gym membership, only the increase of self-control was directly related to regular (maintained) participation. The more regularly participants attended the gym, the more they improved in the self-control competence. Changes in self-regulation competence were not predicted by the gym attendance patterns. Thus, it is also likely that the improved self-regulation in our sample resulted from other factors than maintained gym attendance.

The improvements we observed in volitional competencies were significant but small. Two potential explanations exist. First, our sample of adult participants was probably too old to show stronger effects. Volitional regulation has been



## VOLITION AND GYM ATTENDANCE

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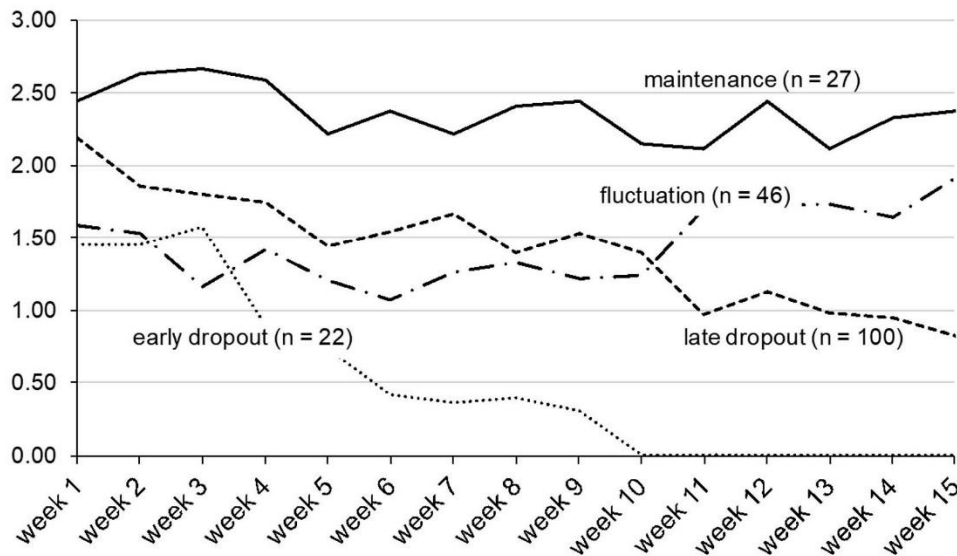


Figure 2. Average gym attendance across 15 weeks for the normatively classified groups.

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found to develop primarily during the first decade of life and to stabilize by age 10 (Vazsonyi & Jiskrova, 2018). Indeed, numerous studies with preschool samples documented long-term benefits of exercise participation for children's volitional regulation (Becker, McClelland, Loprinzi, & Trost, 2014; Howard, Vella, & Cliff, 2018; Piché, Fitzpatrick, & Pagani, 2012). Even though other researchers have found evidence that volition continues to change during later life, this change is not as strong as in childhood (cf. McClelland, John Geldhof, Cameron, & Wanless, 2015). Second, there are presumably more important sources of volitional development than the adherence to sport and exercise. Indeed, developmental psychologists have found parenting style, quality of home and school environments, and natural maturation to have a powerful impact on the development of self-control (McClelland et al., 2015).

Regarding the predisposition model, solely emotional self-awareness predicted participants' gym attendance over time. Emotional self-awareness refers to the ability to maintain awareness of own feelings, both positive and negative, when difficulties arise (Kuhl & Fuhrmann, 1998). A new exercise behavior is often demanding. Being aware of own feelings

in such a situation seems indeed helpful, as Woolley and Fishbach (2016) found that only when people felt immediate pleasure from a workout, they persisted more in the workout. Other volitional competencies were not predictive of gym attendance in our research. These results are at odds with previous studies in which participants high in trait self-control reported exercising more frequently than participants low in self-control (Bertrams & Englert, 2013; Gillebaart & Adriaanse, 2017; Martin Ginis & Bray, 2010). Differences in research design might be responsible for this. First, the previous studies measured volition as a global trait or resource, whereas we measured single subcomponents or competencies. A global trait may have a stronger effect on an outcome behavior than when the trait is subdivided into separate subcomponents. Second, previous studies assessed exercise behavior via self-reports, whereas we recorded gym attendance using an electronic check-in system. Self-reports might in part strengthen the previous findings, which could be based on common method variance, whereas behavioral data in our study might provide a more conservative estimation.

Finally, we observed that participants who attended the gym more regularly during the study period reported experiencing less stress in their lives. In contrast, participants who early reduced the frequency of gym attendance (early dropouts) had the highest score in life stress. On the one hand, these results may reflect the protective role of exercise participation against stress (Gerber et al., 2014; Gerber & Pühse, 2009; Klaperski, Seelig, & Fuchs, 2012). On the other hand, however, the high stress score may explain why the early dropout group did not attend the gym more often and regularly: participants with higher stress score presumably had less time for leisure activities, which might result in sporadic and irregular attendance. Future researchers might consider incorporating qualitative interviews to resolve this question.

### Strengths and Limitations

Strengths of this multicenter study include a reliable measurement of gym attendance by a magnetic card system and a prospective longitudinal design over 15 consecutive weeks. However, there are also several limitations that should be considered in interpreting the present results. First, even though we implemented a reliable assessment of gym attendance, we did not account for actual exercise behavior. Mere gym attendance does not necessarily imply that participants actually engaged in exercising. Participants may have swiped their gym membership cards and engaged in nonexercise behaviors, such as visiting salons and wellness area. Researchers should therefore include objective exercise measures, such as pedometry and apps that record the effective “time on task” while exercising. Second, we only used a questionnaire to assess volition. Even though questionnaires such as the VCI represent appropriate methods to assess various volitional competencies simultaneously, they do not capture the inherent in-action nature of volition. A suitable way to measure the proficiency of volitional regulation more objectively is the ego depletion paradigm (Muraven & Baumeister, 2000), which has been profitably used in the sport and exercise domain (Englert, 2016). In this paradigm, two volitional tasks are performed subsequently. Volitional resources are depleted in the first task and the depletion effect is measured in the second task. The magnitude of the depletion

effect thus reflects how good people are in volitional regulation. The disadvantage of the ego depletion paradigm is that it does not allow for simultaneous measurement of single volitional competencies. Therefore, we suggest including both the VCI and the ego depletion paradigm in future research. Third, we did not control for the type and form of exercise in the present study. Hence, we cannot conclude whether endurance or resistance exercise training has a stronger effect on volition. Similarly, we do not have evidence on whether there is a difference between exercising individually or in organized groups with regard to volitional improvement. Further research is thus required to evaluate the impact of different types (and forms) of exercise on volition. Fourth, study attrition and exercise nonadherence might potentially affect the ability to detect effects in this study. Only 27 participants (14%) were maintainers, whereas the majority (62%) were classified as early or late dropouts. To detect a significant instead of marginal Group  $\times$  Phase interaction for self-control, for example, by the observed small effect size ( $f = 0.19$ ) we would need at least 30 participants in each group. Finally, volitional competencies were only measured at two points in time. Researchers might beneficially include multiple measurements in future studies to test more complex, mediational models. For example, it could be tested whether initial improvement in self-control results in better planning skill and in more frequent exercise participation over time.

### Implications

Because emotional self-awareness predicted participants' gym attendance over time, deliberate fostering of gym members' emotional awareness could promote more frequent gym attendance and engagement. Gym owners and trainers might, for example, incorporate pleasurable elements into a workout (e.g., gym machines with gamification elements) or enrich the workout with immediate feedback, while casually reminding the members of their feelings during and after the workout. Being aware of positive experience while exercising could promote long-term participation even without the need to exert much of self-control resources (Woolley & Fishbach, 2017). Furthermore, our results indicated that gym attendance predicted



small but significant improvements in self-control. Hence, the benefit of improved self-control can represent an additional reason to start gym membership along with typical benefits such as better health, strength, appearance, and well-being. Gym owners and trainers can, for example, make potential clients aware of both physical and mental benefits of regular exercise, which means, that exercise participation results not only in better fitness and health, but also in more willpower.

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## 4 General Discussion

### 4.1 Summary

This dissertation is comprised of two Q1 journal publications that investigated the relationship between motivational (publication 1) as well as volitional (publication 2) variables and exercise adherence. Motivational and volitional determinants are commonly recognized factors that might impact the continuation of exercise adherence given their key roles in sustaining exercise engagement (cf. Martinent & Decret, 2015; Teixeira et al., 2012). Since many people who take out memberships at fitness centers fail to stay on track and maintain exercise in the long run (Dishman & Buckworth, 1996; FIA, 2001; Rand et al., 2020), it was of particular interest to capture these dispositional characteristics of new gym members under daily life conditions that may foster, or be fostered by, regular exercise engagement (cf. Englert et al., 2020) in order to fill a gap in the literature. Both journal papers are based on a longitudinal multicenter design under real-life conditions with repeated measurements in four waves ( $T_{\text{week}1}$ ,  $T_{\text{week}4}$ ,  $T_{\text{week}15}$ ,  $T_{\text{week}30}$ ) over a 30-week period, performed in a large network of 16 gyms spread across Germany, targeting individuals ( $N=229$ ) who had recently joined. This study could therefore investigate varied types of exercise motivation proposed by SDT, the implicit and explicit achievement motive (and its congruence), and the volitional competencies on (actual) gym attendance in a single research design.

In particular, journal paper 1 explored motivational characteristics of new gym members that may affect regular (i.e., long-term) exercise engagement. Accordingly, the scientific contribution sought to examine the extent to which the achievement motive, autonomous forms, and controlled forms of exercise motivation predict gym attendance over 30 consecutive weeks in a sample of new gym members. Furthermore, the research captured changes in exercise motivation in order to analyze changes in gym attendance or drop-out and also considered the discrepancy between actual and self-reported gym attendance. The findings show that people systematically overestimated their actual gym attendance. However, the results reveal no evidence of an association between participants' achievement motive (implicit, explicit, and its congruence) and their attendance at the gym, either self-reported or actual. The level of intrinsic motivation measured four weeks after the study start ( $T_{\text{week}4}$ ) positively predicted self-reported, but not actual, gym attendance over the 30-week period, whereas identified regulation was unrelated to gym attendance. The evolution of intrinsic motivation from week five onwards

( $T_{\text{week4}}$  to  $T_{\text{week15}}$ ) was unrelated to gym attendance; however, on a theoretical and general level, the results provide support for the postulates of SDT as they demonstrate that the quality of motivation positively influence PA maintenance. Specifically, changes in identified regulation were predictive for both self-reported and actual gym attendance. Consequently, these findings confirm that continuous and regular participation in an exercise program is more likely when individuals enjoy the program and consider it personally important. This result makes sense, since those who have internalized the value of exercise and find it important on a personal level are less likely to experience motivational setbacks (Thøgersen-Ntoumani & Ntoumanis, 2006). In contrast, controlled forms of exercise motivation did not predict gym attendance, aligning with previous research on SDT and PA (Teixeira et al., 2012). In addition, this research showed that participants systematically overestimated their gym attendance when self-reporting.

Journal paper 2 explored volitional characteristics of new gym members that may affect, or be affected by, regular (i.e., long-term) exercise engagement. This research simultaneously tested the competing hypotheses of whether a predisposition or a socialization model best fits the data when examining the (bidirectional) relationships between volitional competencies and (actual) exercise behavior over 15 consecutive weeks in a sample of new gym members. The results provide empirical support for the socialization model and, therefore reveal that self-control can be predicted by exercise behavior when people gain successful experience at self-regulating their behavior. These findings align with a growing body of literature showing that completing tasks requiring self-control, such as visiting a gym regularly, can lead to positive changes in people's overall self-control abilities (cf. Englert et al., 2020; Friese et al., 2017).

Building on the extant literature, both publications contribute meaningful theoretical and practical knowledge to the field about predicting objective (exercise) behavior. Given the essential role of PA maintenance in long-term health benefits (Marcus et al., 2000), the findings also provide key insights that can guide future research. Even though the journal papers cover a variety of theoretical issues, they both illustrate the importance of studying psychological determinants (e.g., exercise motivation and volitional competencies) for promoting more frequent gym attendance and exercise engagement (Amireault & Godin, 2015, Nigg et al., 2008).

## 4.2 Interpretations and Implications

Please note that the results of each study were thoroughly discussed in their respective articles, so this section only addresses interpretations, and implications beyond the aspects previously discussed in the manuscripts.

*Interpretations.* Motivation and volition (e.g., self-control, self-regulation) can interplay in all life phases, with motivation likely to be dominant in the decision and evaluation phases and volition having a stronger role in the planning and action phases. In particular, Vohs et al. (2008) showed that making difficult choices impaired subsequent volition, indicating that volition supports motivational processes when the task becomes difficult. Similarly, Gröpel and Kehr (2014) found that participants who were motivated by working on a difficult task showed no signs of self-control depletion, indicating that motivation alone was enough to drive behavior. This means that motivation is often sufficient to drive behavior when everything goes smoothly, while volition supports motivation (or takes over) when things become difficult. This research also assumes that both motivational and volitional processes are relevant for regular participation in sport and exercise, but both influencing factors were investigated separately in relation to exercise adherence (i.e., gym attendance). This addressed the gaps in the literature, since the inclusion of both motivational and volitional predictors exceeds the length of a single paper and more crucially, they did not interact in the present dataset. That said, the results of both journal papers are in line with SDT which proposes that self-determined motivation indicates a high degree of self-control (Deci & Ryan, 1991). Detailed information and relevant statistics were added to Footnote 1 in publication 1.

Publication 1 examined the relationship between the achievement motive characteristics (implicit and explicit), their congruence, and autonomous and controlled forms of exercise motivation on gym attendance. In particular, explicit motives are supposed to be related to immediate responses and choice behavior and predictive for short-term behavior. However, since this study was a longitudinal study design, the explicit achievement motive was unrelated to gym attendance, which is in line with recent research (Gröpel et al., 2016). However, it might be assumed that the explicit achievement motive would predict whether a gym member attended the gym or not.

In addition, the interaction effect of the implicit and explicit achievement motive congruence on gym attendance was hypothesized. However, the expected effect was not observed, which is also in line with recent research (Gröpel et al., 2016). Kehr's (2004b)

compensatory model of motivation and volition may provide an explanation for this finding. This model assumes that discrepancies between implicit and explicit motives lead to psychological conflicts, but people compensate for it by exerting self-control that, in turn, consumes volitional strength. Recent research found that individuals who were prompted to complete tasks incongruent with their implicit motive characteristics performed as well as individuals who completed motive congruent tasks (Gröpel & Kehr, 2014). Yet, subjects later showed reduced volitional skills (i.e., resources). Thus, it is likely that volition compensated for the somewhat lowered motivation due to a weak explicit achievement motive among the participants. Future research may include examining the compensatory role of volition while applying the compensatory model of motivation and volition (cf. Gröpel et al., 2016). Moreover, future research should continue to investigate the congruence of both motive characteristics as the interaction of the two provides the most fruitful insights about the motivational determinants of PA (Müller & Cañal-Bruland, 2019).

The levels of gym attendance in the current study gradually declined from  $T_{\text{week4}}$  until  $T_{\text{week30}}$  for both actual and self-reported gym attendance. This means that at  $T_{\text{week30}}$ , the participants did not attend the gym as much as in the early phase (e.g.,  $T_{\text{week4}}$ ) of their exercise program. This finding is in line with previous research (Della Vigna & Malmendier, 2006; Middelkamp et al., 2016). As participants attended the gym mainly to increase their levels of PA or to address their PA concerns (Crossley, 2006), one might conclude that participants showing low attendance rates returned to being physically inactive after the study period (cf. Rand et al., 2020). Finally, the findings that men visited the gym more frequently than women is in line with recent research, which has identified males to have higher attendance rates than females (Althoff et al., 2017).

Publication 2 aimed at testing the bidirectional association between volitional competencies on both the predisposition and socialization model. However, the bidirectional relationships were not tested within one complex model because the predisposition model could not be supported, meaning that the conditions for a potential mediation effect through gym attendance were not met (Baron & Kenny, 1986; Yzerbyt et al., 2018). Further research should place emphasis on testing the bidirectional association within a single model. Furthermore, measuring psychological mediators or moderators alongside physiological mechanisms are recommended to gain better understanding of processes governing self-control in relation to PA (cf. Englert et al., 2020).

***Practical implications.*** Fitness centers and gyms have the potential to help address behavioral changes to promote PA in an effective and scalable manner; however, they currently face serious economic challenges since their members often fail to stay on track in the long run and, therefore cancel or fail to renew their memberships. This, in turn, might also lead to serious public health challenges that are often both preventable and manageable.

The findings of this dissertation have a number of significant practical implications and provide an integrative potential for gym owners, practitioners, and trainers to improve the quality and precision of the counseling, coaching, and training they provide. Most importantly, the current findings (of publication 1) highlight that attendance rates for new gym members decline over time for both actual and self-reported gym attendance. In particular, gym attendance dropped with each subsequent measurement from a mean of 1.65 (actual attendance) or 2.44 (self-reported gym attendance) in  $T_{\text{week}4}$  to 0.99 or 1.84 in  $T_{\text{week}30}$ , respectively, which is in line with previous research (Della Vigna & Malmendier, 2006). This means that gyms face the challenge to maintain exercise attendance levels among new members. The current findings (especially publication 1) suggest that interventions should encourage more frequent attendance in the first weeks of the membership. Trainers or practitioners should seek to provide members with a positive experience to ensure that they enjoy the program, consider PA important on a personal level, and most importantly, that they look forward to returning. Helping gym members to maintain or even increase their autonomous motivation in the first weeks of an exercise program is likely to be a good way to promote continuous and regular participation in PA. In particular, gym members' early attendance behavior, such as the frequency and consistency of attendance, is important for supporting regular gym attendance (cf. Rand et al., 2020).

This could be realized by implementing multiple activity-related and purpose-related (achievement) incentives, such as immediate feedback while exercising. Technology has the potential to help address this challenge and promote regular PA in an effective, low cost, and scalable manner. Indeed, much effort has been put into the design of electronic exercise equipment to encourage PA (Murnane et al., 2020). Many standard fitness machines of established producers (e.g., Matrix®, Milon®, eGym®, Technogym®) have an integrated display, which provides the user with performance goals along with immediate, online feedback on how well they are doing with regard to these goals. In addition, there are often gamification elements (e.g., earning points, likes, smiles) built into the software and displayed on the screen. In fact, research has shown the impact such interfaces can have on promoting PA attitudes and

behaviors (Murnane et al., 2020). In particular, Woolley and Fishbach (2016) demonstrated that immediate rewards while working out increase persistence in an exercise program (see also Abe et al., 2011). Having such equipment may allow the exercise program to run smoothly so participants consider their workouts pleasurable and personally rewarding.

However, it is important to establish habitual behaviors (i.e., repeatedly performing the same behaviour over time) by encouraging the members to attend the gym regularly (e.g., attending the gym at the same time each week) (Lally et al., 2010; Rand et al., 2020; Rebar et al., 2016). This might be achieved through exercise plans detailing time and workout activities. Recent research has indeed shown that regularly engaging in action plans leads to a significant increase in PA (Kaushal et al., 2017) with little conscious deliberation (Ouellette & Wood, 1998). In this way, having a positive experience when pursuing a fitness goal (e.g., such as better stamina or body performance) at a gym can assist in achieving goals by facilitating persistence without the need to exert self-control (Wankel, 1993; Woolley & Fishbach, 2017).

By contrast, publication 2 reveals that regularly attending the gym can actually lead to positive changes in people's overall self-control (cf. Englert et al., 2020; Friese et al., 2017). Although not predictive in the present study, the implicit motives of each new gym member must be considered. Since these motives are inspired by situational incentives (Rheinberg & Vollmeyer, 2012), the Multi-Motive Grid (MMG; Sokolowski et al., 2000) should be employed as early as the contract talk. This measure is a frequently used and simple approach to assessing implicit motives for *n*Power, *n*Achievement, and *n*Affiliation. Depending on the characteristics, exercise plans should be adapted accordingly. Specifically, members with a high need for affiliation should engage in group exercise classes, whereas athletes with a high achievement motive should work out on ergometers or treadmills. For many people, exercising is a costly investment in their future health, and they view it as an activity with present costs and future benefits (Rohde & Verbeke, 2017). Therefore, if gyms implement these strategies in the early phase of a gym membership, it may help reduce attrition, especially among new members.

***Corona crisis and eHealth.*** Due to the unexpected and unprecedented Corona pandemic in 2020/2021, people are now foregoing gym attendance or group-based exercise classes, leading to an increasing trend of gym members cancelling or considering the cancellation of their contracts. It is not only the fear of infection that is keeping people from their workout routines, although this certainly plays a role. Since March 2020, the requirement of social distancing, self-quarantining, and the limited access or closure of many gyms have made it difficult to exercise. People have begun to search for alternative forms of exercise and are now

more accustomed to working out at home (e.g., body weight training) while using Mobile Fitness Applications (MFA) or going for a run outside. This behavior is becoming more entrenched in individuals' habits and is advantageous for those with high exercise barriers. People might develop habits that suit their lifestyle better or that they are more comfortable with. This will continue to have a big impact on the fitness industry in the future.

However, combining the popularity of MFA and the ongoing search for exercise alternatives with the empirical findings of this research would also have practical implications for eHealth technology. At present, there are a myriad of fitness-related smartphone applications (MFA) available for free and for purchase (Cowan et al., 2013). Apps allow their users to set goals, track activity, and share progress on social media (Sama et al., 2014). However, technology usage attrition is a concern among the providers since users tend to delete these applications within only a short period of time (Herrmann & Kim, 2017). This might be due to uncertainty as to whether these apps really help in achieving and maintaining exercise goals (e.g., delayed rewards). This might also be due to the lack of immediate rewards (e.g., pleasure and enjoyment), lack of connection to national PA guidelines, or due to user-unfriendly interfaces (Knight et al., 2015). The findings of this research suggest including interfaces that provide immediate feedback, such as gamification elements, to indicate a more personalized experience, such as pleasure and enjoyment while using the application. Previous research has shown that individuals who exercise for enjoyment are more likely to adhere to their exercise programs (Wankel, 1993). In addition, coaching by the MFA should provide tailored narrative-based feedback (e.g., health messages) (Murnane et al., 2020) to increase knowledge and awareness of the workout importance. This would then mean that continuous workout using the MFA would bypass the exertion of self-control, actually strengthening self-control. Tailored feedback is important since growing evidence suggests that feedback currently provided by MFAs might fail to motivate behavior, may harm self-integrity, or even fuel negative mindsets about exercise (Murnane et al., 2020). Adapting the content of the MFA according to an individual's motive characteristics would also likely provide added value.



### 4.3 Limitations and Future Research

The present research (i.e., longitudinal gym study) has a number of limitations which warrant caution when interpreting the findings. Most of them have been addressed in the respective journal papers, but some general issues are considered here.

First, the longitudinal study was performed in gyms with similar offers, including endurance and resistance exercise training, group-based fitness classes (e.g., aerobic, indoor cycling, Pilates, Zumba<sup>®</sup>, Body Pump<sup>®</sup>, body forming) as well as wellness areas and salons (cf. DIN 33961-1:2015-11; DSSV, 2019; Paoli & Bianco, 2015). However, the type of gym, such as *boutique studios* or gyms solely with female members, which might have affected participants' implicit achievement motive, were not accounted for as gyms often differ in their incentives. Where such incentives are lacking, participants might not have experienced rewarding affective experiences (e.g., more strength, improved stamina, better body balance) because implicit achievement motives were not aroused and, therefore did not predict (long-term) gym attendance. In recent research, showing motivational pictures (e.g., a woman winning a race) has been found to arouse the implicit achievement motive and improve performance (Latham & Piccolo, 2012; Shantz & Latham, 2009). Future research should be more selective with the gym type and category (e.g., low budget or premium) as well as the atmosphere in order to provide similar (affective) incentives.

Second, the selected gyms included in the present research provided comparable pricing and contract menus offering annual memberships with an average cost of 49 EUR (*SD* 5 EUR). However, factors such as contract length or the price of the membership may influence members' attendance behavior at gyms. Further research, might therefore investigate the impact of shorter-term contracts and different pricing schemes on maintaining gym attendance (cf. Rand et al., 2020).

Third, participants were asked to report their prior experience in sport and exercise since past behavior has an impact on the maintenance of exercise attendance (McEachan et al., 2011). However, they indicated 45 different fitness and/or sport disciplines in total they had previously participated in. This high variation in past sport and exercise experience (and the low number of people within each sport or exercise discipline) did not allow for meaningful analyses of how past experience impacted gym attendance. Future studies might include surveys to control for participants with similar exercise backgrounds.

Fourth, both publications made use of the magnetic card system at each gym, which evidence suggests is a reliable and valid assessment of exercise adherence (Jekauc et al., 2015; Rand et al., 2020). However, the gym membership card swipe data was described as *objective exercise behavior*, which was not completely accurate because the actual objective exercise behavior was in fact not recorded. Specifically, it was not possible to discover the amount or type of exercise behavior in which gym patrons were engaging. Participants may have swiped their gym membership cards and engaged in non-exercise behaviors, such as visiting salons and spas. This aspect might impair the generalizability of this study. Future research should therefore consider measures that account for the actual *time on task* (Woolley & Fishbach, 2017), such as standard fitness machines of established producers (e.g., eGym®, Matrix®, Milon®, and Technogym®) or other forms of assessment for exercise behavior (e.g., observational, journaling) rather than focusing on gym attendance only.

Fifth, to avoid seasonal effects, the longitudinal study ran for 12 months. However, this might also be responsible for variations in PA or cancelling of gym contracts during the study period. Reasons given among gym members for starting in the winter (e.g., New Year's resolutions) or summer (e.g., wanting a "beach body") might not be strong enough to maintain continued attendance, especially when the delayed rewards (e.g., more muscle mass) are not obtained (Rothman, 2000). Additionally, disruptions to routines in winter (e.g., bad weather conditions) and/or summer (e.g., extended holidays) might have prevented participants from establishing strong habits associated with maintaining new behaviors (Kwasnicka et al., 2016; McEachan et al., 2011; Rand et al., 2020).

Sixth, inconsistency in the data collection cannot be ruled out. Although the DHfPG students were required to attend a comprehensive briefing prior to the study to help them develop a clear sense of direction early on and to act according to the standardized procedure, some trainers may have deviated from the instructions. An indication of this was that analyzing the data revealed that participants partially filled out questionnaires simultaneously or too late. Therefore, future studys should focus on consistent supervision in the data collection.

Finally, this study employed contemporary theoretical frameworks such as the AMT, SDT and Kuhl's (2000) Theory of Volition to address the research goals. It was supposed that motives and autonomous motivation are highly relevant for the maintenance of exercise behavior. However, it would be interesting to apply alternative theoretical models, such as the Rubicon Model of Action Phases (Heckhausen & Gollwitzer, 1987). According to this model,

the weighting of pros and cons and the weighting of expectations and values (e.g., for gym attendance) constitute a *motivational phase*, whereas the phase after intention is a *volitional phase*. The model describes how motivation and volition can work together in a course of action and is not restricted by assuming that motivation only applies in the *motivational phases* and volition only in the *volitional phases*. Future research might include this model to investigate psychological variables on exercise adherence.

## 5 Conclusion

In conclusion, this dissertation introduced a novel and unique approach under real-life conditions to understanding the psychological factors (i.e., motivational and volitional variables) that facilitate persevering with regular PA. This research is particularly relevant, given that participants in exercise programs tend to discontinue their programs during the first six months, and, therefore do not engage in regular PA in the long run. Two (sub-)studies based on a common dataset (i.e., a 30-week longitudinal multicenter study) investigated the relationship between psychological variables (i.e., motivational variables and volitional competencies) and exercise participation to understand factors that are associated with continued, or discontinued, gym attendance. This dissertation contributes important information about predicting objective behavior.

Specifically, publication 1 focused on the role played by motivational characteristics (proposed by AMT and SDT) of new gym members in the evolution of gym attendance and demonstrated that people attend the gym more frequently the more they identified the workout as enjoyable and personally important. In contrast, publication 2 provides evidence that self-control skills do not necessarily predict regular exercise behavior, along with evidence that these personal dispositions and characteristics can be predicted by exercise behavior when people experience successfully self-regulating their behavior (cf. Englert et al., 2020).

Gym owners and practitioners need to be aware of this to keep their members and clients on track. It is essential to find ways to increase interest and enjoyment experienced during PA—especially in the early stages of exercising—to promote the adoption of regular and sustainable PA engagement. This, in turn, might result in stronger volitional competencies as a consequence of improved exercise adherence. At any rate, researchers should pay attention to the personal characteristics or dispositions that may act as effect modifiers in experiments, observational studies, and interventions. Furthermore, adding analyses that shed light on the interaction between motivation and volition could contribute significantly to our understanding of consistency with PA.

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## 6 References

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## **Eidesstattliche Erklärung**

Ich, Philipp M. Kopp, geb. 13.05.1985, erkläre hiermit an Eides statt, dass ich die bei der **Fakultät für Sport- und Gesundheitswissenschaften** der Technischen Universität München zur Promotionsprüfung vorgelegte Prüfung mit dem Titel

### **Motivation, Volition, and Gym Attendance – A longitudinal Prospective Study**

an der **Professur für Sportgeräte und Sportmaterialien** unter der Anleitung von und Betreuung durch **Univ.-Prof. Dr.-Ing. Dipl.-Sportl. Veit St. Senner** ohne sonstige Hilfsmittel erstellt und bei der Abfassung nur die gemäß § 6 Abs. 5 angegebenen Hilfsmittel benutzt habe.

Ich habe die Dissertation in keinem anderen Prüfungsverfahren als Prüfungsleistung vorgelegt.

Ich habe den angestrebten Doktorgrad noch nicht erworben und bin nicht in einem führenden Promotionsverfahren für den angestrebten Doktorgrad endgültig gescheitert.

Die Promotionsordnung der Technischen Universität ist mir bekannt.

München, 23.10.2020

Philipp M. Kopp