Subjective Physical Age and its Role in Health Behavior Change Strategies for Physical Activity

by

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Lifelong Learning and Institutional Development
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For my parents
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Abstract

With an increasing age levels of physical activity tend to decrease, though maintaining a healthy and active lifestyle is a crucial factor in the prevention of severe chronic diseases. Due to this it is of great importance to understand age-related changes and maintenance of behaviors such as physical activity. Effects of chronological age on processes of health behavior change are well documented, but probably fail to demonstrate the impact of aging comprehensively. Therefore, other age-related factor should be investigated which might provide new insights in the adoption and maintenance of physical activity throughout the life-span.

The primary goal of this dissertation was to introduce subjective physical age as a facet of subjective age and investigate its additional value in the prediction of physical activity while focusing on intentional processes. The second goal was to highlight self-regulatory processes which aid the transition of intentions into behavior, in the light of subjective physical age. Furthermore, differences in social-cognitive predictors and their interplay were investigated.

Results from this dissertation suggest that subjective physical age contributes to in the explanation of physical activity, even when controlling for strong correlates of subjective age (health status & chronological age). Those who feel physically younger indicate higher levels of physical activity. Feeling physically younger is also related to better self-regulatory planning skills which help to translate intentions in actual behavior. Finally, results provide insights in differing cognitions regarding health behavior change predictors and mechanisms between those who feel physically younger, as old as they are, and older.

These findings are of special interest, as subjective physical age can be intervened upon to change cognitions about own ageing and age-related, physical capabilities in health behavior change interventions. They also provide a new proxy to tailor content towards the characteristics of participants in tailored, web-based health behavior change interventions to further personalize content (e.g., in web-based interventions for rehabilitation patients).
Introduction

1

Introduction
Introduction

Engaging in a healthy lifestyle is beneficial for overall health throughout the life course. Independent of one’s age, a healthy lifestyle can help to prevent of chronic diseases and it also increases well-being. Common guidelines (e.g., moderate physical activity for at least 30 minutes on 5 days a week) are well known among the broad population. Most people do not meet such recommendations, though they might intend to live a more active and healthy lifestyle. Furthermore, with increasing age, people are prone to further decrease in their compliance with such guidelines, not meeting recommendations. In addition to that, studies suggest that with increasing chronological age, the inter-variability and intra-variability of performance, also in healthy lifestyle factors like physical activity, can show great differences between and within individuals. This leads to the suggestion that chronological age alone might not be an appropriate indicator to explain such differences (see also Salthouse, 1991). But what, potentially, are other age related concepts to explain such differences? In the context of health behavior research concepts like future time perspective (Gellert, Ziegelmann, Lippke, Schwarzer, 2012), or residual life expectancy (Ziegelmann, Lippke, & Schwarzer, 2006) have shown to be appropriate to predict changes in behaviors and social-cognitive antecedents like outcome expectations or planning. Another promising concept to explore such processes might be subjective age, the age someone perceives themselves to feel like (Barak & Stern, 1986; Kleinspehn-Ammerlahn, Kotter-Grühn, & Smith, 2008; Westerhof & Wurm, 2015). To date, there is little research in the field of subjective age, especially in the field of health behavior research. This provides an avenue for first analyses on a broader, more general scale to test this concept regarding its eligibility in relation to health behaviors, such as physical activity. Since the potential effects of subjective age will be tested on a broader scale, meaning to cover a broader age range, a more sensitive measure would probably be needed to come to any effects at all. Therefore, the current dissertation will introduce subjective physical age as
a new concept to investigate its potential importance in relation to physical activity as a health behavior.

This doctoral thesis addresses subjective physical age, as a facet of subjective age, as a factor in health behavior change processes in self-reported physical activity. To test assumptions on the additional value of subjective physical age in relation to physical activity across the lifespan, different research strategies were applied. This includes testing for direct effects via regression analysis, testing for a potential mediation via planning, and differences in principle mechanisms of health behavior strategies among those who feel physically younger, those as old as they are, and those who feel older. Therefore, cross-sectional data and data with two measurement points from two online studies with diverse samples were analyzed. Implications for future research and potential applications, especially in the field of web-based tailored interventions and medical rehabilitation were discussed.

In the following, I will outline why subjective physical age was investigated, why its relationship with physical activity was investigated, and why the specific study samples were chosen. The chapter will close with an overview of the subsequent chapters.

**Subjective Age**

Rapid demographic changes in western societies towards an increasingly older population led to an increasing interest in the field of age and aging research (e.g., Magnus, 2009). On the one hand, this is reflected by the reception of the phenomenon of aging in the broad public by the media (e.g., newspaper, magazines) and on the other hand by an increasing interest in investigating aging as a phenomenon on a psychological level. Though age-related changes in physiology and cognitions are well documented in relation to chronological age, more and more inter-individual and intra-individual variability highlight the need to further investigate age and aging (Lindenberger & von Oertzen, 2006; Lövdén, Bergman, Adolfsson, Lindenberger, & Nilsson, 2005; Myerson, Robertson, & Hale, 2007). This is also supported by Salt-
house (1991) who argues that other indicators might be more suitable to investigate age and aging as a process than chronological age alone – as long, as they can provide additional information on the phenomenon. One of such indicators could be subjective age.

Kastenbaum and colleagues (1972) investigated different aspects and facets of aging, describing them as personal age, interpersonal age, and consensual age. Personal age is proposed to consist of a) a potential component of total functional age and b) a basis of classifications to create and modify “old behavior” (Kastenbaum et al., 1972). Interpersonal age is defined as how old a person seems to others and consensual age as the agreement between personal and interpersonal age (Kastenbaum, et al., 1972). They came to the conclusion that personal age is especially distinguished into how old someone looks and how old someone feels and further identified a strong bias towards reporting a younger personal age which increases with advancing age (Kastenbaum et al., 1972). Various facets of subjective age are already used, as pointed out by Barak & Stern (1986). Some of these are stated below and are related to Table 1 which also states results from the aforementioned paper (Barak & Stern, 1986).

**Ideal age:** Response to the question “We would like to know how old you feel. Would you say you feel young, middle aged, old or very old?” (Markides & Boldt, 1983).

**Comparative age:** Response to the statement “I feel older, the same, younger than my real age.” (Baum & Boxley, 1983).

**Feel age:** Numerical response to "Some people have told us that they feel a different age — either older or younger — than their actual age. What age do you feel on the inside?" (Underhill & Cadwell, 1983).

**Cognitive age:** "I feel as though I am in my . . ."; "I look as though I am in my . . ."; "I do most things as though I were in my . . ."; "My interests are mostly those of a person in his/her . . ." (Barak & Stern, 1985).

**Stereotype age:** 12 bi-polar items rated in comparison to “an old person” and “a middle-ages person” to determine stereotype age: "insecure-secure, worthless-valuable, not free to do
things-free to do things, useless-useful, look to the past-look to the future, ineffective-effective, dissatisfied-satisfied, shaky-steady, inactive-active, not respected-respected, sick-healthy, unsure-confident.” (George, Mutran, & Pennybacker, 1980).

What these different operationalizations have in common are evaluative processes of oneself and others, which are essential for understanding subjective age. These processes are pointed out by Westerhof and Wurm (2015), but also Montepare (2009), as stated below. Considering the various facets of subjective age, a more general aspect of subjective age is common research practice, asking “How old do you feel?” (e.g., Demakakos, Gjonca, & Nazroo, 2007; Kleinspehn-Ammerlahn et al., 2008), leading to a general self-evaluation (which all of the aforementioned measures have in common) with a numerical reply which results in a continuous measure. The aspect of feeling or perceiving a different age with a higher likelihood towards a younger age has especially tracked the attention of researchers.

In a first overview Barak and Stern (1986) reported mainly correlates of different facets of subjective age and to what extent they interrelate with various other health related measurements (see Table 1). These first correlational results provide insights in the potential relationship between different subjective age concepts (as described above) and health as well as health related outcomes. In the context of my dissertation, particularly the relationship between subjective age and health, more precisely physical activity as a key component of health, builds the center of attention. Those who feel younger report better health or higher well-being as well as better outcomes on other health indicators, such as exercising (Demakakos et al., 2007; Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Westerhof & Barrett, 2005). Furthermore, people who feel younger report significantly higher levels of general self-efficacy compared to those who feel as old as they are and those who feel older (Boehmer, 2007). Still, little is known about how subjective age is related to social-cognitive predictors of health behavior change.
Table 1

Overview of health and health behavior related variables in relation to subjective age constructs on a correlational level (Barak & Stern, 1986)

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Effect direction</th>
<th>Subjective age measure</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health</td>
<td>-</td>
<td>Comparative age</td>
<td>Baum &amp; Boxley (1983); Linn &amp; Hunter (1979)</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>Identity age</td>
<td>Bultena &amp; Powers (1978); George et al. (1980); Markides &amp; Boldt (1983); Mutran &amp; Burke (1979); Mutran &amp; George (1982)</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>Stereotype age</td>
<td>Mutran &amp; Burke (1979); Mutran &amp; George (1982)</td>
</tr>
<tr>
<td>- Days sick</td>
<td>+/-</td>
<td>Identity age</td>
<td>Mutran &amp; George (1982)</td>
</tr>
<tr>
<td>- Doctor visits</td>
<td>+</td>
<td>Identity age</td>
<td>Mutran &amp; George (1982)</td>
</tr>
<tr>
<td>- Hospital visits</td>
<td>+</td>
<td>Identity age</td>
<td>Mutran &amp; George (1982)</td>
</tr>
<tr>
<td>Psychological</td>
<td>-</td>
<td>Comparative age</td>
<td>Baum &amp; Boxley (1983)</td>
</tr>
<tr>
<td>Health</td>
<td>-</td>
<td>Comparative age</td>
<td>Baum &amp; Boxley (1983); Linn &amp; Hunter (1979)</td>
</tr>
<tr>
<td>Locus of control</td>
<td>-</td>
<td>Cognitive age</td>
<td>Barak &amp; Gould (1985)</td>
</tr>
</tbody>
</table>

Note. + positive direction; - negative direction; +/- no direction;

Self, Identity, and Subjective age

Westerhof and Wurm (2015) described the origins of subjective age research (focusing on ideal age) in self and identity research. This especially included processes of self-consistency and self-enhancement, suggesting that both processes shape age identities. Self-consistency reflects the motive of staying the same stable person over time, whereas self-enhancement
reflects maintaining a positive self-image while focusing on self-esteem as a positive illusion (Westerhof & Wurm, 2015). They state that “individuals are able to maintain consistency by assimilating new experiences into their existing self-concepts and thereby identifying with the younger age they used to be” (Westerhof & Wurm, 2015, p. 148). This would provide especially older adults with a positive bias towards younger ages, as this fosters the identification with younger ages and age groups by enhancing their self-esteem and well-being – especially in cultures that devalue old age (cf., Weiss & Lang, 2009, 2012).

Due to empirical evidence from longitudinal studies, Westerhof and Wurm (2015) developed a heuristic model with suggested pathways on how subjective age might relate to psychological resources, health, and survival (see Figure 1). They conclude that subjective age leads to an accumulation of psychological resources that, in turn, help to maintain a good health, which contributes to survival. This process also includes feedback loops, meaning that a loss or gain in psychological resources or health can also have an influence on subjective age. Additionally, this process takes place in the individual and in the sociocultural context.

Figure 1. A heuristic model of pathways linking subjective age, psychological resources, health, and survival (Westerhof & Wurm, 2015).

Temporal Framing of Subjective Age

Montepare (2009) hypothesizes that subjective age is constructed by an internal evaluation process by which a person evaluates themselves to distal reference points in the past, present, and future (e.g., experience, current state, future outlook). However, it still remains unclear
which one of the three reference points has the greatest impact on the suggested self-evaluative process. In line with previous research on future time perspective (Gellert et al., 2012) or residual life expectancies (Ziegelmann et al., 2006), I assume that in the current dissertation the future component of this self-evaluative process plays a key role due to the future-oriented nature of the social-cognitive predictors (e.g., outcome expectation or self-efficacy) to predict changes in intentions to engage into physical activity and physical activity itself. Furthermore, this internal evaluation (Montepare, 2009) seems to be complemented by an external evaluation, as subjective age can be manipulated via downward social comparison by giving positive feedback about performance in comparison to the rest of the (chronological) age group (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013). This might also be related to findings that those who perceive themselves as younger, in comparison to their chronological age, are less susceptible to negative stereotypes of aging (Eibach, Mock, & Courtney, 2010), and hence might not behave in a stereotypical way.

In addition, I used subjective physical age as a domain-specific proxy of subjective age, asking specifically how old participants feel physically. This relates to past findings on other constructs, such as self-efficacy (Maibach & Murphy, 1995) or locus of control (Lachman, 1986), and is based on the assumption that such domain-specific measures would show a higher sensitivity for changes in the specific domain (but not another), as well as a higher explanatory value of such a specific measure in a specific context (cf., Lachman, 1986; Maibach & Murphy, 1995). Considering the notion of functional aspects of personal age, as suggested by Kastenbaum and colleagues (1972), this aspect of subjective age would reflect an aspect of physical functioning (see above).

The Relevance of Investigating Subjective Age

As briefly mentioned before, recent changes in age distributions in western populations towards an aging population have increased scientific effort to investigate the phenomenon of
age and the aging process. Current research mainly aims at the understanding of such processes and how negative effects of aging can be prolonged or reversed, especially in the fields of medicine and natural sciences (e.g., Tosato, Zamboni, Ferrini, & Cesari, 2007; Gomes et al., 2013). Understanding age and aging from a psychological perspective, however, can also draw on the subjective experience of the individual itself. Salthouse (1991) came to the conclusion that chronological age alone might not be a suitable proxy to explain age-related phenomena and that other constructs might be more suitable as long as they can provide additional information (e.g., by explaining additional variance). This might also hold true in the context of health and health behaviors. In the context of health behavior research, this additional value was already demonstrated by studies which focused on future time perspective (Gellert et al., 2012) or residual life expectancy (Ziegelmann et al., 2006a). Results on general subjective age in relation to health outcomes and dimensions of health lead to the suggestion that subjective age, and especially subjective physical age, might be worth investigating when studying health behaviors such as physical activity.

Barak and Stern (1986) showed modest to high correlations between subjective age and health on a correlational level (see Table 1). In addition to that, health (overall health, relative health, instrumental health, and chronic conditions) explains a moderate amount of variance in subjective age perception (Hubley & Hultsch, 1994) and that combinations of different health dimensions explain different facets of subjective age (e.g., feeling younger: vitality and satisfaction with health; feeling older: general health and physical functioning; Hulsch & Russell, 2009). This is also supported by findings in a cross-lagged study design with subjective age and different dimensions of health, providing support for the bivariate relationship between self-rated health and subjective age and the direct effects between subjective age, physical conditions, and mental health (Spuling, Miche, Wurm, & Wahl, 2013).

Further findings by Barak and Stern (1986) also highlight the relationship between subjective age and physical exercising, showing that those who feel younger also exercise more.
This link is also present in the heuristic model presented by Westerhof and Wurm (2015; see Figure 1) which assumes that health behaviors represent psychological resources which contribute to health and survival. This highlights the importance of health behaviors such as physical activity. A study by Caudroit, Stephan, Chalabaev, and Le Scanff (2012) dug deeper into this and showed that subjective age is related to intentions to engage in physical activity when moderated by self-efficacy. People who feel younger find it easier to form intentions to engage into physical activity when they also have a high self-efficacy (Caudroit et al., 2012). However, no current study has focused on the transition from intentions to engage into physical activity into the actual behavior under the lens of subjective age. Therefore, this will be the main purpose of my dissertation project.

**Explaining and Changing Health Behaviors**

Health behaviors, such as physical activity, play a key role in sustaining a healthy lifestyle and overall health throughout the lifespan. But how can such behaviors be established and sustained over time? Most people know about common recommendations for health behaviors, such as being physically active on a regular basis, keeping a balanced diet, refraining from smoking and drinking no or less alcohol. However, most people find it rather hard to engage into a healthy lifestyle and sustain or habituate lifestyle changes once established. While having good intentions to engage into such changes, most fail to translate such intentions into actual behavior (Sniehotta, Scholz, & Schwarzer, 2005). But why is that the case? Explanations for this can be drawn from models and theories of health behavior change (though the terms models and theories can be differentiated, they will be used interchangeable in this work). Such theories try to explain processes of health behavior change and maintenance via social-cognitive predictors of behavior change (cf., Conner & Norman, 2005). Various theories identified similar (e.g., locus of control and self-efficacy) or same (e.g., outcome expectations) of such social-cognitive predictors (see Table 2).
Table 2

Overview of social-cognitive predictors of health behaviors across different theories (Lippke & Ziegelmann, 2008)

<table>
<thead>
<tr>
<th>Theories</th>
<th>Self-efficacy</th>
<th>Outcome expectations</th>
<th>Risk Perception</th>
<th>Goals</th>
<th>Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBM</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PMT</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>TPB</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>SCT</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>TTM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HAPA</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*Note. HBM = Health Believe Model; PMT = Protection Motivation Theory; TPB = Theory of Planned Behavior; SCT = Social Cognitive Theory; TTM = Transtheoretical Model; HAPA = Health Action Process Approach*

Though there is an overlap of social cognitive predictors between the different theories, there are differences in their orchestration and hypothesized mechanisms (cf., Conner & Norman, 2005; Lippke & Ziegelmann, 2008). The Health Action Process Approach (HAPA; Schwarzer, 2008) especially takes all of social-cognitive determinants of the currently most known theories into account (see Table 2) and provides a good basis for the transfer of current findings of this dissertation into health behavior research which relies on other theories and constructs. Therefore, I have decided to make use of the HAPA as a theoretical background for several reasons which I will point out further in the following.
The Health Action Process Approach

The Health Action Process Approach (Schwarzer, 2008) represents a hybrid model which integrates components of several other theories of health behaviors (see Table 2). The HAPA differentiates three distinct stages and categorizes these into pre-intenders, intenders, and actors with individual needs and characteristics. This distinct separation between the stages would be shown by a discontinuity pattern for each of the three stages (cf., Lippke, Fleig, Pomp, & Schwarzer, 2010; Lippke & Plotnikoff, 2014) which would be characterized by the interplay of the following social-cognitive constructs for each stage. Separating the process of health behavior change has the advantage that it provides additional structure to research and findings, and makes it also easier to apply health behavior change strategies when investigating health behaviors and potential other antecedents that interrelate with such processes (e.g., subjective age). Therefore, the three stages are described in more detail below.

According to the HAPA, the pre-intentional stage has the aim to form intentions to engage in the target behavior and is characterized by motivational constructs and the absence of a goal (“I don’t have the intention to be physically active.”). One of these motivational constructs is the individual risk perception which is characterized by the individual appraisal of vulnerability and the severity of diseases (“I have a high risk to experience a heart attack.”). Furthermore, future oriented positive and negative outcome expectations also come into play (“Regular physical activity is good for my health.” and “Regular physical activity will cost me a lot of time.”). In addition to that, task self-efficacy also plays a key role in the formation of intentions (“I am confident that I can be physically active.”).

The intentional stage has the aim to support the realization of formed intentions into actual behavior and is characterized by self-regulatory, volitional constructs such as action and coping planning (Schwarzer, 2008). Action planning consists of concrete plans that help to engage in the behavior by defining situational cues like when, where, and how the behavior should be carried out (“I plan to take a walk each Monday at 6 pm.”). Coping planning con-
sists of a barrier management by anticipating potential problems and preparing suitable counter strategies beforehand (“When it is raining on Monday, I do some fitness at the gym instead.”). Additionally, maintenance self-efficacy helps to stick to the plan and the activities (“I am confident that I can initiate the behavior.” and “I am confident that I can maintain the behavior, even in the face of barriers.”).

![Figure 2. The Health Action Process Approach (HAPA; Schwarzer, 2008).](image)

The action stage is characterized by a constant, self-regulatory monitoring of the behavior. In this stage it is important to shield the intention and the behavior from potential distractions and to monitor the behavior and progress subsequently. Also, recovery self-efficacy is important in this stage as a crucial component to overcome relapses and to re-initiate and maintain the behavior again.

The HAPA provided the theoretical background for a study to explain intentions to engage into physical activity in relation to general subjective age beforehand (cf., Caudroit et al., 2012). However, this study only focused on the pre-intentional stage, leaving a research gap to be investigated concerning the intentional and action stage. Applying the HAPA as a theoretical framework in this dissertation also helps to interpret findings in the light of previous research and helps to connect the different findings with past studies. Furthermore, the comprehensive composition of the HAPA concerning social-cognitive predictors of health behav-
iors will help to transfer parts of this dissertation into other fields of health behavior research which might also apply to other theories to explain health behaviors (see Table 2).

**Self-Regulation in Health Behaviors**

Self-regulatory abilities are a key component in the process of adopting and changing health behaviors within the HAPA’s intentional and action stage (see Table 2 & Figure 2). Self-regulation represents the ability of an individual to attain and pursue goals, including initiated and automated processes with a strong focus on these goals. Besides goal setting, goal striving is one of the two major domains of self-regulation (Mann, de Ridder, & Fujita, 2013). Goal striving presents the planning and execution of actions to facilitate processes of goal attainment and shielding of such goals from potential disruptions. In their review, Mann et al. (2013) conclude that self-regulation is especially important for goal striving by meeting two self-regulatory challenges: 1) to plan and execute behaviors that promote goal attainment by knowing what they can do and when to act; 2) to manage and overcome threats by frustration, temptations, and distractions people face to protect valued goals. Mann and colleagues (2013) identified four major strategies to address these challenges: *prospection and planning, automating behavior, construal,* and *effortful inhibition*. As I will focus on the intentional stage of the HAPA, prospection and planning, and subsequent anticipation are of particularly great importance as they draw on a future oriented framing, as suggested for subjective age (Montepare, 2009).

Self-regulatory effort is an essential feature of the intentional stage in the HAPA (cf., Schwarzer, 2008; Sniehotta et al., 2005). Several studies show the potential importance and effectiveness of such prospective planning components for health behaviors. For example, Sniehotta et al. (2005) demonstrated the effectiveness of planning and action control in a cardiac rehab patient sample by testing the model structure of the HAPA by disentangling the so-called intention-behavior gap. Accordingly, to translate intentions into actual behavior via
goal striving, planning seems to be an adequate construct. As mentioned above, *action plans* help people to specify what, where, when and how long they want to perform the specific behavior after setting their goals and *coping plans* help to anticipate barriers that are experienced in daily life and pose a threat to maintaining the behaviors people want to pursue. Gollwitzer and Sheeran (2006) showed that self-regulatory strategies, which help to initiate behavior, are of importance when striving for goals (actions plans; $d = 0.61$), and in maintaining behaviors in the face of barriers (coping plans; $d = 0.77$). This highlights the importance of planning in the process of adopting and pursuing behavior-related goals.

**The internet as a Vehicle for Health Behavior Research**

Technical advances in internet raised the interest of social scientists to use it as a vehicle for their (behavioral) research. Using the internet for research provides several advantages, but also confronts researchers with problems and disadvantages. I will outline both, advantages and disadvantages, in the following and provide arguments why I have decided to use the internet at the end of this section.

In general, the internet seems to offer promising approaches to undertake psychological research (cf., Reips & Bosnjak, 2001). Not only questionnaires are realized in such a context, but also intervention research and psychological experiments (Reips, 2002). With an increasing access of the population to broadband internet, current research shows a steadily increase of internet users throughout every age group. Not only is the increasing accessibility one of the biggest pros of internet research, but also that very diverse samples from different areas (urban, sub-urban, countryside) can be reached for questioning and studying (Rademacher & Lippke, 2007). Currently about 77% of the German population uses the internet and another ~3% plans to use the internet in the near future (Initiative D21, 2014). The current age structure of internet users in Germany allows especially for studying persons in younger and middle aged cohorts with still fair amounts of users in the older age groups (see Table 3; Initiative
D21, 2014). Data show that younger persons and higher educated individuals especially make use of the internet (Initiative D21, 2014). In addition to that, online studies can provide already filled in data sets with additional information like the time someone took to fill in the questionnaire (Reips & Bosnjak, 2001).

### Table 3

**Internet users according to age groups (Initiative D21, 2014)**

<table>
<thead>
<tr>
<th>Year</th>
<th>20 – 29 years</th>
<th>30 – 39 years</th>
<th>40 – 49 years</th>
<th>50 – 59 years</th>
<th>60 – 69 years</th>
<th>70+ years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>98.1%</td>
<td>94.8%</td>
<td>90.5%</td>
<td>79.1%</td>
<td>64.5%</td>
<td>29.4%</td>
</tr>
</tbody>
</table>

Health behavior research also makes use of the internet to access this population by helping people to establish and sustain health behaviors and health behavior changes (e.g., physical activity) by recruiting people to fill in online questionnaires or providing online interventions (e.g., Reinwand et al., 2013). Studies show that there are no differences in the reliability and validity of paper and pencil or online questionnaires (Riva, Teruzzi, & Anolli, 2004). Given this, the internet seems to provide a feasible means for studying the broader population.

### Objectives

The aim of this dissertation is to investigate the importance of a domain specific subjective age component, subjective physical age, in the light of health behavior and health behavior change, specifically for physical activity, to identify subjective physical age as a potential predictor for physical activity. This will be done by applying (advanced) multivariate statistical methods to test whether subjective physical age significantly contributes to the prediction
of physical activity besides chronological age. In addition to that, the dissertation will investigate the role of self-regulatory planning as a mediator between subjective physical age and physical activity. Another objective of the dissertation is the investigation of differences in social-cognitive predictors between those who feel physically younger, those who feel physically as old as they are in terms of their chronological age, and those who feel physically older. Hence, the major aim of the current dissertation is to show the additional effect of considering subjective physical age as an important predictor for physical activity in health behavior change research and to highlight differences between the three aforementioned groups.

**Outline of Dissertation**

*Chapter 2* provides a first validation of the subjective physical age measure by incremental and external validation. Furthermore, I tested if subjective physical age has an influence on physical activity. This was done by testing for linear effects of subjective physical age and self-reported physical activity when controlling for chronological age, social-cognitive predictors of physical activity, and self-regulatory skills. This was also to test for additional predictive value of subjective physical age in terms of additional explained variance in physical activity after 4 weeks. Data were drawn from an observational study in which social-cognitive and self-regulatory constructs as well as self-reported physical activity and subjective physical age were assessed.

In addition to Chapter 2, in *Chapter 3* a non-linear relationship between subjective physical age and physical activity was tested to explain if those who feel younger are more active because of self-regulatory planning. Here, a mediating effect between subjective physical age and self-reported physical activity is hypothesized on the basis of previous research on health behavior change models and results provided by *Chapter 2*. This was done while also including health status, chronological age, intentions and past behavior as predicting variables.
*Chapter 4* investigates differences in social-cognitive predictors of health behavior change and principle HAPA mechanisms between those who feel physically younger than they are, as old as they are, and older as they are. Significant mean differences between all three groups were expected – especially those who feel younger should differ from the other two groups. Differences in principle HAPA mechanisms were expected as well.

*Chapter 5* summarizes the results of the previous chapters and discusses their findings and implications. All chapters provide an independent insight and might be read without knowledge about the prior ones. Theoretical interrelations are described in *Chapter 1* and associations in their findings are summarized in *Chapter 5*. The last chapter provides theoretical implications for health behavior research, recommendations for future research as well as potential applications for health promotion.
Figure 3. Structure of the empirical chapters.

- **Chapter 2**: Direct effect
  - Two Measurement Points
  - Used variables & covariates:
    - Gender, Marital Status, School Education, Vocational Training, Employment Status, Health Status, Chronological Age, Subjective Physical Age, Self-Efficacy, Action Plans, Coping Plans, Past Physical Activity, Subsequent Physical Activity

- **Chapter 3**: Mediation and indirect effect
  - Health Status, Chronological Age, Subjective Physical Age, Intention, Past Physical Activity, Action Planning, Coping Planning, Subsequent Physical Activity

- **Chapter 4**: Group differences in HAPA constructs & mechanisms
  - Subjective Physical Age, Vulnerability, Positive & Negative Outcome Expectations Intention, Action Planning, Coping Planning, HAPA-Stages
References


2

Direct Effects of a Domain Specific Subjective Age Measure on Self-Reported Physical Activity

Wienert, J., Kuhlmann, T., & Lippke, S. Direct effects of a domain specific subjective age measure on self-reported physical activity – Is it more important how old you are or how old you feel? Manuscript submitted for publication to European Journal of Ageing.
Abstract

Research has shown that physical activity is important for healthy aging. At the same time, physical activity and different age factors are connected. The present study investigated whether subjective physical age and chronological age are significantly interrelated with physical activity over time. A study design with baseline assessment and a 4 week follow up period was conducted with an online sample \((n = 543)\), aged 25 – 78 years \((M = 39.70, SD = 10.85)\). Regression analysis with enter method was used to predict subsequent physical activity by baseline predictors. Subjective physical age intercorrelates with chronological age, and subjective physical age predicted subsequent physical activity when controlling for baseline variables until past behavior was entered. Subjective physical age seems to be more important for physical activity than chronological age. This is an important finding as subjective physical age might be intervened on to enable individuals becoming more physically active.

Key words: subjective age, domain specific measure, social cognitive predictors, online study
Introduction

Maintaining a healthy lifestyle throughout the lifespan is an important factor in the prevention of chronic diseases (e.g. for cardiovascular diseases: Archer and Blair 2011). A sufficient amount of physical activity contributes to such a lifestyle and has a positive impact on health (WHO 2010). The broad population is probably well aware of the benefits of regular physical activity and risks of inactivity, most do not meet common recommendations, though they might have the right intentions to engage into a more active lifestyle (Rhodes and de Bruijn 2013). Engaging in and maintaining an active lifestyle receives more attention considering the advancing demographic changes in some societies, since active individuals report a better physical and mental health (Bertheussen et al. 2011). In line with Salthouse (1991) some studies in the context of health behavior research provided support for his argument that chronological age alone might not be a suitable predictor, as long as other age concepts can also contribute to the explanation of age-related phenomena (cf., Gellert, Ziegelmann, Lippke, and Schwarzer 2012; Kotter-Grühn, Grühn, and Smith 2010; Ziegelmann, Lippke, and Schwarzer 2006). On of such age concepts could be subjective age. The current study focused on subjective physical age, as a possible domain of subjective age, and investigated its’ predictive value in the explanation of physical activity as a starting point for future research.

Overall subjective age seems to be a promising construct to investigate health and different health domains. This has already been shown on a correlational level for physical and mental health (Barak and Stern 1986; Kleinspehn-Ammerlahn, Kotter-Grühn, and Smith 2008) and in a crossed-lagged study with different health domains (Spuling, Miche, Wurm, and Wahl 2013) indicating that those who feel younger report better health in some domains. Furthermore, subjective age explained between 10% and 15% of variance in health in a study by Hubley and Hultsch (1994). Additionally, those who indicate a younger subjective age also seem to have higher intention to engage into physical activity when self-efficacy is also high (Caudroit, Stephan, Chalabaev, and Le Scanff 2012).

Social-cognitive theories of health behavior change have been proven to provide successful means when modeling physical activity (cf., Conner and Norman 2005; Lippke and Ziegelmann 2008), especially when they consider the so called intention-behavior-gap (e.g., planning: Schwarzer 2008). One of such models is the Health Action Process Approach (HAPA; Schwarzer 2008), which includes various social-cognitive predictors for health behavior change.

Predictors for health behavior
Besides the assumed modeling of health behavior, the HAPA provides information about basal social-cognitive predictors for the adoption and maintenance of health behaviors, such as physical activity. In general, the HAPA separates them in *motivational* and *volitional* constructs. Motivational constructs focus on the formation and implementation of intentions to engage into the target behavior. Such constructs are risk perception, and positive and negative outcome expectations. These are associated with a future perspective on the target behavior and ideally benefit the formation of intentions to engage into the behavior (Schwarzer, 2008). Volitional constructs represent self-regulatory efforts and help to translate good intentions into actual behavior. Such constructs include action planning as a means to engage into the behavior and coping planning to deal with anticipated barriers by building counter strategies and subsequent mindsets (Schwarzer 2008). Gholami, Knoll, & Schwarzer (submitted for publication) report small to medium effect sizes on health behavior change for all HAPA components, except risk perception. This was also shown specifically for physical activity in three longitudinal studies with rehabilitation samples (Schwarzer et al. 2008) and for self-efficacy and planning (e.g., Kreausukon, Gellert, Lippke, and Schwarzer 2012; Koring et al. 2012; Mullen et al. 2012).

**Subjective Age**

Theory describes subjective age as the outcome of a self-evaluative process of distal reference points in the past, present, and future (Montepare 2009) and is usually operationalized as the difference between chronological age and the indicated perceived age, the age a person perceives to feel (Barak and Stern, 1986; Kleinspehn-Ammerlahn et al. 2008). Stephan, Chalabaev, Kotter-Grühn, and Jaconelli (2013) showed that subjective age can be manipulated via downward social comparison. This would complement the suggested internal self-evaluation with an external, comparative evaluation. Additionally, those who feel subjectively younger seem to be less susceptible for negative aging stereotypes (Eibach, Mock, and Courtney 2010), hence might not behave in a stereotypical way. Subjective age also seems to be associated with health and well-being, which was shown by several studies. Those who feel younger report a better health or higher well-being in different domains and better outcomes on other health indicators (Demakakos, Gjonca, and Nazroo 2007; Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, and Smith 2009; Westerhof and Barrett 2005). Furthermore, a higher self-efficacy also seems to be associated to a younger subjective age (Boehmer 2007).

The current study also draws on results from research on domain specificity. For measures such as self-efficacy (Maibach and Murphy 1995) and locus of control (Lachman 1986) domain specificity has been shown to increase validity and interrelation with other measures. Thus, the current study uses *subjective physical age* as
a domain specific measure of subjective age. We suggest that this might also provide similar benefits as for other measures, namely a higher explanatory value and a higher sensitivity for changes in one domain (cf., Lachman 1986; Maibach and Murphy 1995).

**Aims**

The present study will focus on exploratory testing of hypotheses by building on past findings from a study by Caudroit and colleagues (2012) which investigated the influence of subjective age on the forming of intentions to engage in physical activity. We explored differences in chronological and subjective physical age when predicting self-reported physical activity using motivational and volitional components of the HAPA as the theoretical outline. The study will provide a more detailed understanding of how chronological and subjective age might differ in predicting physical activity. This will be done by measuring domain specific subjective age via subjective physical age.

The study will provide first insights if chronological age or subjective physical age might be more influential for self-reported physical activity after 4 weeks in an observational online study. This was done by testing for a direct relationship of subjective age on intentions to engage into physical activity which is moderated by self-efficacy. Following this, the present study will focus on testing the direct relationship between subjective physical age and self-reported physical activity when controlling for sociodemographic variables, health status, chronological age, self-efficacy, action planning, and coping planning. Specifically we investigated whether high intercorrelations between chronological age and subjective physical age exist (Hypothesis 1) to test for similar effects compared to general subjective age (cf., Barak and Stern 1986). Given the past results concerning general subjective age and health outcomes, it is expected that subjective physical age shows an inverse direct relationship with physical activity, indicating that people who feel physically younger show an increase in self-reported physical activity (Hypothesis 2). Furthermore, physical subjective age is assumed to be a better predictor for self-reported physical activity in comparison to chronological age (Hypothesis 3) when testing for direct effects. The latter would indicate that additional variance can be explained by subjective physical age, which would highlight the additional predictive value for physical activity besides other strong predictors.

**Method**

**Sample and Participant Selection**
This study was carried out as an online survey for which participants from various sources were recruited (e.g., newspaper, flyer, radio), using the software *dynQuest* (Rademacher and Lippke 2007). After informed consent was given, participants followed a link to a self-administered questionnaire (t1). After four weeks, they received an e-mail invitation to answer a follow-up online questionnaire (t2). In total, 2201 potential participants responded to the initial website with the questionnaire. Warm-up questions were applied at t1 (first five questions) to ensure sincerity of participation, and to reduce the impact of drop-out from the study itself (Reips 2002). In total, 158 participants decided to quit during the warm-up phase, and were excluded from the subsequent analyses. Furthermore, 480 participants were excluded from subsequent analyses because they did not meet the inclusion criteria (missing values on relevant constructs at t1 and t2). Outlier analysis for inconsistent replies was performed (three standard deviations of subjective age measures), excluding 21 more participants. The crossover point of subjective age at 25 years has been applied to the data to ensure same meaning of subjective age for the initial sample (cf., Galambos, Turner, and Tilton-Weaver 2005), yielding for 112 study participants to be excluded. During the 4 week period between t1 and t2, 888 participants dropped out of the study (see Figure 1).

**Figure 1 Study exclusion and drop-out.**
Significant differences ($p < .05$) between study drop out and study participants occurred in terms of gender (more men dropped out), school education (more participants with lower education dropped out), vocational education (more participants with a lower vocational qualification dropped out), exercise related coping plans (participants who left the study made more use of plans) and exercise behavior (participants who left the study exercised less).

The final sample consisted of 543 (24.6%) participants for the analyses to predict physical activity, aged 25 to 78 years, with a mean age of $M = 39.70$ ($SD = 10.85$) to draw general conclusions over a wide life-span. Of the initial sample 71.4% were women, 58.4% were living with a partner, 80% had completed senior high school, and 61.4% of them held a university degree.

**Independent Measures**

Past studies displayed the significant role of predictors like self-efficacy and planning on health behavior (e.g., Kreauskon, Gellert, Lippke, & Schwarzer, 2012; Koring et al., 2012; Mullen et al., 2012). These predictors were included in the subsequent analysis as independent variables, to show the additional predictive value by using chronological and subjective physical age. The independent variables are stated in the following.

**Age measures.** Age measures are differentiated into chronological age and subjective physical age. Besides the usual question “How old are you?”, participants were asked “How old do you feel physically?” and “How old do you feel cognitively?”. In line with previous subjective age research, a difference score for both measures was calculated (perceived age – chronological age = subjective age), resulting in a subjective physical age score. A negative value represents a youthful subjective age, and a positive value represents an older subjective age.

**Health status.** Current health status has been assessed via single item from the German SF-12 (Bullinger and Kirchberger 1998) asking, “In general, would you say your health is” recoding the answer format for the analysis ($1 = poor$, $2 = fair$, $3 = good$, $4 = very good$, $5 = excellent$).

**Self-Efficacy.** Three types of self-efficacy were assessed, each with three items ($1 = totally disagree$, $2 = disagree$, $3 = agree$, $4 = totally agree$): motivational (e.g., “I am confident that I can be physically active for 30 minutes on 5 days a week”), maintenance (e.g., “I am confident that I can do at least 30 minutes of strenuous physical activity 5 days a week, even though I need a few attempts”), and recovery self-efficacy (i.e. “I am confident that I can be physically active for 30 minutes on 5 days a week again, even though I adapted my concrete plans to do so several times”). Due to a single factor structure and to reduce the amount of information, all self-
efficacy measures were aggregated to an overall score by averaging. Cronbach’s Alpha for the aggregated physical activity items was .87 (9 items).

**Planning.** To delineate differences in planning, action plans and coping plans were assessed (1 = totally disagree, 2 = disagree, 3 = agree, 4 = totally agree). Three action plan items were used to specify the concrete performance and the setting related to the behavior, stating, “I already made detailed plans of when and how often I would like to be physically active” (Cronbach’s α = .91). Three coping plan items were used to specify if people were able to deal with certain barriers while performing the behavior, asking, “I already made detailed plans, what I can do in difficult situations to stick to my goals” (Cronbach’s α = .85).

**Dependent Measures**

**Behavior.** Physical activity was assessed by asking how often (1 = less than 1 time a week for 30 minutes, 2 = at least 1 time a week for 30 minutes or more, 3 = at least 3 times a week for 30 minutes or more, 4 = at least 5 times a week for 30 minutes or more) within the last month the person had been active in terms of physical fitness (e.g., going to the fitness studio), active commuting (e.g., taking the bicycle instead of the bus or car) and physical activities in daily life (e.g., gardening). All three indicators correlated significantly at p < .01 and were aggregated to represent the broadness of the construct (discriminant validity; Lippke, Ziegelmann, Schwarzer, and Velicer 2009).

**Data Analysis**

We used Pearson’s correlation coefficient to calculate the relationship between age measures and all variables used in following analysis, to explore intercorrelations and possible problems with multicollinearity. Hierarchical multiple regression analysis with the ‘enter method’ for the independent measures at t2 was applied to test further hypotheses using SPSS 20.0 software. In the first step of every regression analysis, background variables were included to control for sex, marital status, education status, and employment status. Furthermore, the variance inflation factor (VIF) and the tolerance were checked for multicollinearity. No predictor raised serious concern for multicollinearity regarding a cut off at 10 for the VIF and tolerance values below 0.2 (Field, 2009).

**Results**

Chronological age showed a significant interrelation with perceived physical age (r(541) = .83, p < .01). Additionally perceived physical age significantly correlated with physical activity at both measurement points as
Direct Effects of a Domain Specific Subjective Age Measure on Self-Reported Physical Activity

well (T1: \( r(541) = -0.10, p < .05 \); T2: \( r(541) = -0.12, p < .01 \)). Subjective physical age was significantly interrelated with all other variables related to the HAPA at \( p < .01 \), except action plans at t1 (see Table 1).

Step 1 included control variables (gender, marital status, school education, vocational training, employment status, and health status). Step 2 included chronological age, step 3 included subjective physical age, step 4 included self-efficacy, step 5 included action planning, step 6 coping planning, and step 7 past physical activity.

Predicting Physical Activity

At Step 1, control variables were entered into the model, of which only employment status (\( B = .09, t(541) = 2.24, p < .05 \)) and health status (\( B = .26, t(541) = 6.19, p < .001 \)) were significant. Chronological age entered the model at Step 2 (\( B = .02, t(541) = 0.33, n.s. \), not reported in Table 2) and subjective physical age at Step 3 (\( B = -0.14, t(541) = -2.85, p < .01 \)). Behavior specific self-efficacy entered the model at Step 4 (\( B = .21, t(541) = 4.88, p < .001 \), not reported in Table 2). Action plans entered the model at Step 5 (\( B = .23, t(541) = 5.34, p < .001 \), not reported in Table 3), and coping plans at Step 6 (\( B = .10, t(541) = 2.09, p < .05 \)). Past behavior at t1 entered the model at Step 7 (\( B = .43, t(541) = 10.60, p < .001 \)). Until the sixth step of the model, subjective physical age was able to predict subsequent physical activity (\( B = -0.12, t(541) = -2.63, p < .05 \)) among employment status (\( B = .10, t(541) = 2.54, p < .05 \)), health status (\( B = .12, t(541) = 2.78, p < .01 \)), self-efficacy (\( B = .12, t(541) = 2.63, p < .01 \)), action plans (\( B = .19, t(541) = 4.03, p < .001 \)), and coping plans (\( B = .10, t(541) = 2.09, p < .05 \)). When past physical activity was entered in step 7 only action plans remained significant predictors next to past behavior. In this model 33% of the variance could be explained by the variables.

Discussion

As expected, chronological age and subjective physical age correlated significantly with each other and health status replicating previous findings for subjective age (Barak and Stern 1986). These findings strengthen the argument to place subjective physical age in the common body of subjective age literature, by providing incremental validity in predicting health behavior. Subjective physical age was among the most important predictors for physical activity behavior at t2 until past physical activity entered the final model. The study confirmed that subjective physical age shows a significant intercorrelation with chronological age (H1), and that subjective physical age is another predictor of physical activity besides common predictors (H3). However, when past behavior was regarded, subjective age was not a significant predictor anymore. This might be explained by the high overlap between subjective physical age and health.
Subjective physical age showed a negative relationship with physical activity. Considering that a negative score indicates a younger subjective age, partial confirmation was given that subjective age measures show negative association with physical activity after 4 weeks, meaning that individuals who feel physically younger also show healthier behavior – in this case physical activity (H2). However, results should be interpreted with caution as past behavior explained a large amount of variance in the final step of the model, rendering most predictors to be non-significant.

Correlational findings on subjective physical age seem to stand in line with previous findings on subjective age and health, showing an inverse relationship with physical activity. This might be explained by the often stated value of youth in western societies, which has been mentioned in past studies (Barak and Stern 1986; Montepare and Lachman 1989). A high level of physical fitness might be accountable for more youthful age identities and outdated stereotypes of aging (Montepare 2006; Stephan et al. 2012). This delineates what
Table 1

*Intercorrelations, Means, and Standard Deviations for Age Measures, Self-Efficacy, Plans for Physical Activity Behavior (N=543)*

<table>
<thead>
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<th>Variable</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>M</th>
<th>SD</th>
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<td>-0.19***</td>
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<td>-0.24***</td>
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<td>0.01</td>
<td>-0.12**</td>
<td>-0.21***</td>
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</table>

Note. * p < .05, ** p < .01, *** p < .001
Table 2

Hierarchical Multiple Regression Analysis Predicting Physical Activity After 4 Weeks (N=543)

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<tr>
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<th>$\Delta R^2$</th>
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<td>&lt;.01</td>
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<td>.01</td>
<td>-.14**</td>
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<td>.12**</td>
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<td>-.07</td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>.05</td>
<td>.04</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>Action plans</td>
<td>.08</td>
<td>.03</td>
<td>.11*</td>
<td></td>
</tr>
<tr>
<td>Coping plans</td>
<td>.03</td>
<td>.04</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Past physical activity</td>
<td>.45</td>
<td>.04</td>
<td>.43***</td>
<td></td>
</tr>
</tbody>
</table>

$R^2$                               | .33  |
$N$                                 | 543  |

Note: * $p < .05$. ** $p < .01$. *** $p < .001$.

$^1$ Control variables are included in every step of the regression analysis. Steps 4 and 5 were excluded from the subsequent table to reduce the information. This information can be obtained from the authors.
Caudroit and colleagues (2012) state as the bidirectional relationship of subjective age, which might be influenced by a still predominant biomedical model of health and illness where physical health is of great importance. Findings on the bidirectional effect between subjective age and self-rated health by Spuling and colleagues (2013) could support this explanation. This bi-directional effect was also supported by a study by Knoll, Rieckmann, Scholz, and Schwarzer (2004) who reported that physical limitations after cataract surgery might be of greater importance in the construction of subjective age. Wurm, Tomasik, and Tesch-Römer (2008) found this in relationship to positive views on aging. This might be a result of self-evaluation of ones’ physical condition (cf., Montepare 2009). Those who experience less impairments and problems might feel physically younger, and are therefore more likely to engage in active lifestyles. Future causal research is needed to support this assumption.

**Study Limitations and Future Directions**

One limitation of this study refers to the measurement of physical activity and social cognitions by self-report. There is evidence that self-reports overestimate physical activity (Gillison, Standage, and Skevington 2006), but also evidence for the validity of self-reports in physical activity (Miller, Freedson, and Kline 1994). Future studies could examine physical activity objectively, in order to provide more validation to the current findings.

Generalization of the study results is limited due to the given sample characteristics. High drop-out from t1 to t2 also leads to the suggestion that selected persons continued to participate in the study, leading to a biased subgroup of the initial sample. However, according to Frick, Bächtinger, and Reips (2001) and Reips (2002), drop-out is always an issue in online research and not unusual especially when no incentives are given. Therefore, future studies could aim to retain more study participants in the study by providing incentives for continued participation (e.g., a voucher). Future studies should also be realized in change settings where interventions address social cognitive predictors over a longer time period to make changes more visible.

**Implications and Conclusions**

By studying subjective physical age as a part of health behavior processes, some implications can be drawn for current research and field projects. Our results show the significant impact of domain specific subjective physical age on self-reported physical activity. This implies that subjective physical age should be considered in the development of interventions targeting health behaviors, especially physical activity. Such an approach can be especially
helpful for so called *tailored interventions*, which are personalized by a variety of factors to increase commitment and adherence of intervention participants due to a higher personal relevance of the provided content (Hawkins et al. 2008). Social comparison could be one approach to do so by inducing younger subjective age identities via tailored messages or providing appropriate reference groups for comparison to intervene on subjective physical age (Stephan et al. 2013).

For health behaviors, planning and the prioritization of goals seem to be of great importance (Gollwitzer 1993; Reuter et al. 2010; Wiedemann et al. 2011). Therefore, research in self-regulatory strategies might be of interest in relation to subjective physical age and physical activity. Furthermore, research in aging and health behavior should consider subjective physical age measures as a suitable predictor for physical activity, and should consider this during the process of study planning.
References


Direct Effects of a Domain Specific Subjective Age Measure on Self-Reported Physical Activity


Montepare JM, Lachman, ME (1989) “You’re only as old as you feel”: Self-perceptions of age, fears of aging, and life satisfaction from adolescent to old age. Psychol Aging 4: 73–78. doi: 10.1037/0882-7974.4.1.73


3

Adopting and Maintaining Physical Activity Across the Life-Span: The Importance of Subjective Physical Age and Planning Mediating Intention into Physical Activity

Abstract

Purpose

The current study aimed at investigating the role of subjective physical age for adopting and maintaining physical activity. Furthermore, we tested whether the relationship between subjective age and activity is mediated by planning.

Methods

In an online sample, $N = 1,358$ participants were interviewed at two measurement points. Structural equation modeling was applied to test the relationship between the investigated variables.

Results

The model showed a good fit (CFI = .97, TLI = .94, RMSEA = .05) and supported the mediating role of planning via an indirect path ($\beta = -.02$, $S.E. = .01$, $p = .032$).

Conclusion

The results provide support that those who feel physically younger make more use of planning as a self-regulatory skill to adopt higher levels of physical activity. This opens avenues for future interventions helping people to become more active.

Key words: subjective age, planning, self-regulation, intention-behavior-gap, health behavior
Introduction

Maintaining a healthy lifestyle throughout the life course is crucial for general health – especially in old age. Health behavior, and especially physical activity, can help to prevent a variety of acute and chronic diseases throughout the life-span of human development and is beneficial for health and well-being [1-2]. Even though many people know about this, most of them do not meet common recommendation for physical activity (e.g., being active for at least 30 minutes for 5 days a week). This seems to be especially true for aging populations, as older individuals tend to engage less in physical activity [3].

Past research showed that especially health status is strongly related to feeling younger (subjective age) and younger age identities [4]. Health is also a valued goal in old age [5] which is in turn related to higher levels of physical activity [1-2]. Other studies showed that older individuals find it generally hard to apply self-regulatory strategies (e.g. when creating plans to engage in physical activity) [6], however planning seems to be a useful means in higher older age groups (age measured according to the calendar) to engage in physical activity [7].

These findings might not hold true for subjective age due to higher resources (e.g., SOC-Strategies) [8] or due to a cultivation of self-regulatory abilities throughout the life-course, which might be an indicator for successful aging as suggested by Montepare [9]. Past research showed that subjective age predicts intentions to engage in physical activity when mediated by self-efficacy [10] while controlling for chronological age and health behaviors (physical activity) [4].

Other studies also showed the significant role of predictors like planning and past behavior, which are related to current and subsequent health behavior [11]. Furthermore, other researchers showed that health status and subjective age seem to have an overlap or at least an interrelation,
as health explains up to 15% in subjective age variance [10, 12]. Caudroit and colleagues [10] showed that subjective age is related to behavior intentions via mediation by self-efficacy. Thus past behavior and health status seem to be important correlates when investigating the relation between subjective age and physical activity. Among other social-cognitive predictors that facilitate these behaviors, self-regulatory strategies such as planning, are proposed by models like the Health Action Process Approach (HAPA) [13] to mediate the relationship between intentions to engage in health behaviors.

Intention and Planning

Formed intentions are a necessary antecedent to goal achievement/realize behavior change. However, past research has shown that intentions alone are not sufficient enough to do so, leading to the so called intention-behavior-gap, as many fail to translate good intentions into actual behavior [13-14]. Further studies showed that self-regulatory strategies – such as planning – can help to bridge this gap [14]. Mann, de Ridder, and Fujita [15] also concluded that self-regulation is especially important for goal striving by meeting two self-regulatory challenges: 1) to plan and execute behaviors that promote goal attainment by knowing what they can do and when to act; 2) to manage and overcome threats due to frustration, temptations, and distractions people need to protect valued goals from such distractions. Mann and colleagues [15] identified four major strategies to address these challenges. One of these strategies is prospective planning and anticipation. To translate intentions/goal striving into actual behavior, planning seems to be an adequate vehicle [13]. Action plans help people to specify what, where, when and how long they want to perform the specific behavior after setting their goals and coping plans help to anticipate and overcome barriers that are experienced in daily life and pose a threat to maintaining behav-
Adopting and Maintaining Physical Activity Across the Life-Span: The Importance of Subjective Physical Age and Planning Mediating Intention into Physical Activity

iors people want to pursue. Furthermore, action planning and coping planning seem to be suitable strategies to cross the intention-behavior gap across the lifespan [16].

Gollwitzer and Sheeran [17] showed that self-regulatory strategies, which help to initiate behavior, are of importance when striving for goals (actions plans; $d = .61$), and in maintaining behaviors in the face of barriers (coping plans; $d = .77$). These results are backed up by a recent meta-analysis on implementation intentions focusing on physical activity: Though the effect sizes are small to medium, the authors point out the supporting role of such strategies to promote physical activity – especially when barrier management is part of it [18].

Subjective age

From a theoretical perspective subjective age is defined as a self-evaluative process of past, present and future points in time [9]. Current research suggests the importance of social comparison to explain subjective age perceptions and the predominant phenomenon of older age groups feeling younger [19]. This would complement the internal evaluation (e.g. How fit am I?) by an external evaluation (e.g. How fit am I compared to …?). One predominant facet of subjective age is so called *perceived age or felt age*, indicating how old a person feels. Here subjective age is referred to as the difference between perceived age and chronological age and was thoroughly investigated by Barak and colleagues [4, 20].

Subjective age has rarely been assessed by distinguishing between different domains of aging [4, 20-21]. Domain specific measurement has several advantages in comparison to generalized measurement, as this has been pointed out for constructs like locus of control [22] or self-efficacy [23]. Such advantages would be better explanatory and predictive value [23] and higher
sensitivity for changes that occur in one domain, but not another, which would not be assessed by generalized measures [22].

Previous studies of subjective age showed that this age measure comes to contraindicative results when compared to findings in chronological age. Barak and Stern [4] showed that physical health, cognitive health, and physical activity are important correlates of subjective age: those who feel younger report a better health and higher levels of activity. This holds also true for well-being and other health indicators [24-26].

In order to better understand the role of subjective age in physical activity, the current study investigated if subjective physical age is a predictor of physical activity, and whether self-regulatory planning mediates the effect of subjective physical age on physical activity. The main rational of the current study is that individuals who feel younger are seemingly less susceptible for negative stereotypes of aging [27], and in line with Caudroit and colleagues [10], we expect that subjective physical age predicts counter-stereotypical behavior such as making more use of plans to engage in physical activity. Furthermore, future orientation is usually associated with self-regulatory planning [28] as those individuals who feel physically younger use more planning to engage in future oriented activities such as physical activity when perceiving an extended future time perspective. This should be indicated by a negative path between subjective physical age and planning, a positive path between planning and subsequent physical activity, and a negative indirect effect.

**Aim**

The current study investigated the predictive value of domain specific subjective age, precisely subjective physical age, for physical activity in an online sample with two measurement points.
The study tested structural assumptions on the relationship between subjective physical age, planning, and physical activity. Considering previous findings on planning skills in older individuals, we hypothesized that planning mediates the relationship between subjective physical age and physical activity when controlled for other central determinants of behavior change.

**Method**

Sample and Participant Selection

The sample participated in an observational online study with two measurement points using the software *dynQuest* [29]. Initially $N = 2,201$ participants took part in the survey of which $n = 566$ participated in the second measurement point four weeks later. Outlier analysis was performed (three standard deviations of subjective age measure) and resulted in excluding $n = 21$ more participants. Galambos, Turner, and Tilton-Weaver [30] investigated at which chronological age the *personal meaning* of subjective age changes. According to their study, this point is at a chronological age of 25.5 years [30]. This cross-over point has been applied to the current data to ensure same personal meaning of subjective physical age for all participants.

Significant differences ($p < .05$) between study dropouts and participants who remained in the study at Time 2 occurred in terms of gender (more men dropped out), school education (more people with lower education dropped out), vocational education (more people with a lower vocational qualification dropped out), coping plans (participants who left the study made more use of plans) and behavior (participants who left the study were less physically active).

To adjust parameter estimation for selective dropout, *Full Information Maximum-Likelihood-Estimation* (FIML) was applied [31, 32]. As opposed to missing value imputation procedures or
listwise deletion, where data would be added or deleted, FIML estimates the variance-covariance matrix on basis of all information available in the data [31]. Hence, the parameter estimates are based on all available T1 and T2 cases. Furthermore, Enders [31] points out that it is reasonable to expect that FIML estimates reflect the true parameter value, even when listwise deletion is unbiased. Overall parameters of the final study sample of \( n = 1,356 \) cases were estimated.

The age of the sample ranges from 25 to 79 years (\( M = 40.52; SD = 10.99 \)), 52.7% of those who participated were women, 42% were living with a partner, 57.2% had completed senior high school, and 38.1% also held a university degree.

### Procedure

Participants were recruited by personal invitations, press releases (radio, newspaper and magazine reports), and advertisements posted on a university web-site. After informed consent was given, participants followed a link to a self-administered questionnaire (T1). After four weeks, they received an e-mail invitation to answer a follow-up online questionnaire (T2).

### Independent Measures

Age measures. Age measures are differentiated into chronological age and subjective physical age. Besides the question “How old are you?” (Question 1), participants were asked “How old do you feel physically?” (Question 2). In line with previous subjective age research, a difference score for both measures was calculated (perceived age (Question 2) – chronological age (Question 1) = subjective physical age), resulting in a subjective physical age score. A negative value represents a youthful subjective age and a positive value represents an older subjective age.
Health status. Current health status was assessed via single item from the German SF-12 [32], “In general, would you say your health is” recoding the answer format for the analysis (1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent).

Intention. Participants were asked about their intentions to engage into regular physical activity (1 = totally disagree, 2 = disagree, 3 = agree, 4 = totally agree). Intentions have been assessed according to suggestions by Nigg [34], addressing three different intensity levels of physical activity. “I intend to perform the following activities at least 5 days per week for 30 minutes. . .”:
(1) “. . . strenuous (rapid heartbeats, sweating) physical activities”; (2) “. . . moderate (not exhausting, light perspiration) physical activities”; and (3) “. . . mild (minimal effort, no perspiration) physical activity.” A scale has been aggregated including all intensities to obtain an index that reflects the broadness of the construct (discriminant validity) [35].

Planning. Two types of planning were assessed, action plans and coping plans (1 = totally disagree, 2 = disagree, 3 = agree, 4 = totally agree). Three action planning items were used to specify the concrete performance and the setting related to the behavior stating: “I already made detailed plans . . .”, “. . . where I will be physically active” (Cronbach’s α = .91). Three coping planning items were used to specify if people were able to deal with certain barriers while performing the behavior asking: “I already made detailed plans . . .”, “. . . what I can do in difficult situations to stick to my goals (Cronbach’s α = .85).

Dependent Measures

Behavior. Physical activity was assessed by asking how often (1 = less than 1 time a week for 30 minutes, 2 = at least 1 time a week for 30 minutes or more, 3 = at least 3 times a week for 30 minutes or more, 4 = at least 5 times a week for 30 minutes or more) within the last month the
person had been active by means of physical fitness (e.g., going to the fitness studio), active commuting (e.g., taking the bicycle instead of the bus or car) and physical activities in daily life (e.g., gardening). All three indicators correlated moderately ($r = .21$) but significantly at $p < .01$ and were aggregated (discriminant validity) [35].

Data Analysis

Pearson’s correlation coefficient was applied in a first step to investigate the relationship between all measures being used and to check for consistency with previous results in health behavior and subjective age literature. This was done with SPSS 21.

To test the specific hypotheses of the current study, a structural equation model was used to estimate the direct, indirect, and conditional associations between the independent variables, the mediator, and the depended variable by using Mplus 5.1 [32]. The model has been evaluated based on recommended fit indices and cut-offs. Fully standardized coefficients (stdyx standardization = Est.) are reported [32]. In line with previous research, intention was specified to have an indirect effect on behavior via planning and past behavior to have a direct effect on behavior [14, 28]. According to the hypothesis, subjective physical age was also specified to have an indirect effect on physical activity. Planning was conceptualized as a latent factor consisting of action planning (parceled) and coping planning (parceled) assuming that the shared variance of both variables represent the sole planning – hence self-regulatory – aspect. Full Information Maximum Likelihood (FIML) was applied to handle missing values [32]. Coefficients, standard errors, as well as direct and indirect effects were calculated and a bias-corrected-bootstrap with 5,000 draws was applied since indirect effects generally violate assumptions of normal distribution [36].
### Table 1 Summary of Intercorrelations, Means, and Standard Deviations

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Health Status</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Chronological Age</td>
<td>-.08**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Subjective Physical Age</td>
<td>-.43***</td>
<td>-.35***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Intention</td>
<td>.07*</td>
<td>.07**</td>
<td>-.11***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Action Planning</td>
<td>.17***</td>
<td>.03</td>
<td>-.15***</td>
<td>.30***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Coping Planning</td>
<td>.23***</td>
<td>.12***</td>
<td>-.22***</td>
<td>.21***</td>
<td>.49***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>7 Past Physical Activity</td>
<td>.29***</td>
<td>.02</td>
<td>-.24***</td>
<td>.30***</td>
<td>.30***</td>
<td>.31***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Subsequent Physical Activity</td>
<td>.26***</td>
<td>.01</td>
<td>-.22***</td>
<td>.22***</td>
<td>.29***</td>
<td>.28***</td>
<td>.56***</td>
<td>1</td>
<td>2.26</td>
<td>0.69</td>
<td>1 - 4</td>
</tr>
</tbody>
</table>

**Note.** N = 1,358. * p < .05; ** p < .01; *** p < .001.
Results

Pearson correlation coefficient revealed significant interrelationships between nearly all indicators and the outcome measure (all $p < .01$; see Table 1). On a correlational level, those who indicate to have a younger physical subjective age seem to use significantly more self-regulatory abilities – in this case planning (action plans $r = -.15, p < .001$; coping plans $r = -.23, p < .001$; see Table 1). The hypothesized bootstrapped model had a good fit with the current data ($\chi^2(9) = 35.13, p < .001$, CFI = .97, TLI = .94, RMSEA = .05 [90% CI = 0.031, 0.063]).

![Figure 1: Structural equation model including standardized coefficients and confidence intervals at the lower and upper 2.5%-boundary of direct and indirect effects](image)

Figure 1 represents the final model with a direct, significant path from past behavior to subsequent behavior. Additionally, planning was significantly correlated with subsequent behavior,
and planning mediated the effects of intentions and health status on behavior. As hypothesized, the relationship between subjective physical age and physical activity is mediated via planning (subjective physical age t1 → planning t1: $\beta = -.09$, S.E. = .04, $p = .015$; planning t1 → physical activity t2: $\beta = .23$, S.E. = .05, $p < .001$). This is also supported by the significant indirect effect ($\beta = -.02$, S.E. = .01, $p = .032$), even after applying bootstrap procedure ($\beta = -.02$, S.E. = .01, $p = .037$).

### Table 2. Unstandardized, standardized and bootstrapped estimates and standard errors

<table>
<thead>
<tr>
<th>Path</th>
<th>Function</th>
<th>Unstandardized</th>
<th>Standardized</th>
<th>Bootstrapped$^c$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Est.</td>
<td>S.E.</td>
<td>Est.</td>
</tr>
<tr>
<td>P → SPA</td>
<td>b path$^a$</td>
<td>0.25***</td>
<td>0.05</td>
<td>0.23***</td>
</tr>
<tr>
<td>I → P</td>
<td>a path$^b$</td>
<td>0.21***</td>
<td>0.03</td>
<td>0.26***</td>
</tr>
<tr>
<td>HS → P</td>
<td>a path$^b$</td>
<td>0.11***</td>
<td>0.03</td>
<td>0.15***</td>
</tr>
<tr>
<td>CA → P</td>
<td>a path$^b$</td>
<td>0.003</td>
<td>0.002</td>
<td>0.06</td>
</tr>
<tr>
<td>SA → P</td>
<td>a path$^b$</td>
<td>-0.01*</td>
<td>0.004</td>
<td>-0.09*</td>
</tr>
<tr>
<td>PPA → P</td>
<td>a path$^b$</td>
<td>0.27***</td>
<td>0.03</td>
<td>0.29***</td>
</tr>
<tr>
<td>PPA → SPA</td>
<td>baseline control</td>
<td>0.46***</td>
<td>0.04</td>
<td>0.46***</td>
</tr>
<tr>
<td>SA → P → SPA</td>
<td>indirect effect</td>
<td>-0.002*</td>
<td>0.001</td>
<td>-0.02*</td>
</tr>
</tbody>
</table>

**Note.** I = intention, P = planning, CA = chronological age, HS = health status, SA = subjective physical age, PPA = past physical activity, SPA = subsequent physical activity

* $p < .05$; *** $p < .001$

$^a$ b path: Path between mediator and outcome as part of the mediation model

$^b$ a path: Path between independent variables and mediator as part of the mediation model

$^c$ For bootstrapping estimates (resamples = 5,000), unstandardized coefficients are reported.
Chronological age was not significantly interrelated with planning when controlling for health status, subjective physical age, intention, and baseline behavior.

**Discussion**

The aim of the study was to investigate the structural relationship between subjective physical age, planning, and physical activity. This was done in an online sample with two measurement points where planning was considered as a latent factor consisting of action planning and coping planning. The hypothesized model demonstrated a good fit to the data, hence giving proof to the suggest model structure with planning as a mediating factor between health status, subjective physical age, intentions, and past behavior. Furthermore, we showed that subjective physical age has a negative relationship with the latent planning factor. This indicates that participants who felt physically younger made more use of planning as a self-regulatory skill to increase their physical activity.

The current results indicate that subjective age seems to have an influence not only on intentions, as demonstrated by Caudroit and colleagues [10], but also on changing behavior via planning as a mediator. This extends the current knowledge of subjective age research by providing a closer look at the mediated relationship between subjective physical age and physical activity. Findings on this relationship fit well into the current body of knowledge regarding health behavior change considering the intention-planning-behavior relationship which has been intensively researched [13]. It also follows up on previous research on the role of (domain specific) subjective age in relation to health behaviors such as physical activity [20].

One central issue in subjective age research is the assumption on the direction of the effect. The current study follows the assumption of Caudroit and colleagues [10] that subjective age is a
predictor for intentions and in this study for behavior change. This is due to findings on the experimental manipulation of subjective age as researched by Stephan and colleagues [19] who showed the manipulation of subjective age via downward social comparison. Participants in an intervention group received positive feedback on handgrip performance and were compared to a control group which did not receive any feedback. By inducing a younger subjective age within the experimental group, grip strength increased significantly after the manipulation. This finding might support the direction of the effect as suggested in the current study. Furthermore, Spuling and colleagues [37] investigated the causal interplay of subjective age and four health domains (physical conditions, functional health, self-rated health, and mental health), coming to inconsistent results. Subjective age seems to be an antecedent of physical conditions and mental health, but has a mutual relationship with self-rated health and no influence on functional health at all, giving rise to the suggestion that there is a high overlap between subjective age and self-rated health. This was also shown by the rather high bivariate correlation ($r = -0.43, p < .001$). Future studies should further investigate the effect-directions in subjective age research.

**Study Limitations and Future Directions**

A central limitation of this study was the high dropout between both measurement points. Though high dropout rates are a common phenomenon in online research [38], future studies should also apply various methods to reduce high dropout rates – which were not applied in the current study. Such methods could be *seriousness checks* for participation, *high hurdle techniques*, and a *warm-up phase* [38]. This brings forward the issue of missing data handling in the current study. FIML is known to be one of the most appropriate and precise technics for handling missing data with several advantages compared to ad-hoc methods (e.g., listwise deletion) or imputation techniques (e.g. EM algorithms) [31].
A second limitation of this study was that only planning was used as a latent factor in the model. Due to the selective sample of the study, the findings can only partially be generalized as the initial sample had a higher level of education, and included slightly more women. Future studies should try to retain more men and individuals with a lower educational status in the study.

Another limitation might be related to the physical activity measure which was used in this study. The narrow definition of the current measurement leads to the thought of differences in the distribution of activities between different (chronological) age groups. This means that older individuals might prefer activities for commuting or physical activities in daily life over physical fitness compared to younger age groups. Considering this rational, it would be an interesting research topic for future studies to investigate. Especially when comparing results for chronological age and subjective age following the proposed argument of the current study of a lesser susceptibility for negative aging stereotypes for individuals with a younger subjective age. In this case, older individuals who feel younger would show a similarity in activities compared to individuals with a younger chronological age. Furthermore, future studies should try to replicate the current findings with other physical activity measures (e.g., standardized questionnaires and objective measures) as these might come to different results or ideally validate the current results.

Additionally, the current study only investigated parts of the HAPA model due to missing constructs in the raised data. Future studies should also consider further social cognitive predictors (e.g. outcome expectations) and facilitators (e.g. social support) to thoroughly test assumed mechanisms and come to a more comprehensive understanding of health behavior change in the light of subjective age research.
Conclusion

The current findings contribute to a better understanding of subjective age concepts on health behaviors and on self-regulation by investigating the relationship of subjective physical age, planning, and physical activity. They imply mainly two aspects: a) Subjective physical age can explain additional variance in physical activity when controlling for intentions and chronological age, implicating the potential importance of individual age perceptions regarding physical activity. b) Planning is of significant importance with an increasing younger subjective physical age and could especially be considered in tailored interventions (interventions that are tailored towards individual characteristics) in combination with subjective physical age as participants with a younger subjective physical age might need less help with self-regulatory processes.

The results contribute to the further advancing field of aging and health behavior research as they show that individuals who feel physically younger make more use of planning to be physically active when accounted for chronological age. This is an important finding as it shows that chronological age alone might not be a suitable means to research differences and changes in self-regulation and physical activity across the lifespan and that subjective age perceptions might have a greater influence on such processes, similar to findings on residual life expectancy [39] and future time perspective [28].
Conflict of interest

Julian Wienert, Paul Gellert and Sonia Lippke declare that they have no conflict of interest.

Human rights and informed consent

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all patients for being included in the study.
Adopting and Maintaining Physical Activity Across the Life-Span: The Importance of Subjective Physical Age and Planning Mediating Intention into Physical Activity

References


Adopting and Maintaining Physical Activity Across the Life-Span: The Importance of Subjective Physical Age and Planning Mediating Intention into Physical Activity


4

Testing the Health Action Process Approach in Relation to Subjective Physical Age

Abstract

This study investigated differences in social-cognitive predictors and self-regulatory strategies of physical activity by three different subjective physical age groups. In this cross-sectional study, 528 participants across the chronological age span from 25 to 86 years were separated into three groups: those who feel physically younger than they are chronologically, the same age, and older. Participants were assessed regarding their vulnerability, outcome expectancies, intentions, planning, self-efficacy, and behavior stages. Data were analyzed via mean comparison and multi-group structural equation modeling. Mean differences for all but one construct were eminent in all groups. The model showed marginal differences in direct effects for the groups, but different working mechanisms regarding indirect effects. Results provide insights into group and working mechanism differences with regard to subjective physical age. These may be used to tailor health promoting interventions according to participants’ needs as a more suitable proxy than chronological age.
Introduction

Being physically active on a regular basis is beneficial for preventing several acute and chronic diseases (Penedo & Dahn, 2005; Powell, Paluch, & Blair, 2011). Past research showed in many cases the inverse relationship between increasing chronological age and physical activity (e.g., Troiano et al., 2008). Considering the constant demographic changes in some societies towards an older population with higher life expectations, it is of utmost importance to find ways to help people to maintain their health and a healthy lifestyle. Furthermore, the advancing field of health behavior research also supports the notion that chronological age alone might not be a suitable means to assess changes in aging anymore (e.g., Gellert, Ziegelmann, Lippke, Schwarzer, 2012; Ziegelmann, Lippke, & Schwarzer, 2006) and that other indicators might be more suitable as long as they provide additional information (cf., Salthouse, 1991). One of such possible measures is subjective physical age, the age a person physically feels like.

Research on subjective age shows a modest to high relationship between subjective age and health on a correlational level (Barak & Stern, 1986). Furthermore, variance in health explained by subjective age (Hubley & Hulsch, 1994) and a cross-lagged panel design with different health dimensions (Spuling, Miche, Wurm, & Wahl, 2013) supports assumptions concerning the relationship between the both. The high interrelationship between health and physical activity also highlights the potential importance of investigating the role of subjective age within this context, especially since a younger subjective age is associated with higher levels of physical exercising (Barak & Stern, 1986) and intentions to engage into physical activity (Caudroit, Stephan, Chalabaev, & Le Scanff, 2012).
To address changes in health behaviors, such as physical activity, social-cognitive models of behavior change have been tested thoroughly in different studies and interventions to determine important social cognitive predictors and how these explain and correspond with behaviors. Such social cognitive predictors are of high importance for behavior change as these are generally changeable and can be addressed in interventions (cf., Conner & Norman, 2005; Lippke & Ziegelmann, 2008). However, most people know that it is hard to translate good intentions into actual behavior, which results in the intention-behavior-gap. This gap can be addressed via volitional strategies, such as planning, which is a crucial component of the Health Action Process Approach (Schwarzer, 2008).

**Health Action Process Approach (HAPA)**

The Health Action Process Approach (HAPA; Schwarzer, 2008) tries to explain the adoption and changes of health. It is a hybrid model, which can be interpreted either as a continuous or as a stage model (e.g., Plotnikoff et al., 2009). Pre-intentional social-cognitive factors such as outcome expectancies and risk perception are prerequisites to form intentions to engage into a behavior. The model especially applies self-regulatory strategies (planning) to cross the so called intention-behavior-gap (Reuter et al., 2010) which help to adopt and maintain the target behavior, hence mediating the relationship. Action control strategies, such as monitoring, help to facilitate the established behavior. Self-efficacy is seen as a stage specific predictor and is theoretically divided according to the pre-intentional, intentional, and action stage. Structure and mechanisms of the HAPA have been tested in several studies for a variety of behaviors, providing evidence for the suggested interaction between social-cognitive predictors, self-regulation, and behavior (Schwarzer, 2008).
Subjective Age

Subjective age is usually assessed as the difference between chronological age and perceived age (e.g., Barak & Stern, 1986; Kleinspehn-Ammerlahn et al., 2008). According to Montepare (2009) subjective age is understood as a self-evaluating process, considering the past, present, and future of oneself. Latest research outlining the importance of downward social comparison to manipulate subjective age (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013) suggests that this would complement the internal evaluation by an external evaluation.

Furthermore, those who indicate a younger subjective age seem to be less susceptible for negative aging stereotypes (Eibach, Mock, & Courtney, 2010), hence might not behave in stereotypical way. Additionally, those who feel younger also report a better health or higher well-being as well as better outcomes on other health indicators (Demakakos, Gjonca, & Nazroo, 2007; Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Westerhof & Barrett, 2005). Furthermore, people who feel younger report significant higher levels of general self-efficacy compared to those who feel being as old as they are and older (Boehmer, 2007).

The current study applies a domain specific type of subjective age: subjective physical age. This type of subjective age builds upon findings on other domain specific measures such as self-efficacy (Maibach & Murphy, 1995) or locus of control (Lachman, 1986). Assumed advantages of such a domain specific measure are a higher sensitivity for changes in one domain but not another, as well as a higher explanatory value (cf., Lachman, 1986; Maibach & Murphy, 1995).

To better understand the differences in HAPA related constructs and structures between subjective physical age groups, the current study investigates the assumption that those with a younger subjective physical age have a stronger bias when comparing themselves against peers.
and stereotypes of the same chronological age. This would result in mean differences and differences in frequencies between groups. Furthermore, we will investigate possible differences in parts of the assumed structure of principle HAPA mechanisms. Following findings that individuals who feel younger are seemingly less susceptible for negative stereotypes of aging (cf., Eibach et al., 2010), we expect that the group indicating a younger subjective physical age shows lower levels of vulnerability, negative outcome expectancies and higher levels of self-efficacy, intentions, and planning. Additionally we also assume that this group has advanced the furthest according to the HAPA stages. We also assume that these group differences become visible when testing principle HAPA mechanisms.

**The Present Study**

According to previous findings on subjective age, social comparison, and denial of negative aging stereotypes, we expect significant differences in all HAPA related constructs and the HAPA stages (Vulnerability: younger < same < older; Negative outcome expectancies: younger < same < older; Positive outcome expectancies: younger > same> older; Intentions: younger > same > older; Self-efficacy: younger > same > older; Planning: younger > same > older; HAPA stages: younger > same > older). Further, on basis of past research we hypothesize that especially the group who feels physically younger translate their intentions differently into planning and behavior (i.e., HAPA stages) than those who feel the same age or those who feel older (younger > same > older). This would be especially visible by the tested mediation between intentions and HAPA stages via planning as well as high self-efficacy beliefs affecting intentions, planning and behavior in the tested model structure for those who feel physically younger in accordance with the aforementioned mean differences.
Method

Participants and Procedure

A random sample from an observational online study with questions about HAPA related constructs, healthy lifestyles, chronic diseases, and medication using the platform TailorBuilder has been analyzed to test the specific assumptions. Only participants with a chronological age of 25 years and older were included into the study: This age was found as the cross-over point that indicates the change of meaning of subjective age as shown in a study by Galambos, Turner, and Tilton-Weave (2005) and should provide consistent meaning of subjective age for the used sample.

Initially 1,281 participants took part in the online questionnaire at the beginning point. Of those, 562 remained in the study seriously until the very last question. After applying the cross-over point, 530 participants remained in the study and screening for outliers (-20/+20 years of subjective physical age) resulted in two more participants to be sorted out. In total \( n=528 \) participants were included into the analyses. The age of the sample ranges from 25 to 86 (\( M = 48.93; \ SD = 12.61 \)) of which 67.2% were women. After applying Full Information Maximum-Likelihood (FIML) estimation to handle missing data, the sample contained \( n=796 \) participants for subsequent analyses.

All participants were informed about the subject of the study and provided informed consent. All procedures performed in this study were in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Measures
Grouping variable

Subjective physical age. Participants were asked “How old do you feel physically?” In line with previous subjective age research, a difference score for both measures was calculated (perceived physical age – chronological age = subjective physical age), resulting in a subjective physical age score. This score has been used to separate the sample into three groups: Those who feel younger than their chronological age (negative subjective physical age score), those who feel being as old as their chronological age (zero subjective physical age score), and those who feel older than their chronological age (positive subjective physical age score).

Predictor variables

Vulnerability. Vulnerability was assessed asking participants three questions (1 = totally disagree to 7 = totally agree) on the likelihood to experience certain diseases: “How high is the likelihood that you will someday experience one of the following diseases? – When I continue my life the way it is now, then there is a high likelihood that I will experience …” (1) “…strong overweight”; (2) “…diabetes”; (3) “…a coronary heart disease” (Cronbach’s α = .86).

Outcome expectancies. To inquire participants opinions about consequences of physical activity, two items about positive and two items about negative outcome expectancies were assessed (1 = totally disagree to 7 = totally agree): “If I am physically active for 30 minutes, 5 times a week…” (1) “…then this is good for my health”; (2) “…then I feel better afterwards” (positive: $r = .85, p < .01$), and (3) ”…this will take me a lot of time”; (4) ”…this will be a financial burden” (negative: $r = .34, p < .01$).

Intention. Participants were asked about their intentions to engage into regular physical activity (1 = totally disagree to 7 = totally agree). Intentions have been assessed via three different
items: “I have the intention to…” (1) “…live healthier”; (2) “…eat healthier within the next months”; (3) “…be physically active on a regular basis within the next months” (cf., Schwarzer, 2007). The scale showed satisfactory reliability (Cronbach’s α = .77) with a single factor. These items were aggregated for further analyses.

**Planning.** According to the HAPA, self-regulatory planning is divided into action planning and coping planning. Action planning focuses on engaging into a behavior, whereas coping planning focuses on overcoming anticipated barriers. Four *action plan* items were assessed, asking “For the next 4 weeks I already made detailed plans…”, “…which concrete physical activity I can do” and three *coping plan* items asking “For the next 4 weeks I already made detailed plans…”, ”…when I have to be especially cautious not to quit” (1 = *totally disagree* to 7 = *totally agree*). The suggested two factor structure could not be replicated via principal component analysis and varimax rotation. A single factor solution with a high reliability emerged (Cronbach’s α = .92). All items were aggregated for further analyses.

**Self-efficacy.** The HAPA describes three different types of self-efficacy according to different stages within the HAPA – task, maintenance, and recovery self-efficacy (Schwarzer, 2007). Participants were asked to respond to items such as “I am confident that I can be physically active at least 5 times a week for 30 minutes or more…”; (task:)”…even when it is sometimes hard; (maintenance:)”…even when I need some time until it becomes a habit”; or (recovery:)“…even when I delayed my concrete plans several times” (1 = *totally disagree* to 7 = *totally agree*). The suggested three factor structure could not be replicated via principal component analysis and varimax rotation for the 7 items. Instead a single factor solution was suggested and showed a high reliability (Cronbach’s α = .94). All items were aggregated for further analyses.
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Outcome variable

HAPA stages. Stages were assessed according to a 5-point algorithm by Lippke and colleagues (2009, 2010) which has been shown to have acceptable measurement qualities, especially when differentiating between intenders and actors. Participants were asked to indicate if they are at least physically active 5 times a week for 30 minutes or more. The algorithm has been separated according to the three stages: Non-intender, intender, actor. Non-Intenders were classified via “No, and I do not intend to start”, intenders via “No, but I am considering it” and “No, but I seriously intend to start”, and actors via “Yes, but I find it rather hard” and “Yes, and I find it rather easy”.

Data Analysis

According to our hypotheses we tested mean differences between three groups in the first step: those who feel physically younger compared to their chronological age (younger), those who feel physically as old as their chronological age (same) and those who feel physically older compared to their chronological age (older). Considering past findings on downward social comparison and subjective age the hypotheses of the current study addressed these issues twofold; in step one, we applied mean comparisons and comparisons between chi² distributions; step two focused on a multi-group structural equation modeling for the three groups testing principle structural assumptions of the Health Action Process Approach (HAPA; Schwarzer, 2008) to make differences in the model structure visible.

Results

One way ANOVA revealed significant differences in HAPA variables between groups. Significant differences occurred for vulnerability $F (1, 609) = 47.083, p \leq .001$, negative outcome
Testing the Health Action Process Approach in Relation to Subjective Physical Age

expectancies $F(1, 609) = 8.855, p = .003$, intentions $F(1, 609) = 4.604, p = .032$, self-efficacy $F(1, 609) = 27.330, p \leq .001$, planning $F(1, 609) = 23.374, p \leq .001$. Only linear terms are reported for the current data as higher order terms were all non-significant. Post Hoc comparison using Bonferroni correction indicated significant mean differences in all variables, except for positive outcome expectancies (Table 1). Chi² distribution testing whether the three HAPA stages differ across groups revealed significant differences between subjective age groups $\chi^2(4, N = 610) = 19.479, p \leq 0.001$ (Table 2).

Table 1.

Means and standard deviations (in parentheses) of the subjective age groups, results from planned pair comparisons, unweighted terms

<table>
<thead>
<tr>
<th>Subjective age group</th>
<th>Feeling younger n = 361</th>
<th>Feeling same n = 153</th>
<th>Feeling older n = 69</th>
<th>Paired comparison</th>
<th>Linear Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vulnerability</td>
<td>2.48 (1.42)</td>
<td>3.01 (1.64)</td>
<td>3.67 (1.67)</td>
<td>Y vs. S***</td>
<td>47.083***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>S vs. O**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>O vs. Y***</td>
<td></td>
</tr>
<tr>
<td>Positive outcome</td>
<td>6.35 (1.45)</td>
<td>6.34 (1.20)</td>
<td>6.49 (0.92)</td>
<td></td>
<td>0.845</td>
</tr>
<tr>
<td>expectancies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative outcome</td>
<td>3.29 (1.62)</td>
<td>3.34 (1.50)</td>
<td>3.84 (1.65)</td>
<td>S vs. O*</td>
<td>8.855**</td>
</tr>
<tr>
<td>expectancies</td>
<td></td>
<td></td>
<td></td>
<td>O vs. Y**</td>
<td></td>
</tr>
<tr>
<td>Intentions</td>
<td>5.91 (1.23)</td>
<td>5.64 (1.20)</td>
<td>5.61 (1.19)</td>
<td>Y vs. S*</td>
<td>4.604*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>S vs. O*</td>
<td>27.330***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>O vs. Y***</td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>4.69 (1.72)</td>
<td>4.22 (1.63)</td>
<td>3.66 (1.72)</td>
<td></td>
<td>23.374***</td>
</tr>
<tr>
<td>Planning</td>
<td>4.55 (1.73)</td>
<td>3.78 (1.69)</td>
<td>3.60 (1.77)</td>
<td>Y vs. S***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>O vs. Y***</td>
<td></td>
</tr>
</tbody>
</table>

Note. Y, Feeling younger as chronological age; S, Feeling same as chronological age; O, Feeling older as chronological age; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$. 
Table 2.

Chi²-test with group affiliation and their percentage (in parentheses)

<table>
<thead>
<tr>
<th>Subjective age group</th>
<th>Feeling younger</th>
<th>Feeling same</th>
<th>Feeling older</th>
<th>Chi²-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAPA Stages</td>
<td>n = 361 (100%)</td>
<td>n = 153 (100%)</td>
<td>n = 96 (100%)</td>
<td>19.479***</td>
</tr>
<tr>
<td>NI = 28 (7.8%)</td>
<td>NI = 20 (14.8%)</td>
<td>NI = 11 (9.3%)</td>
<td>19.479***</td>
<td></td>
</tr>
<tr>
<td>I = 140 (38.8%)</td>
<td>I = 66 (65.7%)</td>
<td>I = 56 (41.2%)</td>
<td>19.479***</td>
<td></td>
</tr>
<tr>
<td>A = 193 (53.5%)</td>
<td>A = 67 (72.5%)</td>
<td>A = 29 (45.5%)</td>
<td>19.479***</td>
<td></td>
</tr>
</tbody>
</table>

Note. NI, Non-Intender; I, Intender; A, Actor; *** p ≤ .001.

The analyzed model had a satisfactory fit to the data ($\chi^2(40) = 70.27, p \leq .01, CFI = .97, TLI = .95, RMSEA = .05 [90\% CI = 0.032, 0.075]$). Figure 1 represents the final model with direct paths between the variables.

Principal structural assumptions of the HAPA were partly replicated. Especially for the group who feels younger and the group who feels being as old as they are, positive outcome expectancies can be identified as a significant predictor for intentions (positive outcome expectancies → intentions: younger $\beta = .14, S.E. = .047, p \leq .01$; same $\beta = .30, S.E. = .073, p \leq .001$). Significant coefficients also emerged for the path from self-efficacy to intentions for all three groups (self-efficacy → intentions: younger $\beta = .23, S.E. = .049, p \leq .001$; same $\beta = .22, S.E. = .079, p \leq .01$; older $\beta = .37, S.E. = .089, p \leq .001$).

For all three groups intentions showed a significant path to planning (intentions → planning: younger $\beta = .45, S.E. = .045, p \leq .001$; same $\beta = .29, S.E. = .084, p \leq .001$; older $\beta = .38, S.E. = .092, p \leq .001$) as well as self-efficacy (self-efficacy → planning: younger $\beta = .38, S.E. = .044, p \leq .001$; same $\beta = .38, S.E. = .078, p \leq .001$; older $\beta = .48, S.E. = .081, p \leq .001$). Significant indirect effects transpired for positive outcome expectancies → intentions → planning (younger
Figure 1. Multi-group structural equation model including standardized coefficients of direct effects.
$\beta = .07, S.E. = .032, p \leq .05$; same $\beta = .09, S.E. = .045, p \leq .05$) and self-efficacy $\rightarrow$ intentions $\rightarrow$ planning (younger $\beta = .11, S.E. = .026, p \leq .001$; older $\beta = .14, S.E. = .051, p \leq .01$).

The path between planning and the HAPA stages was significant for two groups (planning $\rightarrow$ HAPA stages: younger $\beta = .29, S.E. = .048, p \leq .001$; same $\beta = .27, S.E. = .085, p \leq .001$), as well as for the path between self-efficacy and HAPA stages (self-efficacy $\rightarrow$ HAPA stages: younger $\beta = .42, S.E. = .043, p \leq .001$; same $\beta = .34, S.E. = .074, p \leq .001$; older $\beta = .34, S.E. = .100, p \leq .001$). Indirect effects were eminent for intention $\rightarrow$ planning $\rightarrow$ HAPA stages (younger $\beta = .13, S.E. = .029, p \leq .001$) and for the self-efficacy $\rightarrow$ planning $\rightarrow$ HAPA stages relationship (younger $\beta = .11, S.E. = .027, p \leq .001$; same $\beta = .10, S.E. = .050, p \leq .05$). Furthermore, indirect effects with intentions and planning as mediators can be reported for self-efficacy $\rightarrow$ intention $\rightarrow$ planning $\rightarrow$ HAPA stages (younger $\beta = .03, S.E. = .010, p \leq .01$). In general, the results showed distinct differences between the three subjective physical age groups by comparing means and testing principle HAPA mechanisms.

**Discussion**

The aim of the current study was to investigate possible differences in HAPA related constructs and mechanisms between those who feel physically younger, the same age as they are, and older. According to our results, we were able to show that those who feel physically younger seem to differ from those who feel physically as old as they are, but especially from those who feel physically older. This has been shown on a mean level: Those who feel physically younger feel significantly lesser vulnerable, perceive lesser negative outcomes of physical activity, report higher self-efficacy, have higher intentions to engage into a healthy lifestyle, and also make significantly more use of planning components.
These findings provide at least partial support for the stated hypotheses, as there are significant differences between those who feel physically younger and older (vulnerability, negative outcome expectancies, self-efficacy, intentions, & planning). However, only few significant differences between those who feel physically younger and as old as they are (vulnerability, intentions, self-efficacy, & planning) and even fewer between those who feel as old as they are and those, who feel physically older (vulnerability).

Furthermore, marginal differences in principle HAPA mechanisms for testing direct effects can be reported. The strongest differences for direct effects occurred for the group indicating to have an older subjective physical age: Positive outcome expectancies are not interrelated with intentions in this group suggesting that other driving factors besides self-efficacy are important to form intentions in this group (also indicated by a low explained variance: $R^2 = .14$). Furthermore, there is no significant direct effect between planning and HAPA stages. This can have many reasons – one could be that planning has nothing to do with HAPA stages for this group, which would also reflect results from previous research that with an increasing age, people find it harder to regulate themselves to engage into physical activity (Ziegelmann, Lippke, & Schwarzer, 2006).

The assumed mediation between intentions, planning, and HAPA stages only transpired for those who feel physically younger. But most importantly clear differences became eminent when testing for indirect effects with self-efficacy as the predicting variable. Whereas self-efficacy played a key-role in various mediating processes for those who feel physically younger, only one indirect effect for self-efficacy → planning → HAPA stages can be reported for those who feel physically as old as they are, as well as only one indirect effect for self-efficacy → planning → intentions for those who indicate feeling physically older.
The current findings imply that there are significant differences between the three investigated groups. These differences can play a key role when addressing social-cognitive and self-regulatory constructs of physical activity within a broader population. This would mean that interventions based on subjective age perception could potentially be more effective than interventions tailored on chronological age. Such results are especially important for interventions in the field of tailored (online) interventions, which present information and content to the participant based on prior assessed characteristics (Schulz et al., 2014). These interventions are based on the assumption that participants perceive tailored information as more relevant as they reduce incongruities which would usually be perceived in a generic intervention (de Vries & Brug, 1999). Hence, such interventions should be more effective than one size fits all approaches. Addressing constructs based on subjective age in tailored interventions might also reduce such incongruities.

**Limitations and Outlook**

Though this study provides first results when investigating differences between those who feel physically younger, the same, or older according to mean and structural differences some limitations need to be addressed. One major issue is that only principle mechanisms of the HAPA have been tested (cf., Schwarzer, Lippke, & Luszczynska, 2011) and not the complete model or behavior itself. This provides implications for future studies to further strengthen the present results with a study that assesses all the HAPA relevant constructs as well as physical activity. Additionally, the current study is based on self-assessment which is a common practice in health behavior change research. However, the quality of future studies can be improved by measuring at least physical activity objectively (e.g., pedometer). The present study only provides a cross-sectional assessment and therefore a momentary snapshot. Future studies with several measure-
ment points and observed changes over time can provide an advanced understanding on mean differences and change mechanisms according to the HAPA and subjective age.
References


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5

General Discussion
General Discussion

The current dissertation provided insights into the interplay of subjective physical age and the intentional stage of the HAPA, while also testing for differences in principle mechanisms of the HAPA. Feeling (physically) younger, in comparison to ones’ chronological age, should help to defy negative stereotypes of aging (e.g., increased sickness and disability, cannot learn new things, no need to lead a healthy lifestyle; Ory et al., 2003). Hence, feeling younger should be related to some sort of counter-stereotypical behavior which would result in higher levels of physical activity and better self-regulatory skills, possibly due to better cognitive resources, to engage into physical activity. In addition to that, those who feel younger would show different cognitions than those who feel as old as they are or older, compared to their chronological age. These three points were investigated. In the following the main findings will be summarized and discussed in the context of the objectives of this dissertation which I outlined in Chapter 1, and relates findings from the individual chapters to each other. This thesis investigated the predictive and general value of subjective physical age in the context of physical activity as a health behavior. This was realized by using different methodological approaches and designs with different samples.

Chapter 2 investigated the additional value of subjective physical age when predicting self-reported physical activity. In a first step incremental and external validity to place the novel domain specific measure of subjective physical age in the general field of subjective age research were provided. In a second step I tested the direct effect of subjective physical age for self-reported physical activity while controlling for important correlates (socio demographic factors, health status, chronological age), self-efficacy, planning components, and past behavior to focus on the volitional phase of the HAPA. Subjective physical age seemed to reflect the component of
physical functioning in an appropriate way. As Westerhof and Wurm (2015) pointed out, especially physical health and functioning seem to be reflected by (general) subjective age. In this case subjective physical age would represent a more sensitive measure for such health aspects.

Chapter 3 investigated whether there is only a direct effect of subjective physical age on reported physical activity or if this relationship might be mediated via self-regulatory planning by testing for direct and indirect effects while still controlling for chronological age, health status, intentions, and past behavior. The younger someone feels physically, the better the self-regulatory planning skills, which in turn help to engage into physical activity. These results provided support for the expected value of youth, as better, independent self-regulation is associated with a younger chronological age (Ziegelmann, Lippke, & Schwarzer, 2006b). Additionally, the results showed similarities with research on health behaviors and future time perspective (Gellert et al., 2012) which might be an indicator for an extended future time perspective when feeling physically younger.

Chapter 4 investigated if there were any differences in social-cognitive predictors of health behavior change between those who feel physically younger, the same age as their chronological age, and older to provide more detailed insights in the results from Chapter 2 and Chapter 3. This was done by not only testing for differences between principle HAPA components, but also testing for differences in principle HAPA mechanisms. Following the argument from Chapter 3 (cf., Ziegelmann et al., 2006b), results provided insight that only those who feel younger mediate their intentions via planning. Furthermore, self-efficacy appeared to be a driving factor in cognitions for those who feel as old as they are, or older, compared to their chronological age which highlights the importance of such cognitions in the both groups and not only those who feel younger, as suggested by previous research which showed associations with higher self-efficacy
General Discussion

(Boehmer, 2007) or personal mastery (Bergland, Nicolaisen, & Thorsen, 2014) and a younger subjective age.

Main Conclusions

In sum, I hypothesized that subjective physical age might be an additional suitable predictor when investigating social-cognitive processes of physical activity, even when controlling for chronological age and current health status. The present work provided evidence that it seems to be more important how old you feel physically, than you actually are according to your chronological age, when being physically active or at least indicates that you are active and how active you are. Furthermore, I showed that higher levels of physical activity are mediated by planning – meaning that those who feel younger show better self-regulatory planning skills to be physically active. I also demonstrated, that there are differences in social-cognitive predictors of health behavior change among those who feel physically younger, as old as they are, and older and that different working mechanisms emerge for the groups.

The main, concluding results can be summed up in two important points:

Subjective physical age plays a role in modeling physical activity. While many studies were able to show an interrelation between subjective age and health, the current dissertation provides a first comprehensive approach to investigate the relationship between a domain specific subjective age component and the adoption and maintenance of physical activity. Feeling physically younger is of importance when adopting and maintaining a physically active lifestyle and those who feel younger are more active, because they are better planners when it comes to translate their intentions into behavior. However, the results suggest that this is only true for those who
actually feel younger and that those who feel as old as they are, or older, show different cognitive mechanisms when applying self-regulatory strategies to facilitate behavior change.

*General effects of subjective physical age in a lifespan sample.* Most of subjective age research focuses exclusively on older study samples, investigating the common phenomenon that most of them feel younger than they actually are and why. However, little research provides insights in general effects of subjective age constructs in lifespan samples. Though most of the research focuses on samples with a relatively old chronological age, the current study was able to show the general effect of subjective physical age in a study sample with a broad age range. This would indicate that regardless of the current chronological age, subjective physical age has an influence on levels of physical activity.

**Suggestions for Future Research**

Some suggestions for future research can be drawn from the current results which will be highlighted in the following section. These will especially focus on aspects which were not discussed in the empirical chapters and therefore deal with general issues concerning all three empirical chapters as well as general issues in subjective age research.

*Effect Direction*

The first issue is the assumption on the direction of the effect. The current study follows the assumption of Caudroit and colleagues (2012) that subjective age is a predictor for intentions and in this case for behavior itself. This is due to findings on the experimental manipulation of subjective age as researched by Stephan and colleagues (2013) that showed a manipulation of subjective age via social comparison. Participants in an intervention group received positive feed-
back on handgrip performance and were compared to a control group without any feedback. By inducing a younger subjective age, grip strength increased significantly after the manipulation within the experimental group. Furthermore, Spuling and colleagues (2013) investigated the causal interplay of subjective age and four health domains (physical conditions, functional health, self-rated health, and depressive symptoms representing mental health), coming to inconsistent results. Subjective age seems to be an antecedent of physical conditions and mental health, but has a mutual relationship with self-rated health and no influence on functional health at all, giving rise to the suggestion that there is a high overlap between subjective age and self-rated health. Westerhof and Wurm (2015) explicitly state that changes in psychological resources or health can also have an influence on subjective age via feedback loops (see Figure 1). This issue should be addressed in future research as the aforementioned health domains are related to health behaviors, but health behaviors only represent a part of such health domains. Due to the critical reception on causality and cross-lagged panel designs (Rogosa, 1980), this interplay should be further investigated and replicated with other methods such as dual-change-score-models (e.g., Lövdén, Ghisletta, & Lindenberger, 2005).

Lifespan Aspects of Subjective Age

The second issue is the general lack of theory in subjective age research. We favor the idea that subjective age represents the efforts of successful development throughout the life-course. Especially due to the findings that a younger subjective age seems to be associated with higher physical activity, higher self-regulation, as well as higher self-efficacy (Caudroit et al., 2012), which are all characteristics of successful development. The lack of theory has been addressed lately by Montepare (2009) favoring the idea of a younger subjective age as a benchmark for
successful development. This has been further investigated by Ward (2010) delineating differences between felt and ideal age, showing that a younger felt age is associated with positive developmental assessments and higher well-being. This view is challenged by Weiss and Freund (2012) who apply the Social Comparison Theory to explain especially younger subjective age in older individuals. They presented negative, positive and neutral information on the age for the current age group of the participants as well as pictures and showed that older individuals distance themselves from peers to deny age-related losses and maintain younger, positively perceived, subjective age (Bultena, & Powers, 1978; Weiss & Freund, 2012). Considering results from Igier and Mullet (2003) on the Big 5, older age groups were associated with high conscientiousness, high agreeableness, high introversion, and neither high nor low neuroticism, but low on openness by different age groups. Further findings indicate an overlap with some of the associated expectations: Conscientiousness and agreeableness increase during adulthood, extraversion seems to be rather stable, neuroticism decreases across adulthood, and openness decreases within later adulthood (Staudinger, Lopez, & Baltes, 1997).

Staudinger and Kunzmann (2005) discuss whether these changes in personality factors can be understood as coping with developmental tasks (personality adjustment) or as personality growth. They distinguish between the absence of neuroticism and presence of agreeableness and conscientiousness as correlates of personality adjustment and openness to new experiences as a correlate of personality growth (Staudinger & Kunzmann, 2005). Arguing in favor of subjective age being an indicator for successful development, individuals should undergo normative personality adjustment, as personality growth is rather non-normative. Arguing in favor of subjective age being an expression of downward social comparison, individuals somewhat deny their personality adjustment (or maybe even growth) in favor of assimilating to younger age groups. Further
research should consider and include these contrasting opinions to come to a comprehensive understanding and theory of subjective age.

**Interplay of Subjective Age and Ageing Stereotypes**

A major argument in the context of this dissertation was that those who feel younger deny negative aging stereotypes, as shown by the study of Eibach and colleagues (2010), so that they behave in a way that also denies negative ageing stereotypes (“ageist stereotypes”). Negative views on ageing are related to a negative labeling across several functional domains (Cuddy, Norton, & Fiske, 2005) which results in explicit and implicit attitudes towards older people (Kite & Wagner, 2002; Levy & Banaji, 2002). Such attitudes towards older people are also related with a reduced will to live, cardiovascular problems, and accelerated mortality (Levy, 2003). But would it not support ageist stereotypes when all subjective age research shows that feeling younger is beneficial for several health domains?

As we are probably well aware of, the individual and social-cultural context influence each other in both directions (e.g., as suggested by Bronfenbrenner’s ecological framework for human development; Bronfenbrenner, 1979). Plainly spoken, this would mean that the different systems provide us with specific stereotypes about age and aging (e.g., through mass media), but that the individual themselves also shapes such views on and attitude towards age and aging. Due to a still pre-dominant value of youth in most cultures (Barak & Stern, 1986; Montepare & Lachman, 1989), it surely poses a problem to promote results from the current dissertation without supporting ageist stereotypes. Study results like those from Stephan and colleagues (2013) which show that subjective age can be manipulated via downward social comparison also highlight this value of youth. In the current interplay of sociocultural context and the individual, changes in age per-
ception and aging stereotypes might be a suitable approach to devalue the current value of youth to create a greater acceptance towards age and ageing. As a result, this should also decrease the need for feeling younger as this is related to self-consistency and self-enhancement, which would direct both processes in the opposite direction (cf., Westerhof & Wurm, 2015; or the subsequent subchapter in Chapter 1 about Self, identity, and subjective age). However, more research on the interplay of ageist stereotypes and subjective age would be needed, especially including the sociocultural context.

Subjective Age and Chronological Age

Though the current work’s aim was to describe a very general effect of subjective physical age on self-reported physical activity, one cannot ignore the thought that there is a different (personal) meaning of subjective age – and also subjective physical age – in relation to ones’ own chronological age. In the literature, this is often labeled as the subjective age bias (Teuscher, 2009). This bias is assumed to be related to an assumed higher value of youth in most societies and might be related to motivational approaches for self-enhancement or an information-processing approach assuming that the elderly are looking younger nowadays (Teuscher, 2009). In addition to that, downward social comparison might also play a role, as this was shown in an experimental study where subjective age was manipulated via downward social comparison in a grip strength task (Stephan et al., 2013). Considering the assumption by Montepare (2009) that subjective age constitutes of a self-evaluative process, the latter finding could be one indicator for that (“I evaluate myself against the others.”). However, it remains unclear how the suggested time dimensions (past, present, future) interrelate with each other and which dimension plays a key role when. In light of our current research, we assumed that, especially, a future orientation
is important (similar to future time perspective; Gellert et al., 2012) leading to a higher effort to engage into physical activity by the use of planning.

A study by (Galambos & Tilton-Weaver, 2000) showed that there is a cross-over point on from where most develop an increasing tendency to indicate that they feel younger than they actually are. Generally speaking: Most people develop (independent of their chronological age as long as this is above 25 years) the same wish or feeling which would be indicated by a younger subjective age (in this study by a negative score). However, this is clearly an oversimplification of the phenomenon. As subjective age is related to health, it is also sensitive to health changes. This would mean that on one day a person indicates to feel 10 years younger than his or her current chronological age. An injury on the following day, however, could lead to a drastic decrease in subjective age due to experienced severity, impairments, or pain. Nevertheless, making observations in a broad population or smaller sub-samples is an essential key component of the social sciences, which would clearly lead to a loss of information in this case. To investigate the stability and sensitivity of subjective age, longitudinal study designs with intensive measurement (Hofer & Piccinin, 2010; Rast, MacDonald, & Hofer, 2012) would provide deeper insights from a quantitative point of view. Qualitative research could provide insights about the quality of subjective age indications, asking why people indicate to feel younger, as old as they are, or older. This might provide insights in potential dimensions related to subjective age (e.g., health) and the reference points as mentioned by Montepare (2009).

Subjective Age and Self-Reported Physical Activity

Another issue which should be mentioned is the use of self-reported physical activity measures, which should especially be highlighted in the context of subjective age research. This
is especially important considering the reliability of self-reported measures and their potential risk of bias. Study results concerning this issue are inconsistent showing that self-reports overestimate physical activity (Gillison, Standage, & Skevingtion, 2006), but also that self-reports can come to valid and reliable results (Miller, Freedson, & Kline, 1994). Nevertheless, due to the denial of ageist stereotypes, there is a fair chance that self-reported physical activity is even more biased when people also indicate that they feel younger as this would represent the before mentioned value of youth (Barak & Stern, 1986, Montepare & Lachman, 1989). This would also relate to the aforementioned interplay of subjective age and ageing stereotypes (see above), meaning that those who feel younger indicate higher levels of physical activity, because this would be associated with a younger age – independent of their actual level of physical activity. This possible overestimation clearly calls for a replication of the present results with objective measures of physical activity (e.g., pedometers) to test the current assumptions with measures that are not biased due to self-perception.

**Use of Difference Scores in Subjective Age Research**

A general issue concerning the most popular method in subjective age research, namely using difference scores by subtracting the perceived age from the chronological age so that a negative score indicates a younger subjective age identity and a positive score an older subjective age identity, is seldom discussed within research papers. One of the biggest deficits of differences scores is the often assumed lack of reliability (MacKinnon, 2009). Edwards (2001) points out several shortcomings about the use of differences scores, of which internal consistency reliability is the first point to be mentioned. Positive correlations between the measures might be an indicator for a lower reliability as compared to the reliability of each measure itself. Still, he points out
that low reliability is not the biggest issue when using difference scores. Other issues also concern assumptions that differences scores provide conservative statistical tests (corresponds to effect sizes that are biased downward and minimized Type I error rates at the expense of Type II error), measures that elicit direct comparison to avoid problems with differences scores (shifting the building of difference scores from the researcher, to the subject), categorized comparisons to avoid problems (supplements problems of difference scores problems of categorized continuous measures resulting in less explained variance and lowered statistical power), using product terms as viable substitutes for difference scores (cannot capture curvatures in the relationship of X and Y with Z that characterize congruence effects), and that hierarchical tests provide conservative tests of difference scores (does not yield conservative tests for difference scores, but might alter the relationship difference scores are intended to measure). Enders (2001) suggests polynomial regression as a suitable method to investigate research questions that make use of difference scores at least for congruency research in organizational behavior (congruency between different constructs like person and job or employee or organizational values; Edwards, 2001). Polynomial regression might not be applicable as a substitute for the use of difference scores in subjective age research, but the aforementioned points should be considered nevertheless to raise awareness for the methodological limitations of this approach, especially since they are rarely mentioned in subjective age studies.

Avenues for Health Behavior Research via the Internet

Though the internet might provide a good means to conduct studies in a broad or specific population, the internet also has several limitations which should also be discussed in the context of the three studies of the current dissertation. According to Frick, Bächtinger, and Reips (2001)
and Reips (2002), drop-out is always an issue in online research and not unusual, especially when no incentives are given. However, future studies could aim to retain more study participants in the study by providing incentives for continued participation (e.g., a voucher). A warm-up phase could be used to further reduce the impact of drop-out on study outcomes (Reips, 2002).

Nevertheless, the internet might provide some additional benefits for health behavior research as mentioned above (see Chapter 1). The most obvious is the use of programs and applications to facilitate the forming of intentions, the transition process from intentions to behavior and the maintenance of such behaviors, especially for at-risk populations like cardiac rehab patients. Using such programs can help patients to sustain positive gains and behaviors after their treatment, especially when their development is theory-driven (Lippke & Ziegelmann, 2008) and the program contains tailored feedback (Reinwand et al., 2013). So called tailored interventions might also have short comings, which should be considered in future research (Wienert & Kuhlmann, 2015). They also provide improved, personalized feedback to the patient which should improve the personal relevance of the content and therefore decrease inconsistencies which otherwise might lead to study drop out or non-compliance (Kreuter & Wray, 2003). However, no research is currently known which explicitly tailors messages according to subjective age. This highlights the need for further investigations.

**Contributions of the Dissertation**

My dissertation contributes to the current body of knowledge considering subjective age perceptions by a) providing a first validation of a domain specific subjective age measure for subjective physical age b) investigating the direct and indirect effect of subjective physical age on self-reported physical activity and c) providing insights into the different working mechanisms
between those who feel physically younger, as old as they are, and older when adopting a physically active lifestyle.

Potential practical contributions for this research can be seen in the field of health promotion and prevention for at risk populations or within so called change settings (e.g., rehabilitation clinics). Since subjective physical age is not only closely related to health, but also to physical activity, it might be worthwhile to consider it as an additional proxy to address changes in physical activity levels. One potential way to do so is the instilment of younger stereotypes of aging via downward social comparison, or possibly also by changing negative attitudes towards ageing into more positive ones – with the aim to increase physical activity. A possible vehicle to realize this might be the application of so called tailored web-based interventions with the aim to promote health and support prevention. Major advantages of such interventions are that they are tailored towards the specific needs and characteristics of the participants with the aim to reduce incongruences of intervention content as well as increasing the personal relevance of the content (e.g., via language, feedback, or role-models), especially fostering self-efficacy can play a key role within this context.

**Concluding Remarks**

By empirical analyses, the current dissertation has demonstrated that subjective physical age is related to self-reported physical activity. Feeling physically younger, relatively independent of our actual age, has a moderate influence on how active people actually are. This can be achieved by better self-regulatory strategies, which are often of importance for older persons as they help them to structure their daily life. However, the current research suggests that feeling younger also helps the broad population, and therefore also the old, to apply such strategies. Therefore
domain specific research on subjective age in relation to health behavior change strategies should receive a bigger interest in research. Especially since the current dissertation can provide first insights into the validity of such a measure in relation to social-cognitive processes of health behavior change, focusing on the intentional stage of the HAPA.
References


Wienert, J. & Kuhlmann, T. (accepted for publication at European Health Psychologist). A stitch in time saves nine: Things to consider when tailoring your online intervention.

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Wienert, J. & Kuhlmann, T. (accepted for publication at European Health Psychologist). A stitch in time saves nine: Things to consider when tailoring you online intervention.


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I, _____Julian Wiernert______, hereby declare that I have written this PhD thesis independently, unless where clearly stated otherwise. I have used only the sources, the data and the support that I have clearly mentioned. This PhD thesis has not been submitted for conferral of degree elsewhere.

Bremen, April 17, 2015

Signature ___________________________ 

Julian Wiernert