I do as I am: understanding and leveraging identity to promote smoking cessation and physical activity

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Chapter 1

General introduction

THE PROBLEMS OF SMOKING AND LOW PHYSICAL ACTIVITY

Low physical activity and smoking are leading preventable risk factors for chronic diseases (e.g., cardiovascular diseases), mental health disorders (e.g., depression and bipolar disorder), infertility, and premature death [1–3]. Globally, approximately 1/5 of adults still use tobacco and 1/3 are insufficiently physically active [4–6], which contributes to 17 million premature deaths from chronic diseases annually [3]. The health risks associated with physical inactivity and smoking rise significantly after the age of 45 [7–10]. The combined impact of low physical activity and smoking is particularly harmful, more than doubling the risk of premature death and reducing disease-free life expectancy by up to six years [10,11]. It is unlikely that new modifiable risk factors will be identified which have a similar or larger impact on health [12]. The economic burden is equally staggering, with smoking costing USD1.4 trillion (EUR1.37 trillion) and low physical activity costing USD27 billion (EUR26.4 billion) annually in health expenditures and productivity losses [13,14]. Given the profound health and economic implications, addressing smoking and low physical activity is critical.

Quitting smoking and increasing physical activity immediately and significantly reduce health risks, even for those with long histories of smoking or low physical activity [15,16]. Evidence underscores a bidirectional relationship between the behaviors: quitting smoking improves physical activity through, for example, enhanced lung function [15], while physical activity supports smoking cessation by strengthening quit intentions [17] and reducing cravings [18]. These links justify considering both behaviors simultaneously in lifestyle interventions. Unfortunately, existing interventions often yield only small to moderate effects and limited long-term success [19–21]. To illustrate, it may take 20-30 attempts to quit smoking [22], and 18-34% of individuals who have increased their physical activity are likely to revert back to old physical activity behavior within 1-4 months, particularly among minority populations [23]. Such (re)lapse rates often result from exposure to risk situations that undermine healthier behavior plans (see the Supplement 1). These patterns underscore the need for more durably effective approaches, effective also when situational contexts elicit strong associations with previous unhealthy behavior. One promising approach is to focus on identity, or in other words: who one thinks one (truly) is, or would (really) like to be.

IDENTITY

Identity refers to the answers to the question ‘Who am I?’, and includes mental representations we hold about ourselves [24]. Identity is often conflated with ‘self-concept’, but the two are distinct. Self-concept refers to all thoughts about oneself, whereas identity represents a subset of this content [24]. The literature generally categorizes identity into three types: 1) social or group identity, derived from memberships to social groups (e.g., parent,

Christian) [25–27], 2) role identity, derived from societal roles (e.g., activist, secretary) [25,28] and 3) personal or person identity [24,25] shaped by internalized meanings and expectations associated with societal roles (e.g., good friend, healthy person). Role and social identities are interconnected, with role identities often seen as "me" (e.g., I am a parent) and social identities as "we" (e.g., we are scientists) [25]. Role and person(al) identity are similarly connected, as person(al) identity reflects internalized meanings and expectations of specific roles [28].

In the health psychology literature, the term "self-identity" is commonly employed to refer to specific parts of "me" which reflect the importance of behavior in how individual perceive themselves. For example, smoking (as a behavior) can be important for identity, such that a person can hold a strong smoker self-identity [29,30]. In other words, self-identities can be considered specific parts of personal or person identity. However, the interchangeable use of terms reveals inconsistencies in identity terminology, which, in turn, may hinder our understanding of identity's role in smoking cessation and increased physical activity. At the same time, these variations present an opportunity to clarify and compare identity terminology in the contexts of smoking and physical activity – a focus explored in **Chapter 3** of this dissertation. Moreover, as self-identity appears to more directly impact exercise behavior [31] and to have a stronger link to quit intentions and behaviors than group identity [32], this dissertation primarily focuses on self-identity's role in driving behavior change in smoking and low physical activity.

Individuals often hold multiple simultaneous identities [25]. For example, one can simultaneously identify as woman, parent, lawyer and smoker. For smoking and physical activity, this means that individuals can hold simultaneous, distinct identities for both behaviors (e.g., runner and smoker), and simultaneous, non-mutually exclusive identities for one behavior (e.g., smoker AND smoking quitter or runner AND dancer – [see for example 33].

In addition to present identities, individuals typically hold past identities, tied to previous states (e.g., former runner) [34,35], and future possible identities, representing desired or undesired versions of oneself (e.g., ex-smoker) [36,37]. These identities serve as reference points against which individuals compare their current self. Such comparisons provide a sense of self-unity (i.e., existing as an entity separate from other entities) and self-continuity over time [38]. While identity is considered relatively stable over time, the coexistence of past, present and future possible identities demonstrates the malleable nature of identity [25,39–41].

THE POTENTIAL OF IDENTITY TO PROMOTE SMOKING CESSATION AND PHYSICAL ACTIVITY

Targeting identity is promising for smoking cessation and physical activity promotion because it exerts a powerful motivational influence on behavior. This is reflected in Self-Determination Theory [42] which posits that intrinsic autonomous motivation is most likely to drive behavior. In the theory, integrated motivation – where a behavior is part of one's identity – is considered the second most autonomous and influential form of motivation, after intrinsic motivation – where behavior stems from enjoyment and/or satisfaction. Since increasing physical activity and especially smoking cessation are uncommonly driven by enjoyment, identity can be seen as the highest form of autonomous motivation for these behaviors. The potential of identity in motivating smoking and physical activity has also been recognized in relation to the Theory of Planned Behavior [43], one of the most influential frameworks for explaining behavior change. The theory proposes that attitudes towards a behavior, social norms related to a behavior and perceived behavioral control over a behavior influence behavioral intention, which then shape the behavior. Over the past decades, many studies [44–48] have advocated for adding identity as an independent predictor of behavioral intention. Furthermore, Behavior Change Technique taxonomy [49], a widely used evidence-based list of active ingredients which can be leveraged in interventions to change behavior, includes a cluster of techniques specifically related to identity. This highlights the potential of identity to effectively change (health) behavior.

Identity theories further emphasize identity's motivational influence on behavior. Identity Theory [25] and the Identity-Based Motivation model [41] both propose that individuals act in ways consistent with their identity and avoid behaviors that conflict with it. For example, someone identifying as a runner is more likely to adhere to a strict running routine without skipping a session. Identity Theory further argues that the identity most relevant to or readily available in a given situation guides behavior. This means that someone identifying as both a healthy person and a party smoker might choose to smoke at a party – which increases the salience of the party smoker identity – despite the behavior conflicting with their healthy identity. Social Identity Theory [50,51] highlights how group affiliations shape social identities, driving behavior through a desire to belong to the "ingroup". Individuals are more likely to behave according to the norms of a group the more they identify with it. For instance, one may purchase yoga gear after attending classes to align with the dressing standards of the group. Possible Selves Theory [36] underscores the motivational role of future possible identities, where people adapt current behavior to achieve desired future identities and avoid undesired ones. To illustrate, an older adult may start regular physical activity to align with their desired future identity of being a grand-parent able to play with their grand-children. PRIME theory [52], developed to explain addictive behaviors like smoking, posits that behavior is aligned with identity-based rules. Thus, one strongly

identifying as ex-smoker may remain abstinent to adhere to their identity-based rule "not even a puff".

Empirical research supports these theoretical perspectives, showing consistent relations between identity on the one hand and (non)smoking and physical (in)activity on the other. For physical activity, studies indicate that individuals who identify as physically active are more likely to engage in physical activity or intend to do so [53–56]. Similarly, smoking-related identity has been linked to smoking behavior and cessation efforts. Individuals who view themselves as smokers are more likely to smoke and persist in the behavior, while those who identify as nonsmokers, ex-smokers or smoking quitters are more likely to attempt quitting and maintain abstinence [57–61]. These findings underscore the central role of identity in sustained behavior change for both health behaviors, while highlighting the opportunity to translate identity-related insights into practical, actionable interventions. Despite the evidence, translation may be challenged by the absence of a comprehensive, up-to-date synthesis and comparison of identity processes in the context of smoking, a health-compromising behavior, and physical activity, a health-promoting behavior. This gap is addressed in **Chapter 3** of this dissertation.

EXISTING IDENTITY-LEVERAGING INTERVENTIONS

Identity-leveraging interventions aim to connect healthy behavior to central components of who one is. One category of identity-leveraging interventions are future-self interventions. These interventions are rooted in possible self-related theories, which, as seen before, posit that possible future identities, and not only current identity, influence current behavior [36,62]. A clear vision of one's future self can drive the self-regulation needed to achieve the desired future-self [62,63]. Two operationalizations are mental imagery and avatar-based interventions. Mental imagery future-self interventions prompt people to visualize their future selves, typically who they aspire to become (i.e., desired future-self) and/or who they wish to avoid becoming (i.e., undesired future-self). Avatar future-self interventions use graphic technologies to create digital representations of possible future-selves [65]. Other operationalizations, such as interventions challenging identity, are present in the literature [66]. However, less is known about their implementation and effectiveness in the contexts of smoking and physical activity. A current, comprehensive overview of how interventions leverage identity to promote smoking cessation and physical activity, and their effectiveness would provide valuable insights into which approaches are best to use, when to apply them, and under what conditions they are most effective. This gap is addressed in **Chapter 4** of this dissertation.

Mental imagery future-self interventions have shown success in promoting physical activity [67–69], and impacting smoking cessation-related outcomes, such as lower craving intensity, greater quit intention, smoking reduction and abstinence [70–72]. However, some interventions reported no effect on smoking [73] or physical activity [74]. Avatar future-self interventions effectively increased physical activity and its precursors, such as physical activity intention or self-efficacy [75–80], and influenced smoking cessation precursors, including quit motivation, quit intention, and attitudes towards smoking [65,81]. However, as they have more rarely been applied in the context of this behavior, the impact of avatar future-self interventions on actual smoking is unclear. For both types of future-self interventions, effects appear short-lived. Moreover, while future-self and identity-leveraging interventions have been applied in scientific research, their adoption by practitioners for promoting smoking cessation and physical activity remains rare (see the study report in Supplement 2), raising concerns about feasibility and scalability. Finally, while positive user experiences enhance effectiveness [82], little is known about how individuals with different activity levels who smoke perceive identity-leveraging interventions. In summary, experimental studies of both types of future-self interventions in smoking and physical activity contexts seem to yield mixed and short-lived results, avatar-based applications in smoking are scarce and user experiences with identity-leveraging interventions are mostly unknown. This highlights the need to critically evaluate future-self interventions as a means to facilitate smoking cessation and physical activity promotion. This gap is addressed in **Chapters 4, 5, 6 and 7** of this dissertation.

Digital interventions, including eHealth (electronic health) and mHealth (mobile health), have shown promise in influencing health behaviors, among which physical activity and smoking [83–86]. Their key advantages lie in providing scalable, anytime-anywhere support [87], and support tailoring. As a result, smoking cessation and physical activity promotion interventions, including future-self interventions, are increasingly delivered digitally. Seen their growing popularity and potential, this dissertation focuses on digital applications of identity-leveraging interventions in the context of both smoking and physical activity.

Studies show an association between personal, behavioral and/or psychosocial characteristics on the one hand, and smoking-/physical activity-related identity on the other. For example, older individuals, those with lower socioeconomic position and greater nicotine dependence are more likely to identify with smoking rather than quitting or nonsmoking [29,88–91]. However, few studies have explored these relationships, and even fewer have examined the mediating or moderating role of such characteristics in identity-leveraging interventions. Yet, understanding how these characteristics relate to identity and influence the identity-behavior relationship is important for understanding what works for whom and why, in order to maximize intervention effectiveness. **Chapters 3, 4 and 5** in this dissertation provide insight into this.

PERFECT FIT

An interdisciplinary team in the Netherlands recognized the potential of identity to facilitate smoking cessation and increased physical activity. They are developing and testing *Perfect Fit*, a chatbot-based mobile intervention that harnesses identity, among other behavior change techniques, to promote these behaviors [see 92,93 for more details]. However, to deploy it effectively, it is essential to first advance our understanding of how identity relates to smoking and physical activity and of identity-based approaches for promoting change. **Chapters 3, 4, 5, 6 and 7** in this dissertation contribute to this.

THIS DISSERTATION

Interventions that leverage identity by connecting healthier identities to central aspects of who one is offer a promising path to sustainable smoking cessation and increased physical activity. However, to effectively harness identity in interventions with durable results, we must first deepen our understanding of its role in smoking and physical activity, and evaluate interventions that utilize it.

This dissertation has two aims: 1) deepening our understanding of the role of identity in the context of smoking and physical activity, and 2) evaluating interventions (or intervention components) that leverage identity to promote smoking cessation and increased physical activity. To address these aims, five objectives were formulated and are explored across six studies. The six studies employ diverse methodologies, including cross-sectional and longitudinal designs, observational and experimental approaches, and both quantitative and qualitative methods.

Aim 1 – Deepening our understanding of the role of identity in smoking and physical activity

The first aim of this dissertation is to deepen our understanding of the role of identity in smoking and physical activity. To address variations in identity terminology, the first objective is to examine how identity is conceptualized and operationalized in research on these behaviors. **Chapter 3** fulfills this objective through a scoping review that synthesizes and compares empirical evidence for smoking and physical activity.

Despite a strong theoretical foundation and growing evidence, the relationship between identity and these behaviors, including underlying processes, remains unclear. The second objective is to examine these relationships in greater depth. The scoping review in **Chapter 3** also addresses this by synthesizing findings on identity's role in smoking and physical activity, comparing the evidence for a health-compromising (smoking) vs. a health-

promoting-behavior (physical activity). Its focus is on adults aged 45 and older due to their exponentially increasing health risks from smoking and low physical activity.

Understanding the association of personal, behavioral, and psychosocial characteristics with identity can help identify what works best for whom in identity-leveraging interventions. To address this, the third objective is to synthesize evidence on these relationships. Three chapters of the dissertation contribute to this objective. First, the scoping review in **Chapter 3** synthesizes the knowledge regarding the relationship of such characteristics with physical activity and smoking-related identity. Second, **Chapter 4** examines the mediating or moderating roles of these characteristics in identity-based interventions through a mixed-methods systematic review. Finally, **Chapter 5** statistically examines the associations between personal and psychosocial characteristics, and smoking-related identity.

Chapter 2 is a separate protocol paper outlining the methodologies for the scoping and systematic reviews and does not present findings.

Aim 2 – Evaluating interventions (or intervention components) leveraging identity to promote increased physical activity and smoking cessation

The second aim of this dissertation is to evaluate interventions (or intervention components) leveraging identity to promote increased physical activity and smoking cessation. Currently, no comprehensive overview exists of how identity is leveraged in such interventions or their effectiveness. Understanding this can clarify which approaches work best, when to use them, and under what conditions they are most effective. To address this, the fourth objective is to describe how identity is leveraged in interventions aiming to promote smoking cessation and/or increased physical activity. The mixed methods systematic review in **Chapter 4** outlines the impact of identity-leveraging interventions on smoking- and physical activity-related identity and behavior.

The fifth objective is to evaluate the effectiveness of and user experiences with identity-based interventions (or intervention components) which promote smoking cessation and increased physical activity. Four chapters contribute to this aim. The systematic review in **Chapter 4** critically examines the effectiveness of existing identity-leveraging interventions in the context of smoking and physical activity. In **Chapter 5**, an online longitudinal experimental study assesses the effect of envisioning desired and undesired (non)smoking selves on smoking-related identity constructs. In **Chapter 6**, a mixed methods multi-study explores user experiences with future-self interventions related to both physical activity and smoking. Finally, **Chapter 7** uses focus groups to explore and compare perceptions of a mental imagery and avatar-based future-self intervention prototype, designed to promote physical activity prototype. The study examines comprehensibility, feasibility, perceived effectiveness and formatting preferences.

Finally, **Chapter 8** summarizes key findings per objective, situates them within the broader scientific context, discusses implications and offers recommendations for future research and practice. Table 1 presents the dissertation's two core aims, the objectives formulated to achieve these aims and the chapters corresponding to the objectives and aims.

Table 1. Five objectives and their corresponding chapters aligned with the dissertation's aims.

Aims and objectives	Chapter 3 Scoping review	Chapter 4 Systematic review	Chapter 5 Experimental study (*Smoking)*	Chapter 6 Mixed methods multi-study	Chapter 7 Prototype evaluation *(Physical activity)*
Aim 1 – Deepening our understanding of the role of identity in the context of smoking and physical activity					
Objective 1 – Examine the conceptualization and operationalization of identity in smoking and physical activity research	√				
Objective 2 – Investigate the relationship of identity with smoking and physical activity	√		√		
Objective 3 – Explore the relationship of personal, behavioral and psychosocial characteristics with smoking- and physical activity-related identity	√	√	√		
Aim 2 – Evaluating interventions (or intervention components) leveraging identity to promote smoking cessation and increased physical activity					
Objective 4 – Describe how identity is leveraged in interventions promoting smoking cessation and/or increased physical activity		√			
Objective 5 – Evaluate the effectiveness of and user experiences with identity-based interventions (or intervention components) to promote smoking cessation and increased physical activity		√	√	√	√

Note. **Chapter 2** is excluded from this overview as it is a protocol paper for the reviews presented in **Chapter 3 and 4**, and does not present findings. Similarly, the Introduction (**Chapter 1**) and General Discussion (**Chapter 8**) are not included.

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