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Planning and Mental Imagery to Promote Health Behavior Change: A Systematic Review

Planung und Imagination zur Förderung von Gesundheitsverhalten: ein systematisches Review

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Abstract

Planning and mental imagery interventions are two inexpensive evidence-based strategies that hold promise in facilitating changes in health behavior. This systematic review explores whether incorporating mental imagery techniques alongside planning enhances the effectiveness of planning interventions aimed at promoting health-related behaviors. Specifically, the main hypothesis examined whether combining planning with either process simulation or outcome simulation would be more effective in changing behavior than planning alone. It was further hypothesized that each individual intervention component would effectively change behavioral outcomes compared to a control condition. The review yielded 7 original studies analyzing data from a total of 1646 participants. Preliminary evidence was found that multicomponent interventions might be ineffective in changing health behavior relative to each of the components alone. The review also found preliminary evidence suggesting that planning and mental imagery may individually have limited effectiveness in promoting health behavior change. The results are discussed considering the limitations of the included trials and review methods, while also exploring practical implications and directions for future research.

Keywords: action planning, implementation intention, mental imagery, mental rehearsal, process simulations, outcome simulations, health behavior change

Zusammenfassung

Planung und Imagination sind zwei kostengünstige, evidenzbasierte Strategien, die vielversprechend sind, um eine Gesundheitsverhaltensänderung zu erzielen. Diese systematische Übersichtsarbeit beschäftigt sich mit der Frage, ob das Kombinieren von mentaler Imagination und Ausführungsplanung die Wirksamkeit von Planungsinterventionen zur Förderung von Gesundheitsverhalten erhöht. Die Haupthypothese untersuchte konkret, ob die Kombination von Planung mit Prozess- oder Ergebnissimulation eine effektivere Verhaltensänderung bewirken würde als die Planungsstrategie allein. Ferner wurde die Hypothese aufgestellt, dass jede einzelne Interventionskomponente zur signifikanten Veränderung der Gesundheitsverhaltensweisen im Vergleich zur Kontrollbedingung führen würde. In das Review wurden 7 Originalstudien eingeschlossen, in denen Daten von insgesamt 1646 Teilnehmer*innen analysiert wurden. Vorläufige Befunde zeigen, dass mehrkomponentige Interventionen im Vergleich zu den einzelnen Techniken möglicherweise ineffektiv bei der Veränderung von Gesundheitsverhalten sein könnten. Es wurden auch vorläufige Belege dafür gefunden, dass Ausführungsplanung und mentale Imagination allein eine begrenzte Wirksamkeit bei der Förderung von Gesundheitsverhalten haben könnten. Die Ergebnisse werden unter Berücksichtigung der Einschränkungen der eingeschlossenen Studien und der Review-Methodik diskutiert, wobei auch Implikationen für die Praxis und Anregungen für die zukünftige Forschung erörtert werden.

Schlagwörter: Handlungsplanung, Ausführungspläne, Implementationsintentionen, mentale Imagination, mentales Üben, Prozesssimulationen, Ergebnissimulationen, Förderung von Gesundheitsverhalten

Planning and Mental Imagery to Promote Health Behavior Change: A Systematic Review

Reducing the burden of critical behavioral risk factors is crucial for enhancing population health. According to the Global Burden of Disease Study 2019, poor diet quality, physical inactivity, and high BMI combined accounted for 11.9% of disability-adjusted life-years (DALYs) in 2019 worldwide (Murray, Aravkin, et al., 2020). The report also highlights the rapid rise of metabolic risks beyond high BMI, including high systolic blood pressure and high fasting plasma glucose. These risk factors contribute heavily to attributable disease burden and could potentially be exacerbated by unhealthy lifestyle habits. Similarly troubling is the increase in exposure to alcohol and drugs by more than 0.5% per year, which are among the leading causes of attributable DALYs (Murray, Abbafati, et al., 2020). Therefore, the Global Burden of Disease Study 2019 underscores the pressing need for adequate public health action and behavioral research aimed at improving health behavior outcomes.

Scientists seeking to develop effective health promotion programs typically utilize multiple interacting components as opposed to individual strategies in hopes of achieving greater and more sustainable effects (Craig et al., 2008). Two theory-based techniques that have shown considerable promise in fostering behavior change, both separately as well as components of more elaborate interventions, are planning and mental imagery (Bartholomew Eldredge et al., 2016; Hagger & Conroy, 2020). Numerous advantages make these strategies desirable among interventionalists, as they are self-administered and self-directed and have usually been delivered in a written form at minimal human resource expenditure through varied methods, e.g., in a pamphlet or leaflet, via a webpage, or via social media or a smartphone app (Hagger, 2017; Hagger & Luszczynska, 2014). Multicomponent behavior change interventions, which prompt participants to visualize their goal-directed plans, are based on the premise that augmenting planning strategies, such as implementation intentions and action plans, with mental imagery could increase the likelihood of goal attainment (Knäuper et al., 2009). For example, an imagery-enriched if-then planning intervention was effective in reducing alcohol consumption (Haug et al., 2020).

Although complex interventions using a plethora of different techniques are important in advancing health behavior change, disentangling the components used in health-related interventions is crucial to understanding the unique contribution and interactive effects of behavior change techniques as well as their underlying

mechanisms (Michie et al., 2013). When interventionalists compound planning strategies and mental simulations, comprehensively analyzing the two behavior change techniques in systematic literature reviews and meta-analyses becomes challenging. This is why scientists have been urged to adopt factorial multi-arm randomized controlled trials (Hagger & Luszczynska, 2014). Such designs would allow the evaluation of the efficacy of planning as a standalone technique alongside planning interventions supplemented with a mental simulation component. Despite this plea for well-designed experiments, studies on the topic are scarce. More research is needed before the additional effect of combining mental imagery with planning interventions on health behavior outcomes can be subjected to statistical synthesis (Conroy & Hagger, 2018). Therefore, generalizable conclusions on whether mental imagery may enhance or decrease the effectiveness of planning interventions have not yet been drawn.

On these grounds the conduction of a systematic review on the topic was deemed important. The work at hand sought to synthesize and evaluate existing evidence regarding the effectiveness of individual planning interventions compared with the combined utilization of mental simulations and planning strategies, more specifically, implementation intentions and action plans, in fostering changes in health behaviors. Furthermore, this systematic review aimed to identify gaps and limitations in the current literature and provide recommendations for future experimental work.

The present paper provides an overview of various planning approaches, elucidating their definitions and crucial distinctions, while also exploring the theoretical origins and evidence base of planning strategies. Additionally, it examines factors that can either facilitate or hinder their effectiveness. Transitioning further, the paper delves into different types of mental simulations aimed at inducing behavioral change, delineating their theoretical underpinnings, potential mechanisms, evidence base, and moderating factors. Furthermore, the potential relationship between planning strategies and mental imagery within the context of multicomponent interventions is explored. Following the delineation of the research questions and the presentation of the research synthesis methods, an integrative summary of the findings concerning the effectiveness of planning and mental imagery health behavior interventions is provided. In the final section, the results are interpreted in view of existing literature and limitations of the evidence included in the review are discussed. Strengths and weaknesses of the present systematic review are also addressed. In its conclusion, the paper explores implications of the findings for practice, theory, and future research.

Theoretical Background

Altering health-related behaviors poses a significant challenge. Many individuals fail to break health-compromising habits and engage in a health behavior, despite being motivated and having good intentions. The observed modest correlation between intentions and behavior has been dubbed the intention-behavior “gap” and has brought the processes involved in intention enactment to the attention of researchers (Sheeran & Webb, 2016). Several psychological models emerged from attempts at bridging that gap.

Pioneered by the Rubicon Model of Action Phases (Heckhausen & Gollwitzer, 1987), these frameworks differentiate between a motivational phase, in which goal intentions are formed, and a volitional phase, in which planning strategies aid the implementation of the created goal intentions. Other prominent models that include a volitional phase are the Health Action Process Approach (HAPA; Schwarzer, 2008) and the Integrated Change Model (Vries et al., 2005).

Planning Approaches

Planning strategies to attain a desired goal are techniques commonly used in volitional behavior change interventions (Hagger et al., 2016). Multiple planning approaches that differ in concept have been identified in the literature: preparatory planning, implementation intentions, action planning, and coping planning (Rhodes et al., 2020). When individuals develop strategies to improve the accessibility and availability of resources required to achieve a desired objective, they are engaging in preparatory planning (Bryan et al., 2002). Implementation intentions, also referred to as “if-then” plans, are aimed at establishing a cue-response link between an anticipated situation and a specific behavioral reaction, while stipulating the “when”, “where” and “how” of a plan designed to attain a goal (Gollwitzer, 1999). Action plans entail the formulation of a defined series of steps to aid in behavioral action (Leventhal et al., 1965, as cited in Rhodes et al., 2020, p. 575). Like implementation intentions, action plans also include the temporal, contextual and operational aspects of the goal-directed behavior (Rhodes et al., 2020). Coping planning is a self-regulation strategy to overcome obstacles that challenge the initiation or maintenance of intended behavior by linking anticipated risk situations with appropriate coping responses (Sniehotta, Schwarzer, et al., 2005).

In this systematic review the focus lies on implementation intentions and action planning. This is because these two strategies both concentrate on the target goal

behavior and have substantial conceptual overlap. Moreover, researchers have placed implementation intentions and action plans in the same category when aggregating the effects of planning interventions on health behavior in meta-analytic reviews (Adriaanse, Vinkers, et al., 2011; Hagger & Luszczynska, 2014). In contrast, preparatory plans address preceding sub-actions necessary to achieve the intended health behavior, whereas coping plans serve as “back-up” strategies, complementing the initial plan by providing alternative courses of action (Rhodes et al., 2020). The upcoming paragraphs provide a more detailed examination of implementation intentions and action plans.

Implementation Intentions

The Rubicon Model, which serves as the foundation for implementation intentions, views goal intention as essential but not adequate on its own to bring about motivated action (Heckhausen & Gollwitzer, 1987). According to the model, after the feasibility and desirability of different coveted outcomes are assessed in the pre-decisional action phase, people cultivate a goal intention, i.e., a sense of commitment toward achieving the behavioral or outcome goal that is awarded top priority (Gollwitzer, 1990). In the subsequent volitional or “pre-actional” phase, implementation intentions play a pivotal role in paving the way for goal attainment by automating action initiation (Gollwitzer, 1999). Gollwitzer and Sheeran (2008) describe implementation intentions as:

> if-then plans that link situational cues (i.e., good opportunities to act, critical moments) with responses that are effective in attaining goals or desired outcomes (“If situation Y is encountered, then I will initiate behavior Z in order to reach goal X!”). (p. 1)

Implementation intentions are believed to influence behavioral performance via automatic and non-conscious mechanisms, specifically through the increased cognitive accessibility of critical environmental cues and the stronger association formed between the specified cues and the intended behavior (Webb & Sheeran, 2008). Gollwitzer (1999) notes that following the conscious formation of if-then statements, individuals are more likely to promptly recognize and take advantage of favorable opportunities or avoid tempting distractions. This occurs even while focusing on other daily tasks, because action initiation based on established cue-response links demands fewer cognitive resources. Hence, implementation intentions resemble the formation of habits, while having the advantage of bypassing the required repeated

practice of newly formed habits (Gollwitzer, 1999). Furthermore, if-then plans can support individuals striving to break unhealthy habits by enhancing their ability to choose between the unhealthy and healthy options when faced with critical situations (Adriaanse, Gollwitzer, et al., 2011).

Implementation intentions have been extensively studied and rigorously tested. Gollwitzer and Sheeran (2006) conducted the first meta-analysis of ninety-four studies exploring the effects of forming implementation intentions on goal achievement across a range of behaviors. They found that this self-regulatory strategy had a medium-sized effect on goal attainment. Interventions adopting if-then plans as an intervention strategy have been shown to be effective in changing many health-related behaviors, inter alia, smoking cessation (McWilliams et al., 2019), physical activity (Silva et al., 2018), healthy eating (Vilà et al., 2016), and alcohol consumption (Cooke et al., 2023). Although implementation intentions have been shown to be effective in altering health behaviors with overall effect sizes ranging from small to medium, the heterogeneity of effect sizes across studies should be acknowledged (Hagger & Luszczynska, 2014).

Researchers have pinpointed several moderators that influence the efficacy of implementation intentions, rendering them more or less suitable for specific populations and behavioral domains (Rhodes et al., 2020). People who tend to react more impulsively, have poor preexisting planning skills, or individuals with weaker executive functioning may profit less from health behavior interventions adopting planning strategies (Allan et al., 2013; Churchill & Jessop, 2011; Hagger & Luszczynska, 2014).

Strong goal intentions have been shown to boost the effects of implementation intention on goal attainment in experimental research (Sheeran et al., 2005). This is in line with the Rubicon Model, which sees goal intentions as a prerequisite for the enactment of behavior (Heckhausen & Gollwitzer, 1987). There is also evidence that action self-efficacy might positively influence how planning interventions impact behavior, specifically when individuals exhibiting high self-efficacy are working on solving difficult tasks (Wieber et al., 2010). Notably, planning does not appear to impact action self-efficacy (Hagger & Luszczynska, 2014), which represents personal beliefs in one's capability to perform a behavior in the future (Schwarzer & Luszczynska, 2008). The Rubicon Model explains the lack of evidence for interactive effects of planning and self-efficacy techniques on health behavior because it positions self-

efficacy in the pre-decisional phase, whereas planning operates at the post-decisional stage according to the model (Heckhausen & Gollwitzer, 1987).

The nature of behavioral response, i.e., the uptake of a health behavior versus the disengagement from an unhealthy behavior, is also deemed a moderating factor impacting the effectiveness of implementation intention interventions (Hagger et al., 2016). For example, Adriaanse, Vinkers, et al. (2011) demonstrated that when it comes to eating behaviors, implementation intentions are more adept at encouraging healthy eating choices than discouraging unhealthy ones. Furthermore, in their meta-analysis Adriaanse, Vinkers, et al. (2011) found that the quality of the outcome measure and the quality of the control condition moderate the effectiveness of the implementation intention manipulation.

Some conceptual boundaries arise from the definition of implementation intentions. Implementation intention interventions can appear in a self-generated or prespecified style (Rhodes et al., 2020). When forming their own personal if-then plans, individuals ought to identify a fixed environmental event, which dictates “when” and “where” a desired behavior should be performed. Consequently, the selected cues cannot be emotional states (e.g., “When I am feeling sad, I will…”), if implementation intentions are to be utilized correctly (Hagger & Luszczynska, 2014). The subsequent behavioral response should be simple and clearly outlined (e.g., “When I visit the canteen at lunchtime, I will select a salat.”), as opposed to general and complex (e.g., “When I visit the canteen at lunchtime, I will eat healthy.”) (Rhodes et al., 2020). Researchers should consider these conceptual aspects of implementation intentions when selecting the appropriate planning approach for interventions aimed at promoting health behavior change. The characteristics of the behavior change target should also inform the choice of planning strategies. For example, implementation intentions, which rely less on conscious and effortful control compared to action plans, might be more effective than action plans in reducing sedentary behavior which is highly habitual (Maher & Conroy, 2015). The further differences between action planning and implementation intentions will be elaborated on in the following subsection.

Action Planning

The concepts of implementation intentions and action plans align closely, often resulting in their interchangeable usage in the literature (Hagger & Luszczynska, 2014). The lack of a precise definition of action plans and the common emphasis on

the development of critical cue-response links further contribute to the conflation, but upon closer examination, some distinctions become apparent.

An essential distinction of action plans is their tendency to encompass multiple prompts to action for behaviors of varying complexity, as the inclusion of several critical cues and a chain of behavioral responses is more likely to support the pursuit of a broader and less-specific goal intention (Hagger & Luszczynska, 2014). This makes action planning suitable for intervention programs looking to promote both simple (e.g., vitamin consumption; Sheeran & Orbell, 1999) and more elaborate health behaviors (e.g., reduction of dietary fat intake; Armitage, 2004).

Another difference between action plans and implementation intentions lies in their theoretical background. Action planning has its origins in the early contributions to the field of social psychology (e.g., Leventhal et al., 1965), but it also plays an integral part in newer and more elaborate models, such as the hybrid HAPA Model (Schwarzer, 2008) and the I-Change Model (Vries et al., 2005). The HAPA Model positions planning as a mediator between intention and behavior and breaks down the concept of planning into two distinct subcategories: action planning and coping planning (Sniehotta, Schwarzer, et al., 2005). Hence, interventions on health behaviors based on the HAPA Model typically include the formation of coping plans as an additional component alongside action planning (e.g., Sniehotta et al., 2006).

The underlying mechanisms of action planning can also vary from those involved in implementation intentions, taking into account that action planning can occur through both conscious deliberation and unconscious processes (Hagger & Luszczynska, 2014). This mechanism aligns well with dual-process theories of behavior (Hagger et al., 2017; Strack & Deutsch, 2004). Action plans delineating a simple cue-response association may prompt behaviors involuntarily and could aid in habit formation (Fleig et al., 2013; Schwarzer, 2008). However, developing detailed action and coping plans that incorporate multiple references to time, location, and behavior would necessitate deliberate decision-making and self-regulation processes (Bagozzi et al., 2003).

Due to the frequent equation of action plans with implementation intentions and their common inclusion alongside coping plans in integrated health behavior interventions, the evidence supporting the effectiveness of action planning remains limited at present (Rhodes et al., 2020). A meta-analysis of action planning interventions to promote physical activity revealed a small effect of action plans on

physical activity levels when compared to no-treatment controls, and a medium-sized effect when action planning was paired with coping planning (Carraro & Gaudreau, 2013). In the same meta-analysis Carraro and Gaudreau (2013) identified numerous moderating factors that magnify the effects of action planning interventions on physical activity behavior, including strong preexisting intentions, increased age, and low previous level of physical activity. Those undergoing physical therapy and individuals who incorporated four components into their action plans also benefited more from the interventions.

Research corroborating the long-term effects of implementation intentions or action planning leading to behavioral lifestyle changes is limited. Hagger and Luszczynska (2014) noted that longitudinal studies, which evaluate the effectiveness of planning interventions over periods of at least one year, typically employ additional techniques in conjunction with the standard planning manipulation (e.g., Conner & Higgins, 2010; Godin, Sheeran, et al., 2010). Within multicomponent interventions, designed to ensure and maximize the sustainability of health behavior change, mental imagery has been occasionally utilized as a supplemental behavior change strategy. The ensuing paragraphs offer an overview of mental imagery techniques.

Mental Imagery

Imagining oneself in future situations is a skill that athletes traditionally draw upon to boost their motivation, confidence, and performance (Feltz & Landers, 1983; Murphy et al., 2008). More recently, visualization has been adopted in the health domain as a tool to bring about behavioral lifestyle changes (e.g., Andrade et al., 2016). Imagery is a blanket term that covers different techniques, ranging from client-focused therapeutic and counselling strategies like guided imagery and functional imagery training to the more streamlined approach of mental simulations (Hagger & Conroy, 2020). Mental simulations can be defined as the mental rehearsal of an event or a series of events (Pham & Taylor, 1999). The present systematic review concentrates on mental simulations, as this form of mental imagery has the goal of facilitating behavioral change. Given the substantial variation in the definition of mental imagery across the literature, the decision was informed by a recent meta-analysis centered on health interventions (Conroy & Hagger, 2018). The authors specifically examined forms of mental imagery that involved visualizing the adoption or cessation of health-related behaviors. Mental simulations are typically practiced individually, guided by written instructions, but they can also be conducted in groups with a practitioner reading the

exercise aloud (Hagger, 2017). Conceptually, mental simulations can be categorized into two types: outcome and process simulations (Pham & Taylor, 1999).

Outcome Mental Simulations

Centered on the experience of successful goal attainment, outcome imagery encompasses the associated positive feelings and benefits (Pham & Taylor, 1999). Individuals practicing outcome imagery are encouraged to use all their senses to achieve a more vivid and profound visualization of the emotions that would arise from achieving a health goal (Hagger & Conroy, 2020). Due to their abstract nature, outcome simulations are comparable to goal intentions, which do not always evoke specific behavioral reactions and instead depend more on spontaneous action (Taylor, 2011). It is theorized that imagining the desired outcome would lead to changes in an individual's attitudes and motivation towards the actions necessary to attain the wanted result (Hagger, 2017). Outcome mental simulation is therefore regarded as a motivation- and self-efficacy-enhancing strategy (Vasquez & Buehler, 2007).

Process Mental Simulations

Process simulations involve individuals identifying and mentally rehearsing the essential steps required to accomplish a desired goal, which could facilitate behavior change and a better emotional self-regulation (Taylor, 2011). Analogous to planning interventions, process imagery exercises require the specification of the “when”, “where”, and “how” elements of goal-oriented behavior (Hagger & Conroy, 2020). Much like implementation intentions, process imagery is considered a volitional strategy. Aimed at reinforcing the link between environmental and internal cues, process imagery is presumed to render the situational cues more readily accessible and automate the execution of the corresponding behavioral response (Kosslyn et al., 2001). Moreover, it is believed that mentally picturing oneself carrying out the plan stages and performing the behavior will create an imagined personal example (Hagger & Conroy, 2020). This so-called "self-model" bolsters individuals' confidence in performing behaviors successfully, thereby enhancing their motivation for future engagement.

Potential Mechanisms of Imagery Interventions

Various theories have been put forward to describe the mechanisms by which mental imagery techniques lead to behavior change. Bandura’s (1986) Social Cognitive Theory delivers a prominent framework suggesting that self-efficacy and outcome expectancies mediate the impact of mental imagery interventions on behavior

change. Based on the theory, people adopt behaviors by observing and learning from others who have successfully performed them. The successful demonstration of behavior enhances the self-assurance of the viewer and heightens their expectation of favorable consequences from participating in said behavior. In addition to live models, Bandura recognized verbal instructional models, such as a running coach providing guidance, and symbolic models, such as those found in books and movies (Bandura, 1977). As previously mentioned, process mental imagery creates a "self-model" that is believed to function similarly to Bandura's modeling stimuli (Hagger & Conroy, 2020).

Emotional regulation poses a further possible mechanism by which mental simulations turn imagined experience into action (Pham & Taylor, 1999). Visualizing events in one's mind can elicit emotional reactions (Wright & Mischel, 1982). Hagger and Conroy (2020) explain that positive emotional states can reinforce goal-oriented actions by promoting persistence, while simultaneously mitigating negative emotions such as anxiety and worry, which have the potential to obstruct the behavior. During times of stress, engaging in process mental simulations can aid individuals in effectively managing their emotions and facilitating problem-solving tasks (Rivkin & Taylor, 1999).

An alternative cognitive approach to explaining mental imagery effects suggests that cue accessibility mediates the effects of mental imagery interventions on behavior change (Kosslyn et al., 2001). As noted earlier, process mental simulation is thought to strengthen the link between key environmental cues and corresponding behavioral routines (Hagger & Conroy, 2020). The increased accessibility of cues could then encourage the initiation of behavior.

The Elaborated Intrusion Theory of Desires provides a further theoretical perspective on how mental imagery works in changing behavior (Kavanagh et al., 2005). The theory distinguishes between two types of mental processes which elicit desire: basic associative processes and higher cognitive processes. Associative processes arise from learned associations formed between environmental stimuli or physiological cues tied to an “appetitive target” (e.g., food, cigarettes, alcohol) and behavioral responses to the target (Hagger & Conroy, 2020). Associative connections activate intrusive thoughts toward the appetitive target. When the target provokes strong emotional responses, intrusive thoughts trigger higher level elaborative processes, otherwise, they are transient and susceptible to distractions. These effortful cognitive processes entail searching, retaining, and manipulating available information

related to the target in working memory (Kavanagh et al., 2005). Through this additional processing intrusive thoughts become more elaborated, resulting in subjective feelings of desire (Hagger & Conroy, 2020). The theory emphasizes that sensory imagery revolving around the consummatory target plays a key role in both the activation and persistence of desires (Kavanagh et al., 2005). Desire imagery is proposed to add richness and vividness to associative inputs, magnifying their emotional impact and motivational power. Mental imagery associated with a tempting cue could therefore help individuals disengage from an unhealthy behavior by increasing the vividness and potency of the goal-directed avoidance behavior (Hagger & Conroy, 2020). The authors suggest that visualizations could serve as memory cues for the intended goal, when individuals encounter tempting situations triggering desires contrary to the goal.

Evidence Base

Research indicates that imagery techniques are effective in producing health behavior change, as demonstrated by a meta-analysis of twenty-six studies focused on health interventions, which revealed small overall averaged effect sizes of mental imagery interventions on post-intervention target behavior (Conroy & Hagger, 2018). Furthermore, the analysis unveiled a small-to-medium sized effect on physiological measures indicating health improvements, such as body mass index or weight loss. In addition, imagery interventions yielded small effects on intention, perceived control, and attitude, which are psychological factors proposed to mediate mental imagery effects. Research on the mediation of imagery intervention effects is limited, with some tests of mediation producing inconsistent supporting evidence (e.g., Conroy et al., 2015). The demonstrated small effects of mental simulations on social-cognitive variables, along with the observed variability in mediation effects in the literature, spark debate over the prominent role of the Social Cognitive Theory (Bandura, 1986) in explaining the mechanisms by which mental imagery contributes to behavioral change (Hagger & Conroy, 2020).

It is noteworthy that mental simulation interventions have proven effective in a range of different domains. This was established by a newly conducted meta-analytic review of ninety-four studies that uncovered an overall medium-sized positive effect of imagery techniques on behavior change across various fields (Cole et al., 2021). Acknowledging the significant variation in the conceptualization of mental imagery in the literature, the investigators developed a new taxonomy to classify various subtypes of mental simulation. The authors identified nine distinct classes of mental simulation,

differentiated by two dimensions: class and purpose. Accordingly, mental imagery is comprised of three distinct classes: process, outcome, and performance simulations. Cole et al. (2021) further categorized mental imagery based on its purpose, which is determined by whether an inferior, standard, or superior version of the behavior is being imagined. Notably, their meta-analysis revealed that only process and outcome simulations have been effectively applied in health psychology. The meta-analysis examined specific imagery subtypes, revealing that standard performance, superior performance, and superior outcome combined with process simulations, all yielded statistically significant medium-sized positive effects on behavior. The review also identified a statistically significant, albeit smaller, positive effect of superior outcome simulations on outcome measures. However, the analysis did not validate the anticipated beneficial impact of process imagery on the targeted behavior, as it revealed a small positive effect that did not reach statistical significance.

Factors Enhancing the Effectiveness of Mental Imagery Interventions

The meta-analysis by Conroy and Hagger (2018) showed substantial heterogeneity in imagery effect sizes across the included studies, underscoring the necessity for moderator analyses. Findings pointed to greater effects of imagery interventions on health behaviors within older, nonstudent cohorts, particularly when detailed instructions on mental imagery were given, when studies possessed higher methodological quality scores, and when interventions were of longer duration.

Cole et al. (2021) also performed moderator analyses to identify variables that could explain the significant variability in effect sizes observed across studies. Their analysis indicates that the purpose of mental imagery significantly moderates effects sizes, with standard and superior simulations having a more positive impact on behavior compared to imagery focused on poor performance, ineffective planning, or undesirable outcomes. In contrast to the meta-analytic review by Conroy and Hagger (2018), this meta-analysis revealed that simply extending the duration of imagery exercises and incorporating follow-up sessions does not systematically result in improved behavior change. Interestingly, Cole et al. (2021) found that providing participants with extrinsic incentives, such as vouchers, money, or course credit, enhances the effectiveness of mental simulation interventions, presumably by increasing participants' motivation (Brase, 2009).

In addition, a key factor that may facilitate the efficacy of imagery interventions is the individual's imagery ability (Hagger & Conroy, 2020). Imagery is seen as a skill

that can be improved through practice, enhancing the capacity to vividly visualize future events or desired outcomes. Typically, print-based imagery interventions lack exercises for practicing or priming imagery skills. However, Hagger and Conroy (2020) recommend integrating short imagery practice tasks with mental simulation exercises to maximize the behavioral benefits of such interventions.

The optimal effectiveness of imagery interventions also hinges on participants' active engagement with the imagery intervention component (Hagger & Conroy, 2020). Analyzing diaries and written scripts, where participants offer detailed feedback on their experiences with mental simulation exercises, can provide insights into their adherence to the instructions of the imagery task (Pham & Taylor, 1999).

Furthermore, imagery interventions have been shown to be more effective for individuals with some level of motivation to change, although the formation of concrete goal intentions is not a prerequisite (Hagger & Conroy, 2020).

According to the literature, augmenting the mental imagery component with complementary behavior change techniques, such as planning exercises, has the potential to significantly improve behavior change outcomes (Hagger & Conroy, 2020). The following paragraph discusses how mental imagery and planning strategies might relate to each other as parts of multicomponent interventions.

Multicomponent Interventions

The Rubicon Model of Action Phases (Heckhausen & Gollwitzer, 1987) provides a prominent blueprint for interventions incorporating behavior change strategies which target both phases of action to maximize the enactment of intentions (Hagger, Lonsdale, Koka, et al., 2012). Motivational components and volitional components involving cognitive activities (e.g., planning) are anticipated to work synergistically, and their combined or interactive effect is expected to lead to higher levels of behavioral engagement compared to the impact of each component individually (Hagger & Luszczynska, 2014). While examples are limited, there are some prior explorations of this integrated approach (e.g., Milne et al., 2002; Prestwich et al., 2008).

When integrating planning techniques and mental imagery into multitask interventions, it is essential to account for the inherent characteristics of mental imagery strategies, given that the mental simulation category includes both motivational and volitional strategies. As per Taylor and Pham (1996), process simulation constitutes a volitional approach, because it empowers individuals to formulate specific plans by visualizing the sequence of events leading to a desired

outcome. In contrast, outcome simulation does not involve the mental rehearsal of volitional action plans toward a goal, as this motivational technique concentrates primarily on simulating emotions (Taylor & Pham, 1996). Hence, it is the convergence of implementation intentions or action plans with outcome mental imagery that represents the unification of motivational and volitional strategies, consistent with the framework provided by the Action-Phase Model (Heckhausen & Gollwitzer, 1987). Previous research observed that despite increasing motivation, outcome simulations were ineffective in influencing intentions and behavior, possibly because they failed to provide necessary information about the steps required to achieve the desired outcome (Pham & Taylor, 1999). It is hypothesized that the inclusion of planning exercises, such as implementation intentions or action plans, alongside outcome simulation interventions may address this limitation by providing means to implement the imagined behavior (Hagger & Conroy, 2020).

Knäuper et al. (2009) were the first to propose a framework for behavior change interventions that integrates both volitional planning components, specifically implementation intentions and process mental simulations. The authors developed their model based on Taylor and Pham's (1996) comparison of the two self-regulatory strategies. First, both implementation intentions and process imagery generate similar plans, incorporating environmental cues and sequential steps necessary for achieving goals. Second, the effectiveness of both strategies is thought to be driven by the accessibility of critical cues and the strength of the cue-response link. Knäuper et al. (2009) hypothesized that integrating implementation intentions with process mental imagery, focusing particularly on relevant cues and the cue-response association, would enrich the mental representation activated by the verbal plan with vivid multi-sensory information. The resulting more lifelike mental representations would lead to stronger memory traces that enhance the perception of environmental stimuli and enactment of behaviors (Beisteiner et al., 1995). Although the study by Knäuper et al. (2009) did not examine the suggested underlying mechanisms, it is significant as pioneering research that illustrates how targeted process imagery boosts the effectiveness of implementation intentions. However, a more recent study has offered some support for the concept that engaging in process mental imagery, centered on pre-established if-then plans, is a cognitive activity that operates independently of motivation, solely at the cognitive level (Knäuper et al., 2011).

Research Questions

Upon reviewing the presented theoretical considerations and empirical evidence regarding planning approaches and mental simulations, as well as the interplay of the two behavior change techniques within multicomponent interventions, the primary research question of this systematic review became apparent. Does the inclusion of mental imagery enhance the efficacy of planning interventions aimed at promoting health-related behaviors?

To prevent the conflation of disparate concepts, a secondary analysis was planned, differentiating between outcome and process imagery within the realm of mental simulation. This analysis aimed to highlight their distinctness in both content and proposed mechanisms of influence. Notably, Conroy and Hagger (2018) were unable to conduct a moderator analysis on the utilization of process and outcome-focused imagery in health interventions due to an inadequate number of studies incorporating these types of imagery. Conversely, Cole et al. (2021) found that the effects of mental imagery across various domains do not differ between the subtypes of mental simulation. However, the authors warned that due to the very small number of effects in several sub-groups, reliable inferences cannot be drawn.

Finally, the effectiveness of each intervention component was evaluated, expected to align with previously discussed research.

Specifically, this systematic review examined the following hypotheses:

1. The integrated intervention, which combines a planning activity such as implementation intentions or action plans with a mental simulation task—either (a) process simulation or (b) outcome simulation—is expected to be more effective in modifying health behavior outcomes than the planning strategy alone.
2. It was also anticipated that each of the intervention manipulations alone (planning, and if applicable, mental imagery) would be more effective in changing health-related behaviors compared to a no-treatment control condition.

Method

The current bachelor's thesis adopted a systematic review approach to examine the available evidence related to planning and mental imagery health interventions in the literature. The review partially followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement (Page et al., 2021).

Search Strategy

With respect to selection, a systematic search of academic databases CINAHL, MEDLINE, APA PsycArticles, APA PsycInfo, PSYNDEX Literature with PSYNDEX Tests, PubMed, Web of Science, and Scopus was conducted in April 2024. This search encompassed all relevant English-language peer-reviewed journal articles reporting on interventions using planning and mental imagery techniques to promote health behavior change, published before April 15, 2024. To ensure an unrestricted and inclusive search, no filters were specified. Additionally, manual searching in reference lists and in Google Scholar and the Library Portal Primo was performed.

The search terms contained either in the title or in the abstract included: ("implementation intention" or "implementation intentions" or "planning" or "plan*" or "planned" or "action planning") and ("imagery" or "mental simulation" or "mental simulations" or "mental practice" or "mental rehearsal" or "mental preparation" or "visuali*" or "episodic future thinking") and ("health behavior" or "health behaviour" or "smoking" or "physical activity" or "sedentary behaviour" or "sedentary behavior" or "exercise" or "sleep" or "substance use" or "alcohol" or "diet" or "nutrition" or "snacking" or "healthy eating" or "sunscreen" or "blood donation").

These keywords and following eligibility criteria were chosen based on search terms and eligibility restrictions used in the previous meta-analysis addressing imagery interventions in health behavior by Conroy and Hagger (2018).

Study Eligibility

In the eligibility phase, studies were included if they (1) concentrated on changing a target health-related behavior as an outcome, (2) involved imagining the adoption of health-promoting or cessation of health-compromising behavior, and (3) reported on the interactive effects of mental imagery and planning interventions, i.e., compared the effects of the following conditions: implementation intention/action planning only condition vs. a planning plus mental imagery condition. Studies were excluded if they (1) had a clinical sample with mental health conditions, (2) reported on correlational research, (3) had no control group or pre-test measures, (4) focused

solely on outcomes relating to psychological health, (5) utilized an alternative imagery intervention (e.g., relaxation, meditation exercise, arousal reduction imagery, affective imagery, mental contrasting, etc.), (6) had an unclear intervention content, and (7) tested only the independent effects of planning and mental simulation interventions.

Because research on planning and mental imagery is in its infancy, it was decided not to include full-factorial randomized controlled design as an eligibility restriction, due to the anticipated small number of studies. Therefore, this systematic review did not prioritize examining the unique and interactive effects of interventions combining implementation intentions and mental imagery on health behavior, but rather focused on the proposed supplementary effect of mental imagery on planning.

A single reviewer performed the study collection and screening. After the removal of duplicates, the investigator screened the titles, keywords, and abstracts to identify potentially relevant studies. Upon identifying research protocols through the search strategy, the researcher made efforts to obtain the respective studies. In the final stage, full text of the remaining articles was assessed for eligibility based on the defined criteria, with the examiner excluding unsuitable studies at the first reason for exclusion.

Data Extraction and Analysis

After the completion of the search and eligibility processes, the author extracted study characteristics and results from each article included in the review. The following descriptive data were collected and summarized in a table alongside major findings: author(s) and year of publication, target health behavior, sample, study design and follow-up periods, intervention characteristics, behavior change outcomes, and psychological measures.

The findings across studies were narratively analyzed by the investigator using methods of data synthesis commonly employed in systematic reviews (e.g., Luszczynska et al., 2013). Effects of interventions on behavior were retrieved from both main and sub-group analyses in the original studies. These effects were summarized and coded based on a predefined scheme to indicate their direction and significance. If an intervention exhibited a statistically significant positive effect, indicating improvement in health behavior outcomes compared to control or baseline, it was coded as “+”. Conversely, if an intervention demonstrated a statistically significant negative effect, suggesting worsening of health outcomes compared to control or baseline, it was coded as “-”. Effects from interventions that did not reach statistical

significance were coded as “0”. Results were to be summarized as “showing corroborating evidence” for the boosting effect of mental imagery on planning interventions if at least 60% of all studies were coded as “+”. For example, if 6 out of 10 studies included planned contrasts that demonstrated the combined mental simulation and planning condition was more effective in changing health behavior compared to other intervention groups and the control group, it would be considered corroborating evidence. This 60% threshold was utilized in previous reviews (e.g., Boberska et al., 2018; Luszczynska et al., 2013). Moreover, if 50–59% of the included studies revealed significant positive effects, or if the intervention was tested only in a single trial that identified significant effects, this could still be considered "preliminary evidence" to guide future research (Luszczynska et al., 2013).

Results

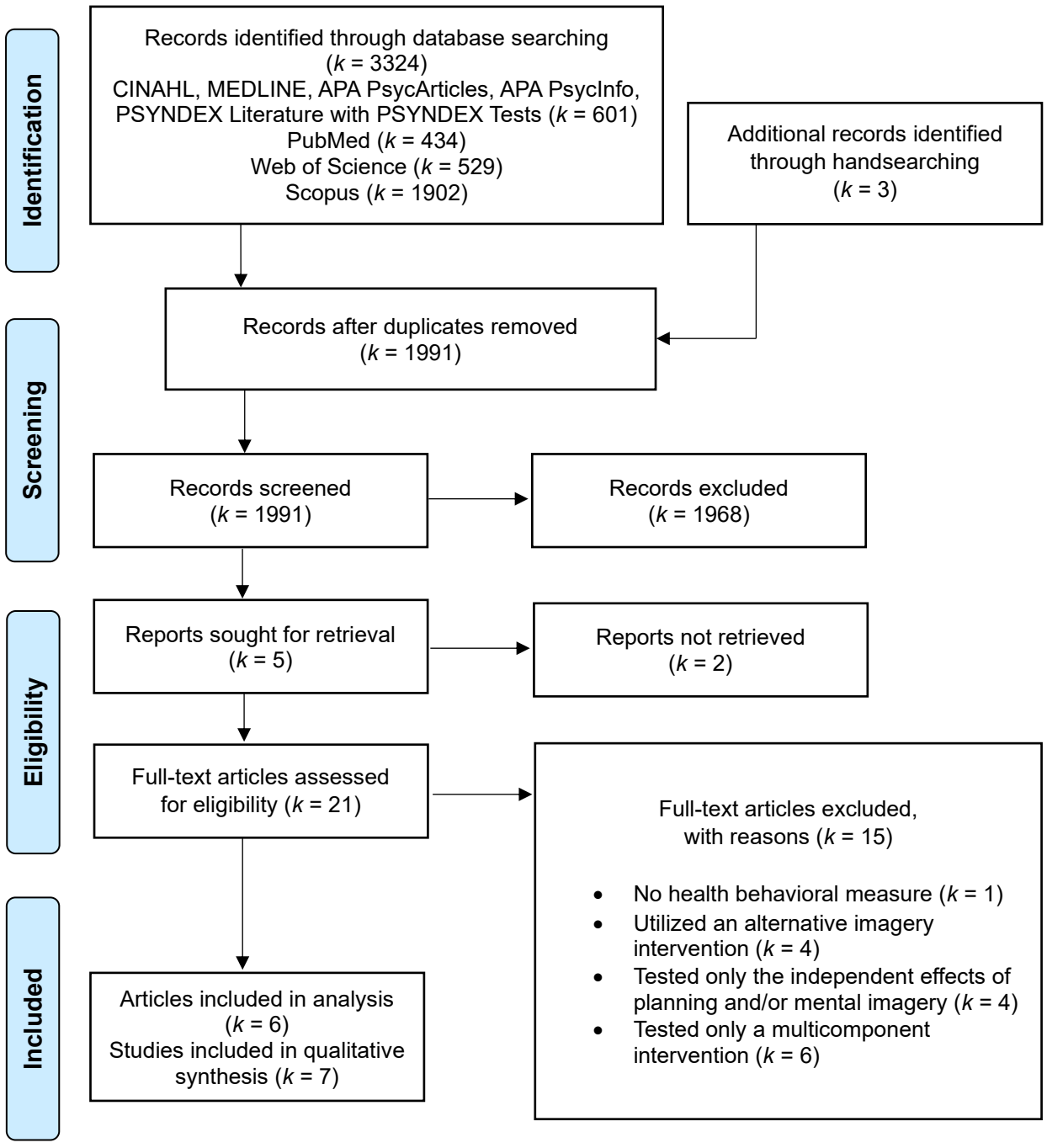
A total of 3324 records were identified as potentially relevant through database searches. A manual search of the reference lists of all included articles and book chapters retrieved from the searches was conducted to identify additional articles. This search yielded three additional records. After removing duplicates and excluding articles unrelated to the topic, five randomized controlled trial study protocols emerged. The reviewer was unable to retrieve two of the corresponding empirical studies, one of which might have potentially met the inclusion criteria for this systematic review (Baldwin et al., 2022). Afterwards, the full text of 21 articles was assessed for eligibility. At this point, the predominant reasons for exclusion were either the exclusive testing of a multicomponent intervention (e.g., Smith et al., 2022), or the independent testing of planning or mental imagery manipulations (e.g., Andersson & Moss, 2011). Frequently, studies were excluded for employing alternative imagery techniques like arousal reduction imagery or mental contrasting (e.g., Loft & Cameron, 2013; Marquardt et al., 2017). A notable exclusion was the study by Smith et al. (2024). This was the only HAPA-based intervention (Schwarzer, 2008), incorporating planning and mental imagery techniques, detected with the search strategy. The study was ruled out because the mental imagery exercise targeted the action control component of the intervention, rather than the preceding planning component. Action control encompasses three key self-regulatory processes: self-monitoring, awareness of standards, and self-regulatory effort (Sniehotta, Scholz, & Schwarzer, 2005). Thus, participants were prompted to imagine performing a preselected behavioral self-

monitoring strategy instead of the targeted health-promoting behavior, which eventually led to confusion among them (Smith et al., 2024).

Ultimately, 7 studies (reported in 6 articles; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Knäuper et al., 2011; Koka, 2016; Koka & Hagger, 2017; Meslot et al., 2016) met all inclusion criteria and thus were included in the systematic review. Figure 1 illustrates details of the selection process. The subsequent paragraphs offer a description of the included studies and an integrative summary of their findings relevant to the research questions.

Figure 1

Flow Diagram of the Selection Process



Description of the Analyzed Material

The included seven studies reported a total of 1646 participants. The sample sizes varied from 64 to 467 analyzed cases. In most of the studies (*k* = 5; 71.43%; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Knäuper et al., 2011; Studies 1 & 2 by Meslot et al., 2016), participants were university students above the age of 18 (mean age: 22.42 years), with only a sub-sample from the second study by Meslot et al. (2016) consisting of nonstudents, recruited from a fitness studio. Two studies (28.57%; Koka, 2016; Koka & Hagger, 2017) were conducted with adolescents aged 14 to 16. Reviewed research covered the following intervention topics: nutrition (*k* = 1; Knäuper et al., 2011), physical activity (*k* = 4; Koka, 2016; Koka & Hagger, 2017; Meslot et al., 2016), and alcohol consumption (*k* = 2; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012). Five studies (71.43%; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Koka, 2016; Koka & Hagger, 2017; Study 2 by Meslot et al., 2016) were described as a randomized controlled trial (RCT); the first study by Meslot et al. (2016) adopted a cluster RCT design, whereas Knäuper et al. (2011) conducted a controlled clinical trial (CCT). In the same study, the control group was given a goal intention task, while the remaining trials deployed a mere-measurement control group.

Nearly all studies (*k* = 6; 85.71%) relied on self-report measures, with only the second study by Meslot et al. (2016) utilizing an objective measure of physical activity. More than half of the studies *(k* = 4; 57.14%; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Koka, 2016; Koka & Hagger, 2017) conducted content analysis on participants' written responses to evaluate compliance with the intervention exercises. Additionally, three studies (42.86%; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Study 1 by Meslot et al., 2016) utilized planning scales as manipulation checks for the planning component. Knäuper et al. (2011) were the sole researchers to formally assess the extent and quality of participants' mental imagery. One trial (Study 2 by Meslot et al., 2016) did not provide details about any manipulation checks. All studies except one (Koka, 2016), incorporated measures of Theory of Planned Behavior constructs (TPB; Ajzen, 1991), with the intention of assessing the mediation of the intervention's effects on TPB and motivational variables. The reported follow-up assessments varied from one week to 19 weeks post-intervention, with three studies (42.86%; Hagger, Lonsdale, &

Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Koka, 2016) conducting a single follow-up at one month post-treatment.

The majority of interventions (*k* = 5 studies; 71.43%) were administered in a pen-and-paper format, while the two remaining intervention programs (Hagger, Lonsdale, & Chatzisarantis, 2012; Knäuper et al., 2011) utilized a website-based format and were distributed via email. Each intervention group in the included trials engaged in a single planning and/or mental simulation exercise, typically lasting 5 minutes, with durations varying from a few minutes to 15 minutes.

Regarding the planning intervention component, over half of the studies (*k* = 4; 57.14%; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Knäuper et al., 2011; Study 1 by Meslot et al., 2016) required the formation of plans in the if-then format, reinforcing the link between the critical situation and action. The rest of the analyzed interventions (*k* = 3; Koka, 2016; Koka & Hagger, 2017; Study 2 by Meslot et al., 2016) entailed devising more global strategies in a free-response format, namely action plans. Notably, Koka (2016) incorporated a second type of planning technique—reasoning action planning—which prompted participants to articulate their reasons for increasing leisure-time physical activity, in addition to devising action plans. All included studies tested the effectiveness of planning manipulations both independently and in synergy with a mental simulation task to promote health behavior change.

The predominant number of the studies (*k* = 5; 71.43%; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Koka, 2016; Koka & Hagger, 2017; Study 2 by Meslot et al., 2016) employed an integrated approach grounded in the Rubicon Model (Heckhausen & Gollwitzer, 1987), investigating both the independent and interactive effects of planning intervention strategies and outcome mental simulations. 60% of these studies (*k* = 3; Hagger, Lonsdale, Koka, et al., 2012; Koka & Hagger, 2017; Study 2 by Meslot et al., 2016) did not disclose the order in which the intervention components were to be performed. In one of the studies, participants initially performed the outcome imagery task (Koka, 2016), while Hagger, Lonsdale and Chatzisarantis (2012) counterbalanced the presentation order of planning and outcome imagery intervention manipulations for participants assigned to the combined condition.

Merely two of the trials (Knäuper et al., 2011; Study 1 by Meslot et al., 2016) focused on process simulations, examining whether imagining the means to achieve a

goal would amplify the effectiveness of a developed concrete plan. Moreover, both studies did not test the independent effect of the process mental simulation component. However, Knäuper et al. (2011) compared the implementation intention targeted process mental simulation with a manipulation termed “goal intention mental imagery”, closely resembling outcome imagery in its content. The sequence of deployment for the two multitask interventions varied: Knäuper et al. (2011) had participants visualize their pre-written if-then plans, whereas in the first study by Meslot et al. (2016) the mental simulation task preceded the formation of if-then plans.

Detailed information regarding the samples, procedures, and measurements utilized in the studies included in this systematic review, along with their respective findings, is presented in Table 1.

A Synthesis of Findings from 7 Studies

Table 2 provides an overview of evidence concerning the effectiveness of planning and mental imagery interventions on health behavior, with the extracted effects coded for analysis. Summarizing the results from focused contrasts between joint planning and mental imagery interventions and planning interventions alone, only two out of seven trials (28.57%; Hagger, Lonsdale, & Chatzisarantis, 2012; Knäuper et al., 2011) provided limited support for the hypothesis that combining mental simulation with planning techniques would enhance engagement in health behaviors more than planning alone. These findings are, however, conditional, as there are specific to a particular context—the combined condition was most effective only among participants with low fruit intake and high alcohol consumption at baseline. Additionally, in the study by Hagger, Lonsdale and Chatzisarantis (2012), the heavy drinkers were initially defined by low motivation and intentions to change. One trial (14.29%; Koka & Hagger, 2017) presented contradictory evidence, indicating that among low-active adolescents the combined action planning and outcome simulation intervention led to fewer subjectively reported exercise sessions compared to each of the components alone. 57.14% of analyzed studies (k = 4; Hagger, Lonsdale, Koka, et al., 2012; Koka, 2016; Meslot et al., 2016) revealed no statistically significant overall effects of integrated mental simulation and planning interventions on health-related behaviors compared to all other groups. These results provided compelling preliminary evidence that the combined use of planning and mental imagery techniques is ineffective in changing health behavior. Consequently, the primary hypothesis of this systematic review, which

postulated that mental simulation and planning components would work synergistically to modify health behavior relative to the planning component alone, had to be rejected.

A supplementary analysis was conducted, distinguishing between process and outcome mental simulations within combined interventions. One out of the two studies (50%; Knäuper et al., 2011) which combined process imagery and implementation intentions offered preliminary indications that such interventions might have limited effectiveness in promoting health related behaviors. However, it suggested that they still might yield better outcomes than if-then plans alone. The first study by Meslot et al. (2016) demonstrated insufficient evidence supporting the superior efficacy of the combined intervention, as medium effect sizes for the between-group comparison for the combined condition did not reach statistical significance.

Resembling the pattern of results from the main narrative analysis, 60% of trials (k = 3; Hagger, Lonsdale, Koka, et al., 2012; Koka, 2016; Study 2 by Meslot et al., 2016) that coupled outcome mental simulations with planning strategies revealed no differences between the combined condition and all other groups, providing no support for an interaction between motivational and volitional strategies.

The effects of individual planning and mental imagery manipulations on health behavior were also analyzed, addressing the secondary research question. Three of the six studies (50%; Hagger, Lonsdale, & Chatzisarantis, 2012; Knäuper et al., 2011; Koka & Hagger, 2017), which included independent mental imagery interventions, provided some preliminary evidence that mental simulation strategies can effectively lead to health behavior change. Nevertheless, these results provided only limited support, as only Hagger, Lonsdale and Chatzisarantis (2012) reported significant overall effects in addition to significant results for sub-groups exhibiting high levels of an undesired behavior. The remaining three studies (Hagger, Lonsdale, Koka, et al., 2012; Koka, 2016; Study 2 by Meslot et al., 2016) reported nonsignificant changes in the mental imagery intervention groups regarding the target behavioral outcome.

Among the seven studies included in the analysis, four (57.14%; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Knäuper et al., 2011; Koka & Hagger, 2017) showed significant improvements post-intervention for planning sub-groups. This research offered conditional preliminary evidence that planning strategies are effective in evoking health behavior change, particularly in cases where individuals display high levels of unhealthy behaviors pre-intervention. Furthermore, the data presented by Hagger, Lonsdale, Koka, et al. (2012) raise

concerns about the generalizability of implementation intention interventions, since if-then planning was not effective across all national samples. The remaining three trials (42.86%; Koka, 2016; Meslot et al., 2016) reported no effect of the planning intervention on behavioral change at follow-up.

83.33% of studies (*k* = 5; Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012; Koka & Hagger, 2017; Meslot et al., 2016) that included psychological measures found no significant intervention effects on TPB variables (Ajzen, 1991), thereby preventing the testing of proposed underlying mechanisms. In contrast, Knäuper et al. (2011) offered partial support for the idea that motivation mediates the effects of outcome imagery.

Table 1

Description of Included Studies

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
Process MI studies						
Knäuper et al. (2011)	Fruit consumption	*Participants:* *n* = 177 (complete cases analyzed) Canadian first-year students *Mean age:* 18.28 years *SD* = 0.72 37.9% males *Follow-up response rate:* 96.36% For the analyses the sample was divided into low fruit consumers (*n* = 99) and high fruit consumers (*n* = 78) according to the baseline data.	*Study design:* 2×4 CCT *Follow-up:* 7 days	*G1: Control group:* repeating a provided goal intention 3 times, writing down the provided goal intention 3 times *G2: II condition:* single repetition of provided goal intention, writing down 3 specific if-then plans to increase fruit intake for the next 7 days *G3: goal intention MI condition (i.e., outcome MI):* repeating a provided goal intention 2 times, writing down the provided goal intention 3 times, mentally imagining oneself consuming extra portions of fruit each day for the next 7 days, concentrating on the positive feelings *G4: II-targeted MI (i.e., process MI & II):* single repetition of provided goal	*Outcome measures:* self-reported 7-day retrospective average fruit consumption adapted from Chapman et al. (2009) *Psychological measures:* TPB variables (Ajzen, 1991): attitudes, behavioral intentions, perceived control, subjective norm *Other measures:* extent and quality of mental imagery assessed with 8 questions, partly adapted from the Ease of Imagination Scale by Ellen and Bone (1991)	*Behavior:* Fruit intake at baseline moderated the effects. Fruit intake was only significantly influenced by condition among individuals who ate low amounts of fruit ($p < .04$), but not among those who consumed high amounts. Participants in the *control group* consumed less fruit at follow-up compared to those in the *II* and *goal intention MI conditions*, who in turn ate less fruit than those in the *II-targeted MI group* ($p < .005$). There was no difference in fruit consumption between the *II condition* and the *goal intention MI group*. At follow-up, the *II-targeted MI group* had a significantly higher fruit intake compared to the control

Table 1 (continued)

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
				intention, writing down 3 specific if-then plans, mentally imagining each of the 3 if-then plans *Intensity & duration:* one-time exercise, duration was not disclosed *Format:* web-based text-format intervention, distributed by e-mail		condition ($p < .006$), as well as the *II condition*, and *goal intention MI condition* ($p < .03$). *Psychological variables:* Participants in the *goal intention MI group* exhibited stronger intentions and more positive attitudes towards eating additional fruit compared to those in other groups. The effect of *goal intention MI* might be partially mediated by motivation.
Meslot et al. (2016) Study 1	Physical activity	*Participants:* *n* = 64 (complete cases analyzed) French undergraduate students *Mean age:* 25.19 years *SD* = 5.44 15.63% males *Retention rate:* 58.88%	*Study design:* three-group cluster RCT *Follow-up:* 1 week, 4 weeks	*G1: Assessment-only control group* *G2: II condition:* writing down specific if-then plans to regularly participate in PA over the next month *G3: Process MI & II condition:* performing the process MI exercise prior to the formation of II, imagining how one would do physical exercise regularly in the upcoming month, writing down the content of the imagery experience	*Outcome measures:* self-reported PA measured in METs/min per week with the International Physical Activity Questionnaire – Short Form (IPAQ-7; Craig et al., 2003) *Psychological measures:* TPB variables (Ajzen, 1991) in the context of PA: behavioral intentions, attitudes, subjective norms, perceived behavioral control *Other measures:* self-reported demographic details, i.e., age, BMI, smoking status, number	*Behavior:* There were no significant differences in PA participation between the *II group*, the *process MI & II group*, and the *control group* at the follow-up. The between-group comparison indicated a moderate increase in PA when *process MI* is added to the *II strategy* compared to the *II condition* alone. However, this effect did not reach statistical significance ($d = .49$, $p = .13$).

Table 1 (continued)

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
				Intensity & duration: one-time exercise lasting a few minutes *Format:* pen-and-paper format intervention	of alcoholic drinks consumed per occasion and frequency of alcohol consumption (Dollinger & Malmquist, 2009; Hagger & Montasem, 2009), and self-reported past PA behavior (Conner & Armitage, 1998) at baseline; manipulation check measures (planning scale from Hagger, Lonsdale, & Chatzisarantis, 2012)	*Psychological variables:* No significant intervention effects on intention were found.
Outcome MI studies						
Meslot et al. (2016) Study 2	Physical activity	*Participants:* *n* = 184 low-active UK residents and university students, who had newly signed up for a fitness studio *Mean age:* 26.95 years *SD = 9.59* 47.28% males *Participants* completed T2:	*Study design:* 2×2 RCT *Follow-up:* 4 weeks, 19 weeks (only for a sub-sample)	*G1: Assessment-only control group* The intervention groups were provided with WHO guidelines for PA. *G2: AP condition:* writing down plans that specify when and how to use the gym regularly over the following weeks *G3: Outcome MI condition:* imagining oneself having accomplished the goal of using the gym regularly over the following weeks,	*Outcome measures:* frequency of fitness club attendance verified through participants' gym records *Psychological measures:* TPB variables (Ajzen, 1991) in reference to gym attendance: behavioral intentions, attitudes, subjective norms, perceived behavioral control *Other measures*: self-reported sociodemographic details and past PA behavior at baseline (Godin & Shephard, 1997)	*Behavior:* Neither the *AP* nor the *outcome MI interventions*, nor the combined *outcome MI & AP manipulation*, had any effect on the frequency of fitness studio attendance 4 weeks post-intervention. No significant effects were observed at the 19-week follow-up for the sub-sample as well. *Psychological variables:* The *outcome MI* intervention had no

Table 1 (continued)

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
		n = 176 R*esponse rate:* 94.57% *Mean age:* 27.15 years *SD* = 9.72 47.16% males *Participants* contacted at *T3*: *n* = 78 42.39% of the initial sample *Mean age:* 21.81 years *SD* = 3.93 25.64% males		concentrating on the positive feelings *G4: Outcome MI & AP condition:* performing both tasks *Intensity & duration:* one-time exercise lasting 5 min *Format:* pen-and-paper format intervention		significant effect on intention.
Koka and Hagger (2017)	Physical activity	*Participants:* *n* = 267 (complete cases analyzed) High-school students *Age:* 14-15 years old *Retention rate*: 59.47%	*Study design:* 2×2×4 mixed-model RCT *Follow-up:* 1 month, 2 months, 3 months	*G1: Assessment-only control group* *G2: Outcome MI condition:* imagining oneself having accomplished the goal of engaging in vigorous PA during leisure time for at least 30 minutes per session, at least 5 days a week, over the next 3 months, concentrating on the positive feelings, writing down the content of the imagery experience	*Outcome measures:* self-reported LTPA with one session lasting at least 30 min (Prestwich et al., 2009) *Psychological measures:* TPB variables (Ajzen, 1991) in the context of PA (Pihu et al., 2008): behavioral intentions, attitudes, subjective norms, perceived behavioral control; a measure of motivation towards PA and a measure of planning at baseline (Pham & Taylor, 1999)	*Behavior:* No significant overall effects for the *outcome MI* and *AP strategies* nor the combined *AP & outcome MI condition* were found. *Sub-group analyses:* PA levels at baseline moderated the effects. Only among low-active adolescents did all 3 intervention groups show significantly higher numbers of self-reported

Table 1 (continued)

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
				G3: AP condition: writing down plans that specify the time, place and type of PA to engage in during leisure time for at least 30 minutes per session, at least 5 days a week, over the next 3 months *G4: AP & outcome MI condition:* performing both tasks *Intensity & duration:* one-time exercise, duration was not disclosed *Format:* text-format intervention	*Other measures:* evaluation of compliance through content analysis of participants' written responses to the intervention exercises	PA sessions at 1-month follow-up relative to the control group (p = .01). The *AP & outcome MI group* displayed significantly fewer self-reported PA sessions at 1-month follow-up compared to the *outcome MI* only and *AP only group* (p = .02). *Psychological variables:* No significant intervention effects on psychological variables were found.
Koka (2016)	Physical activity	*Participants:* *n* = 316 Estonian high-school students *Mean age:* 14.79 years *SD* = 0.71 49.37% males *Retention rate*: 78.80% *(n* = 249 complete cases analyzed)	*Study design:* 2×3 RCT *Follow-up:* 1 month	All participants were encouraged to increase their LTPA by 1 session each week over the upcoming month. *G1: Assessment-only control group* *G2: Outcome MI condition:* imagining oneself having accomplished the goal of increasing LTPA by 1 session each week over the upcoming month, concentrating on the positive	*Outcome measures:* self-reported LTPA with one session lasting at least 30 min (Prestwich et al., 2009) *Other measures:* evaluation of compliance through content analysis of participants' written responses to the intervention exercises	*Behavior:* None of the intervention conditions significantly promoted LTPA among adolescents during the 1-month follow-up period. *Sub-group analyses:* LTPA levels at baseline did not moderate the effects. Identical pattern of effects was revealed for both low and high exercisers.

Table 1 (continued)

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
				feelings, writing down the content of the imagery experience *G3: Standard AP condition:* writing down plans that specify the time, place and type of PA to engage in during leisure time, aiming to increase LTPA by 1 session each week over the upcoming month *G4: Reasoning AP condition:* equivalent to the standard AP, additionally formulating the reason(s) for increasing LTPA by 1 session each week over the next month *G5: Outcome MI & standard AP condition:* performing first the outcome MI and then the standard AP task *G6: Outcome MI & reasoning AP condition:* performing first the outcome MI and then the reasoning AP task *Intensity & duration:* one-time exercise, baseline measure and manipulation completed in 15 min		

Table 1 (continued)

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
				Format: pen-and-paper format intervention		
Hagger, Lonsdale and Chatzisarantis (2012)	Alcohol consumption	*Participants:* *n* = 238 (complete cases analyzed) UK undergraduate students *Mean age:* 20.23 years *SD* = 1.80 44.12% males *Follow-up response rate:* 43.86%	*Study design:* *2*×2 RCT *Follow-up:* 1 month	Guideline limits for alcohol consumption were presented to all participants. *G1: Assessment-only control group* *G2: Outcome MI condition:* imagining oneself having accomplished the goal of maintaining alcohol intake within safe limits on every occasion over the next month, concentrating on the positive feelings, writing down the content of the imagery experience *G3: II condition:* typing specific if-then plans to maintain alcohol drinking within safe limits on every occasion throughout the upcoming month *G4: II & outcome MI condition:* Participants received the II & outcome MI tasks in varied order. *Intensity & duration:* one-time exercise lasting 5 min	*Outcome measures:* self-reported number of units of alcohol consumed and number of heavy episodic "binge" drinking occasions in the previous 4 weeks *Psychological measures:* TPB variables (Ajzen, 1991): behavioral intentions, attitudes, subjective norms, perceived behavioral control; motivation toward the target behavior and planning scales *Other measures:* assessment of the extent of alcohol misuse at baseline with the four-item Fast Alcohol Screening Test (Hodgson et al., 2002), evaluation of compliance through content analysis of participants' written responses to the intervention exercises	*Behavior:* Participants in the *outcome MI group* showed a significant decrease in the numbers of units of alcohol consumed ($p < .01$) and heavy episodic drinking occasions ($p < .05$) at follow-up. There was no significant overall effect for the *II manipulation* or the *II & outcome MI manipulation*. *Sub-group analyses:* Baseline number of alcohol units moderated the effects. Only the sub-group consuming high numbers of units at baseline demonstrated significant effects for *outcome MI* ($p < .01$), *II* ($p < .05$) and *II & outcome MI condition* ($p < .05$). Among heavy drinkers, participants in the *II & outcome MI group* consumed significantly fewer units of alcohol at follow-up relative to all

Table 1 (continued)

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
				Format: web-based text-format intervention, distributed by e-mail		other groups ($p < .01$). High alcohol consumers were characterized by low motivation and intentions to change at baseline. *Psychological variables:* The interventions had no effects on motivation or TPB variables (Ajzen, 1991).
Hagger, Lonsdale, Koka, et al. (2012)	Alcohol consumption	*Participants:* *n* = 467 (complete cases analyzed) Undergraduate students from Estonia: *n* = 185 *Mean age:* 20.94 years *SD* = 2.94 30.27% males Finland: *n* = 119 *Mean age:* 23.66 years *SD* = 4.99 36.13% males UK: *n* = 163 *Mean age:* 19.72 *SD* = 2.87 11.66% males	*Study design:* 2×2×3 RCT *Follow-up:* 1 month	*G1: Assessment-only control group* *Goal setting task in G2,3,4:* setting a goal of keeping alcohol intake within weekly guideline limits based on WHO recommendations *G2: Outcome MI condition:* imagining oneself having accomplished the goal of maintaining alcohol intake within safe limits on every occasion over the next month, concentrating on the positive feelings, writing down the content of the imagery experience *G3: II condition:* writing down specific if-then plans to maintain alcohol drinking	*Outcome measures:* self-reported average number of units of alcohol consumed per week and average number of binge-drinking occasions per week in the past month *Psychological measures:* TPB variables (Ajzen, 1991): behavioral intentions, attitudes, subjective norms, perceived behavioral control; motivation toward the target behavior and planning scales *Other measures:* assessment of the extent of alcohol misuse at baseline with the four-item Fast Alcohol Screening Test (Hodgson et al., 2002), evaluation of compliance through content	*Behavior:* A significant main effect for the *II component* ($p < .05$) and a significant *II* × *nationality* interaction effect ($p < .05$, $p < .01$) were found on the number of units of alcohol consumed and number of binge-drinking sessions at 1-month follow-up. The *II strategy* effectively reduced the number of alcohol units ingested in the Estonian ($p < .05$) and UK ($p < .01$) samples, but it was not successful in the Finnish sample. Only in the UK sample did the *II strategy* successfully decrease the frequency of binge drinking

Table 1 (continued)

Study	Target health behavior	Sample	Study design and evaluation	Intervention (type, intensity, duration, format)	Measures	Results: Effects of interventions on
		Response rate: 67.82%		within safe limits on every occasion throughout the upcoming month *G4: II & outcome MI condition:* performing both tasks *Intensity & duration:* one-time exercise lasting 5 min *Format:* pen-and-paper format intervention	analysis of participants' written responses to the intervention exercises	occasions (p = .01). There were no effects for the *outcome MI condition* or the *II & outcome MI component* of the intervention. *Psychological variables:* The interventions had no effects on motivation or TPB variables (Ajzen, 1991).

Note. Abbreviations: standard deviation (SD), controlled clinical trial (CCT), randomized controlled trial (RCT), group (G), mental imagery (MI), implementation intention (II), action planning (AP), World Health Organization (WHO), leisure-time physical activity (LTPA), metabolic equivalent of task per minute (METs/min), Body Mass Index (BMI)

Table 2

Summary of Evidence Regarding the Efficacy of Planning and Mental Imagery Interventions on Health Behavior

Study	Target health behavior	Results: [a]			
		Effect of MI intervention on health behavior	Effect of II intervention on health behavior	Effect of MI & II intervention on health behavior	Between-group comparison: MI & II vs. II only
Process MI studies					
Knäuper et al. (2011)	Fruit consumption	(+)	(+)	(+)	(+)
Meslot et al. (2016) Study 1	Physical activity	N/A	0	0	0
Outcome MI studies					
Meslot et al. (2016) Study 2	Physical activity	0	0	0	0
Koka and Hagger (2017)	Physical activity	0 (+)	0 (+)	0 (+)	0 (-)
Koka (2016)	Physical activity	0 (0)	0 (0)	0 (0)	0 (0)
Hagger, Lonsdale and Chatzisarantis (2012)	Alcohol consumption	+ (+)	0 (+)	0 (+)	0 (+)
Hagger, Lonsdale, Koka, et al. (2012)	Alcohol consumption	0	(+)	0	0

Note. Several studies conducted sub-group analyses alongside their main analyses. Results from sub-group analyses are presented in the table enclosed in parentheses.

[a] +: statistically significant positive effect, -: statistically significant negative effect, 0: no significant effect

Discussion

The aim of this systematic review was to synthesize the existing literature regarding multicomponent health-promoting interventions that utilize both planning and mental imagery strategies, and to determine whether an integrated approach is more successful in changing health-related behaviors than planning techniques alone. The findings of the review did not corroborate the primary hypothesis, but rather provided preliminary evidence suggesting that health interventions pairing planning approaches with outcome or process mental simulation may not be as effective as anticipated. The

current results also did not provide unequivocal support for the individual use of the two intervention strategies, indicating that these techniques might have limited effectiveness in supporting health-focused behaviors.

The findings of the present review regarding the synergistic approach are not in accordance with previous studies, which have shown that combined motivational and volitional interventions successfully facilitate the enactment of health behaviors (e.g., Hagger & Chatzisarantis, 2009; Milne et al., 2002; Prestwich et al., 2008; Prestwich et al., 2003). However, the null results concerning the combined and individual use of planning techniques and mental simulations are not entirely surprising, considering the substantial heterogeneity in the effects of these behavior change techniques across the literature. Several studies in the health domain have reported either null or even detrimental effects of planning interventions (e.g., De Vet et al., 2009; Jackson et al., 2005; Jackson et al., 2006; Jessop et al., 2014; Scholz et al., 2013; Skår et al., 2011). Nonsignificant findings have also been reported for health interventions adopting mental imagery techniques (Adams et al., 2015; Conroy et al., 2015). The upcoming sections provide multiple conceivable explanations for the results based on both theoretical and empirical grounds.

Explaining the Results: Theoretical and Empirical Perspectives

One explanation for the limited effectiveness observed in multitask interventions combining process simulations and implementation intentions in this review could be an overstatement of the efficacy of process mental simulations in the literature. In earlier research, process simulations have typically been shown to be more effective than outcome simulations (Armitage & Reidy, 2008; Escalas & Luce, 2003; Pham & Taylor, 1999). However, in their meta-analysis, Cole et al. (2021) not only failed to corroborate these findings, but also highlighted that in their often-cited exam studies, Pham and Taylor (1999) did not observe a statistically significant effect of process mental imagery on exam performance compared to the control condition ($p < .09$). Given the scarcity of studies on process imagery since Pham and Taylor's exam studies (1999)—with Cole et al. (2021) identifying only five trials and this systematic review finding just two—caution is warranted when making strong claims about the effectiveness of process simulations. As Knäuper et al. (2011) and Meslot et al. (2016) did not employ a process imagery only condition, the unique effects of process simulations could not be analyzed. Future empirical research should prioritize examining the purported behavioral benefits of process simulations.

It is important to note that the two hybrid interventions combining process mental imagery with implementation intentions were founded on different theoretical approaches. These conceptual differences complicate the comparability of the programs and may have impacted their effectiveness in facilitating behavioral engagement. As previously described, Knäuper et al. (2011) structured their intervention within a framework where both planning and process imagery tasks serve as volitional interventions, operating post-decisionally after the goal intention has been set. Moreover, the process simulation was designed to enhance the planning activity by specifically targeting behaviorally relevant cues and actions identified in the if-then plans. Meslot et al. (2016) based their approach on the theoretically and empirically established distinction between deliberative and implemental mindsets, which are associated with the different action phases of goal pursuit (Gollwitzer, 1990). In the initial pre-decisional action phase, a deliberative mindset characterized by open-mindedness to information facilitates the goal setting process. Conversely, in the pre-actional phase, planning the implementation of a chosen goal is supported by an implemental mindset, which involves more closed-minded processing of information (Gollwitzer, 1990). Laboratory research suggests that while if-then plans trigger an implemental mindset, associated with a narrower focus on the specified situation and linked goal-directed response, individuals shift to an exploratory mindset, marked by open-mindedness to information about possible means to achieve a goal when performing process mental simulation in the volitional phase (Faude-Koivisto et al., 2009). Therefore, process mental imagery and implementation intentions would be most beneficial at different points in time when striving for a selected complex and novel goal. Faude-Koivisto et al. (2009) speculated that at the onset of planning, process simulation should be performed to explore the best ways to achieve a desired goal. In contrast, formulating if-then plans would be most beneficial when finalizing the strategy for when, where, and how to implement goal-directed actions. Meslot et al. (2016) diverged from this proposed framework by omitting a goal intention and positioning process mental simulation in the motivational phase of decision-making as an exercise to reflect on different paths to set up a goal. However, the way the process mental simulation task was operationalized in the study by Meslot et al. (2016) did not clearly reflect this concept. The unclear operationalization of the process simulation manipulation and the lack of a defined goal might have hindered the effectiveness of this multicomponent intervention. This is because the process mental imagery did not

focus on critical environmental cues and goal-directed actions necessary for successful behavioral engagement (Meslot et al., 2016). Based on the promising findings reported by Knäuper et al. (2011), future research should systematically manipulate the order of forming if-then plans and practicing process mental simulation to determine whether task order influences the success of goal attainment. Future replications of the described paradigms should also clarify the formal aspects of the intervention (e.g., order of task presentation) and ensure that study protocols are available and easily accessible (Hagger & Luszczynska, 2014). Another important avenue for future research is to compare the effectiveness of implementation intentions and process simulations in field experiments, as this has so far only been done in a laboratory context (Faude-Koivisto et al., 2009).

This systematic review did not find corroborative evidence for the effectiveness of outcome imagery, as well as its combination with planning tasks. A plausible explanation for this may be the idealized and potentially disruptive nature of outcome visualizations. Like positive fantasies, outcome imagery can boost motivation but may result in anticipatory consummation of success, which in turn can undermine the effort needed for future goal achievement (Oettingen, 1996, 2012). In the future, researchers should consider utilizing realistic performance simulations instead of those focused on idealized outcomes alongside planning to facilitate health behavior change.

The opposing evidence reported by Koka and Hagger (2017) further implies that incorporating outcome simulation as an additional motivation-boosting component alongside action planning might, in fact, be counterproductive compared to single-component interventions. The authors suggest that the motivational and volitional processes could operate independently and plausibly interfere with each other when combined. In addition to the potentially disruptive influence of outcome mental imagery, planning itself might compromise intrinsic motivation by introducing a controlling factor (Smith et al., 2010).

A further potential explanation for the lack of efficacy of interventions integrating motivational (outcome imagery) and volitional (planning) components could be found by drawing parallels between the research on mental simulations and implemental intentions. Pham and Taylor (1999) demonstrated in their research on educational performance that a combined process-outcome simulation did not achieve the anticipated synergistic effect. Instead, students who engaged in the combined mental imagery task performed worse on the exam compared to those who practiced process

simulations alone. Besides, the combined simulation was perceived as more effortful and time-consuming, resulting in negative psychological effects such as increased worry and anxiety, and lower self-confidence among participants in this condition. Taylor and Pham (1996) equated the results from their exam studies with those of a study conducted by Gollwitzer et al. (1990), which demonstrated that increases in outcome value or outcome expectancy do not improve the efficacy of implementation intentions. Based on the similarities between implementation intentions and process simulations, one could argue that integrating outcome simulations, which focus on a desired goal, with action-oriented plans would not strengthen the link between thought and action. Moving forward, interventionalists designing health promotion programs should explore mental contrasting (Oettingen, 2012) as an alternative imagery-based technique that combines motivational and volitional aspects of mental simulation. Mental contrasting involves envisioning a desired future and then promptly identifying and imagining the critical real-life obstacles that could impede goal achievement (Oettingen & Gollwitzer, 2018). The integration of mental contrasting and implementation intentions enables the formation of personally relevant if–then plans, which have been shown to effectively facilitate goal attainment (Wang et al., 2021). Notably, Cole et al. (2021) included mental contrasting in their meta-analysis of mental simulations. The inclusion of this distinct self-regulation strategy confounded their results regarding combined process-outcome simulations.

The speculative nature of the thus far proposed rationale for the inconsistent findings in this systematic review highlights the limited understanding of the interplay between planning strategies and mental simulations within multitask health promotion programs, as well as their underpinning mechanisms. The majority of included trials could not test for mediation effects, as there were no significant intervention effects on psychological variables. This aligns with the expectation that planning manipulations operate independently of intentions, without affecting other psychological variables (Sheeran & Orbell, 1999). However, none of the analyzed studies that reported significant intervention effects on main outcomes administered a planning scale to all participants, to ascertain whether the degree of plan formation mediates the effect of planning interventions on behavior (Scholz et al., 2008).

The present results do not substantiate the motivational benefits of outcome mental imagery manipulations as reported in previous research (Taylor et al., 1998). Only the findings by Knäuper et al. (2011) suggest that higher intentions and more

positive attitudes —indicative of increased motivation—mediate the effects of outcome mental simulations on target health behavior. This is not entirely surprising, as Armitage and Reidy (2008) discovered that only process simulations, as opposed to outcome mental imagery, effectively influenced intentions. These effects were mediated by perceived behavioral control and subjective norms. Regarding process mental simulations, Meslot et al. (2016) were unable to conduct mediation analyses with the proposed mediating variables due to the absence of intervention effects on the main outcomes. In contrast, in accordance with the cue accessibility framework, Knäuper et al. (2011) demonstrated that process mental simulations aimed at implementation intentions are resistant to motivational effects.

Consequently, the mechanisms by which planning and mental imagery techniques jointly lead to behavior change have yet to be established empirically. Future investigations should prioritize examining theoretical mediation processes by including mediators that explain the intervention effects on outcome variables. Studies should incorporate measures of psychological constructs beyond the TPB variables (Ajzen, 1991), to reflect the diverse mechanisms proposed in the literature that underpin behavior change. Further research is required to determine whether various planning approaches and types of mental simulation influence behavioral outcomes via different mechanisms (Hagger & Luszczynska, 2014).

The following paragraphs discuss several moderating factors that might have diminished the effectiveness of the interventions under review, partly accounting for the absence of supporting evidence.

The present results indicate that planning and mental imagery interventions, as well as combined interventions using both behavior change strategies, are particularly effective for individuals who demonstrate high levels of health-compromising behaviors. These findings are consistent with previous research showing that the effects of planning interventions are moderated by initially low levels of physical activity and fruit consumption (Carraro & Gaudreau, 2013; Chapman et al., 2009; Jackson et al., 2005). Hence, people who already engage sufficiently in health-promoting behaviors might benefit less from planning strategies, as they have less room for improvement.

Meta-analytic evidence suggests that planning and mental imagery interventions produce stronger effects in older (26+ years old) and nonstudent samples (Carraro & Gaudreau, 2013; Conroy & Hagger, 2018). It is possible that the young

adults, most of whom were university students, and teenagers enrolled in the included studies were less responsive to the interventions deployed. Children and younger populations might not be optimal target groups for mental imagery and planning interventions. This is because the capacity for mental simulation develops during childhood and the prefrontal brain regions responsible for self-regulation are believed to reach full maturity around the age of 25 (Dahm et al., 2011; Skoura et al., 2009).

As outlined in the theoretical exposition, plans focusing on the avoidance of unwanted behaviors tend to be less effective than planning strategies that reference desirable behavioral alternatives (Adriaanse, Gollwitzer, et al., 2011; Adriaanse, Vinkers, et al., 2011). The attenuating influence of avoidance-oriented planning may provide additional insight into the limited effectiveness of the implementation intention component used in the alcohol reduction programs (Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Koka, et al., 2012).

The findings by Hagger, Lonsdale and Chatzisarantis (2012) contradict the notion that planning interventions are more effective among individuals with strong preexisting goal intentions (Sheeran et al., 2005). However, the evidence base regarding the effects of planning manipulations on “low intenders” is inconsistent (Hagger & Luszczynska, 2014). Some studies indicate that people with low levels of motivation to change might profit more from planning techniques (Browne & Chan, 2012; Godin, Bélanger-Gravel, et al., 2010). Furthermore, Hagger, Lonsdale, Koka, et al. (2012) argued that the high levels of pre-intervention intention to reduce alcohol intake demonstrated by participants in their cross-national study might have diminished the effectiveness of the outcome simulation manipulation, which served as the motivational component in their synergistic intervention. In contrast, Meslot et al. (2016) did not prompt a goal intention ahead of the intervention, arguably rendering the planning task irrelevant for participants who had no intention of engaging in the target behavior. Therefore, the complete absence of a goal intention may account for the ineffectiveness of the planning and mental simulation interventions reported in the studies by Meslot et al. (2016) (Hagger & Conroy, 2020; Hagger & Luszczynska, 2014).

Ultimately, it remains unclear whether hybrid interventions containing both motivational and volitional components would be more effective in facilitating health behavior change among individuals with higher or lower baseline levels of motivation. A potential future research direction would be to systematically manipulate both intention strength and the planning intervention, as well es to investigate the efficacy

of mental imagery interventions targeting low intenders (Hagger, Lonsdale, Koka, et al., 2012; Hagger & Luszczynska, 2014). The present systematic review underscores the necessity for research that explores key moderating factors influencing the outcomes of multicomponent planning and mental imagery interventions across a wider range of behaviors and populations.

Limitations of the Included Trials

The following paragraphs discuss methodological limitations of the included trials that might have influenced the accuracy of the reported results. Additionally, suggestions are provided on how future research seeking to replicate the described interventions can address these limitations.

The included studies involved relatively small sample sizes. Specifically, the first study by Meslot et al. (2016) lacked sufficient statistical power to detect potential differences between the intervention groups, despite medium-sized effects suggested by effect size statistics. Future interventions and replication studies should be conducted on a large scale with high statistical power to detect small effect sizes. The target sample size should be determined by formal statistical power analysis. Replication of the findings reported by this systematic review is especially needed in larger representative samples from the general adult population to assess the consistency of the effects.

None of the analyzed trials included a no-measurement control group that would have received behavioral measures only. This omission might have impacted the results, as there is evidence suggesting that psychological measures could potentially function as interventions themselves and influence behavior change independently of any formal intervention manipulation (Godin et al., 2008). In future research, investigators should consider including a no-measurement control group as an additional control condition to help eliminate potential measurement effects.

The use of a goal-only control condition that prompted extensive goal rehearsal was identified as a further limitation of the study by Knäuper et al. (2011). The repeated emphasis on a relatively easy and simple goal may have triggered a goal activation effect, facilitating the target health behavior without the need for planning, thereby diluting the actual intervention effect (Faude-Koivisto et al., 2009; Knäuper et al., 2011). Future interventions based on the implementation intention-targeted mental imagery framework should focus on difficult-to-implement goals, offering more opportunities for planning (Gollwitzer & Brandstätter, 1997).

Additional recommendations for the control condition include adopting an active control group harboring the same expectations of improvement as the experimental group, to control for potential placebo effects (Boot et al., 2013). Given the unintentional nature of fantasizing about future events (Taylor & Pham, 1996), researchers should also consider conducting a retrospective check to determine whether control participants spontaneously engaged in mental simulation. This measure could help prevent the reduction of mental imagery effects due to impromptu imagery use in the control group (Cole et al., 2021).

The studies included in this systematic review adopted relatively brief follow-up periods, with only two trials providing longer range follow-ups (Koka & Hagger, 2017; Study 2 by Meslot et al., 2016). Future investigations utilizing integrated planning and mental imagery interventions should include longer follow-up periods to evaluate the longitudinal effectiveness of these strategies in changing health behavior outcomes.

Only two studies included measures at one-week follow-up (Knäuper et al., 2011; Study 1 by Meslot et al., 2016). It is conceivable that interventions lacking short-term assessments (i.e., one or two weeks) might have missed any potential positive effects, as these intervention effects may have been unstable and consequently "washed out" after one month (Chatzisarantis & Hagger, 2005). Some indications in the literature suggest that the effects of mental imagery and planning may diminish over longer time periods (Driskell et al., 1994; Rhodes et al., 2020). However, recent meta-analyses on mental imagery do not provide evidence for a reduction in the effects of mental simulation over time (Cole et al., 2021; Conroy & Hagger, 2018). Nevertheless, such unstable effects would be of limited practical significance unless the intervention program aims for one-off behavior change (Hagger & Luszczynska, 2014). To achieve sustained health behavior change over time, future interventions incorporating planning and mental simulation components should include booster sessions during the follow-up period. Mental imagery interventions were found to be more effective when they included a follow-up component, such as booster text messages or maintaining an imagery-related diary (Conroy & Hagger, 2018). Moreover, providing booster implementation intention sessions—whether repeating the original plan or devising more suitable alternatives—enhances the long-term impact of the intervention (Chapman & Armitage, 2010; Conner & Higgins, 2010). To further amplify the behavioral benefits of mental imagery, investigators replicating

these interventions should consider utilizing mental simulations of longer duration and incorporating extrinsic rewards (Cole et al., 2021; Conroy & Hagger, 2018).

The reliance on self-report measures of behavior by all included trials, except the second study by Meslot et al. (2016), may have introduced recall bias in the reporting of behavior (Baumeister et al., 2007; Sallis & Saelens, 2000). To overcome this limitation and ensure more accurate assessments, future research should incorporate objective behavioral measures, such as heart rate monitors and accelerometers for physical activity or expired carbon monoxide for smoking, where feasible.

Imagery ability was assessed only in the study by Knäuper et al. (2011). This represents a significant limitation in the other trials, considering the evidence indicating that imagery ability moderates the effects of mental simulation (Adams et al., 2015; Andrade et al., 2016). Moving forward, researchers should incorporate measures of imagery ability and control for systematic influences of individual differences in mental visualization ability in imagery interventions. Additionally, future studies would benefit from incorporating preparatory exercises to prime participants' mental imagery skills and offering examples of if-then plans to assist participants in selecting suitable cues to action. It is notable that none of the reviewed studies included a mental imagery practice task, and some omitted providing examples. This oversight might have negatively impacted participants' understanding of and engagement with the intervention components (Hagger & Conroy, 2020; Hagger & Luszczynska, 2014).

One final limitation of the analyzed material is that, aside from the study by Knäuper et al. (2011), the remaining included studies were conducted by overlapping research teams. Affiliations with workplace or professional groups can be regarded as a non-financial conflict of interest (Higgins et al., 2019). The lack of independence among research teams may introduce bias, potentially influencing study outcomes and reducing the generalizability of findings. This raises concern because the independence of studies is crucial for unbiased synthesis of evidence in systematic reviews. Moving forward, independent research teams can contribute to advancing planning and mental imagery research by refining research methodology, conducting further replication tests, and introducing novel paradigms that integrate planning approaches with mental imagery techniques.

Strengths and Limitations of Review Methods

The strength of the present comprehensive literature review lies in its reliable, thorough, objective, and reproducible search across a variety of academic databases. Following the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2019), the search strategy was peer-reviewed before being executed by a single investigator. This approach guaranteed the identification of as many relevant studies as possible within resource constraints, thereby minimizing bias and ensuring the reliability of evidence synthesis (Higgins et al., 2019).

Another strength of this systematic review lies in its continuous effort to finely differentiate between various planning approaches and mental imagery techniques. The review highlights the variations in their conceptualization and operationalization, despite the considerable conceptual overlap and conflated reporting in the literature. A further advantage of this work is its detailed examination of various frameworks for multicomponent interventions that combine planning and mental imagery strategies.

However, the systematic review is not without limitations. Firstly, study selection based on eligibility criteria and data extraction were conducted by a single reviewer, contrary to recommendations that these tasks be performed by two independent researchers (Higgins et al., 2019). Secondly, this review did not attempt to search for non-English publications or contact authors to obtain unpublished results of potentially eligible study protocols (e.g., Baldwin et al., 2022).

Thirdly, the risk of bias in the results of included studies was not formally assessed through global ratings, despite recommendations that quality assessments should be undertaken by at least two independent reviewers (Higgins et al., 2019; Page et al., 2021). Notably, all included articles were characterized by strong study designs based on the McMaster Quality Assessment Tool (Thomas et al., 2004). However, there are indications of a high risk of self-selection bias, as well as significant issues with blinding of participants and outcome assessors, as is often the case in behavior change trials (Stacey et al., 2015).

The primary limitation of this systematic review concerns the small number of studies included in the narrative analysis. Due to the modest number of trials and their heterogeneity, the generalizability of findings is compromised, warranting careful interpretation of results. Specifically, regarding the nuanced examination of process and outcome mental simulation within multitask interventions, drawing reliable conclusions is challenging due to the extremely limited research evidence available.

Lastly, the variation in operationalization of theoretical constructs across the included studies may have compromised the qualitative synthesis of findings, further limiting the accuracy of inferences made in this review.

Implications, Future Directions, and Conclusions

The findings of this review have important practical implications for future public health programs utilizing planning and mental simulation interventions. Practitioners are advised to carefully select an appropriate target audience, such as older, nonstudent individuals, exhibiting high levels of a health-compromising behavior and some degree of motivation to change. Designs for multicomponent interventions should incorporate a component presenting reasons for change, along with a goal-setting task (Hagger, 2017). Interventionists are encouraged to incorporate strategies that promote moderating factors likely to enhance the effectiveness of planning and mental imagery interventions (Hagger & Conroy, 2020). These strategies may include providing clear instructions and examples, as well as training in imagery ability. Interventionalists should include measures to assess the fidelity of behavior change techniques used, alongside reliable and valid measures to evaluate the efficacy of the intervention and its underlying mechanisms (Hagger & Conroy, 2020).

This systematic review identified a significant gap in the health psychology literature: the scarcity of HAPA-based (Schwarzer, 2008) multicomponent interventions incorporating both planning and mental imagery techniques, with only one study identified through database searches (Smith et al., 2024). This is unfortunate, as evidence suggests that combining action plans with coping plans is more effective than using action plans alone (Kwasnicka et al., 2013). Furthermore, according to Sniehotta, Schwarzer, et al. (2005, p. 556), planning is defined as the “mental simulation of linking concrete responses to future situations”. Therefore, this review recommends future research to investigate the effectiveness of an intervention combining action and coping planning with targeted mental imagery to promote health behavior change. A fruitful avenue for future work would be to adopt the Health Action Process Approach (Schwarzer, 2008) as a framework by which integrated planning and mental simulation approaches are operationalized.

Another promising line of future research would be to employ a dyadic or collaborative approach, as evidence suggests that planning in partnership with others might be more effective than planning alone (Prestwich et al., 2005). It would also be valuable to investigate how adopting a we-perspective might impact the effectiveness

of mental imagery, particularly given evidence that imagery perspective influences achievement motivation. Research indicates that individuals experience greater motivation to succeed in future tasks when they engage in outcome mental simulations from a third-person point of view rather than a first-person perspective (Vasquez & Buehler, 2007).

Despite its limitations, this systematic review offers valuable insights into the effects of planning and mental imagery interventions on promoting health-related behaviors. The evidence gathered so far suggests that planning techniques and mental simulations may be more effective in altering health behavior when used individually rather than in combination. Moreover, the effectiveness of both individual intervention components and their combination often hinges on the baseline levels of the targeted health-related behavior. However, due to the limited number of studies and their weaknesses, it would be premature to definitively conclude that mental simulation is ineffective in enhancing the efficacy of planning interventions aimed at facilitating health behavior change. Therefore, this review underscores the importance of conducting further replication studies to draw unequivocal conclusions in the future.

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Appendix

Eidesstattliche Erklärung zur Bachelorarbeit

1. Hiermit versichere ich,

   - dass ich die von mir vorgelegte Arbeit selbständig abgefasst habe, und
   - dass ich keine weiteren Hilfsmittel verwendet habe als diejenigen, die im Vorfeld explizit zugelassen und von mir angegeben wurden und
   - dass ich die Stellen der Arbeit, die dem Wortlaut oder dem Sinn nach anderen Werken (dazu zählen auch Internetquellen und KI-basierte Tools) entnommen sind, unter Angabe der Quelle kenntlich gemacht habe und
   - dass ich die vorliegende Arbeit noch nicht für andere Prüfungen eingereicht habe.

2. Mir ist bewusst,

   - dass ich die Bachelorarbeit nicht bestanden habe, wenn ich die mir bekannte Frist für die Einreichung der Bachelorarbeit versäume und
   - dass ich im Falle eines Täuschungsversuchs die Bachelorarbeit nicht bestanden habe und
   - dass ich, sofern ich zur Erstellung dieser Arbeit KI-basierter Tools verwendet habe, die Verantwortung für eventuell durch die KI generierte fehlerhafte oder verzerrte (bias) Inhalte, fehlerhafte Referenzen, Verstöße gegen das Datenschutz- und Urheberrecht oder Plagiate trage.

Berlin, am 29.06.2024 Yoana Ivanova

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