

Predicting transitions from preintentional, intentional and actional stages of change

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Abstract

Stage theories of health behavior change assume that individuals pass through qualitatively different stages on their way to the adoption of health behaviors. Three common stages (preintention, intention and action) can be defined by stage transitions included in current stage theories and supported by evidence. The present study examines whether transitions between these stages can be predicted by social cognition variables derived from prevailing health behavior theories. At two points in time, the motivation for interdental hygiene behaviors and oral self-care was assessed in 288 participants recruited in dental practices. Stage progression and regression over time were analyzed using discriminant function analysis. Progression from preintention to intention was predicted by action planning, whereas coping planning and self-efficacy predicted transitions from intention. Regression from action was predicted by self-efficacy. Results support the distinction of three common stages. Findings are discussed in terms of their contribution to health behavior theory.

Introduction

Stage theories and stage transitions

In recent years, stage theories of health behavior change have received increasing attention in research and health promotion. The idea of people passing through an ordered set of qualitatively different stages [1] on their course to decide on, initiate and maintain health-related behaviors is both intuitive and appealing for the design of interventions [2]. This process includes the possibility of progressing to further or regressing to previous stages [3]. The central outcomes in stage theories are stage transitions rather than behavior itself because in earlier stages no behavior is performed. The notion that the stages are qualitatively different implies that different variables are instrumental for transitions from different stages [1]. This feature differentiates stage theories from social cognition theories such as the theory of planned behavior (TPB; [4]) which construe behavior change as a continuous process.

Stage transitions are shifts in perception and cognition, which means that different information is relevant at different points of this change process [5]. Thus, it is of crucial interest to identify such transition points in the change process and factors that promote progression and regression between stages of change.

Current stage theories include the transtheoretical model (TTM; [3]), the precaution adoption process model (PAPM; [6]), the I-Change model [7, 8], the health action process approach (HAPA; [9, 10]) or the model of action phases (MAP; [5]).

The evidence base for stage theories is somewhat inconsistent: there are findings that support qualitative

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differences between stages [11–16] and findings that question the validity of the stage assumptions, especially with regard to the most frequently applied theory, the TTM [17–19]. A recent meta-analysis on print-tailored interventions [14], however, suggests that tailoring interventions to behavioral stages is more effective than generic, not stage-tailored messages.

Common transitions in current stage theories

Even though the stage theories mentioned above differ in terms of number and definition of stages, as well as the processes proposed to facilitate stage transition at each stage, common transitions can be identified. In order to pool the existing evidence for qualitatively different stages, it is helpful to identify conceptual commonalities in current stage theories, in particular with regard to the number and definition of transitions [20].

The theories mentioned above share at least two critical transitions, which are supported by strong evidence (as will be shown below): (i) the transition from not intending to having formed an explicit behavioral intention and (ii) the transition from intending to act to actually acting [1, 21]. These transitions constitute three stages:

- (i) A ‘preintention’ stage, in which persons have not yet decided to act (precontemplation and contemplation stage within the TTM; unaware, unengaged and deciding stages of the PAPM; premotivational stage in the I-Change model; motivational stage in the HAPA; deliberative mindset in the MAP).
- (ii) An ‘intention’ stage, in which people have decided to act but have not yet started (preparation stage in the TTM; decided to act stage in the PAPM; motivational stage in the I-Change model; volitional-pre-actional stage in the HAPA; implemental mindset in the MAP).
- (iii) An ‘action’ stage, in which individuals act according to their behavioral intentions (action and maintenance stages in the TTM and PAPM; action stage in the I-Change model; volitional-actional stage in the HAPA; implemental mindset in the MAP) (Fig. 1).

Evidence for stages and stage transitions

Pooling evidence from studies examining different theories can enhance the evidence base for these three stages. Additionally, the identification of stage-specific predictors of stage transitions provides evidence for qualitatively different stages [1].

In this study, the potential predictors for transitions between the preintention, intention and action stages were identified by scrutinizing well-evidenced social cognition theories that explain the formation of intention and the initiation of behavior [20, 22]. Thus, in searching for factors that predict stage transitions, this study takes factors from various theories of health behavior and their similarities into consideration.

Preintention stage and transitions from the preintention stage

Qualitative differences between individuals who have not yet formed behavioral intentions (preintention stage) and those who already formed intentions (intention and action stage) are e.g. supported by findings from research on the differential effectiveness of if-then plans. It has been shown that such if-then plans (‘implementation intentions’ based on ‘action planning/coping planning’; [23–25]) are differentially effective depending on the presence of intentions. They are more effective in individuals who have already formed intentions to act than in individuals without such intentions [26, 27]. Such differential effectiveness implies qualitative differences between individuals who have not yet decided to change behavior and those who are already decided. Similar findings have been reported in an experimental study on radon testing [16]. Additionally, experimental research on mindsets [28] supports qualitative differences between individuals with and without goal intentions.

The transition from the preintention stage is characterized by forming behavioral intentions. Thus, predictors for this transition can be compiled from social cognition theories of behavior, which focus on the prediction of intentions. Empirical and theoretical reviews by Weinstein [29] and Maddux [30] suggest strong conceptual and structural

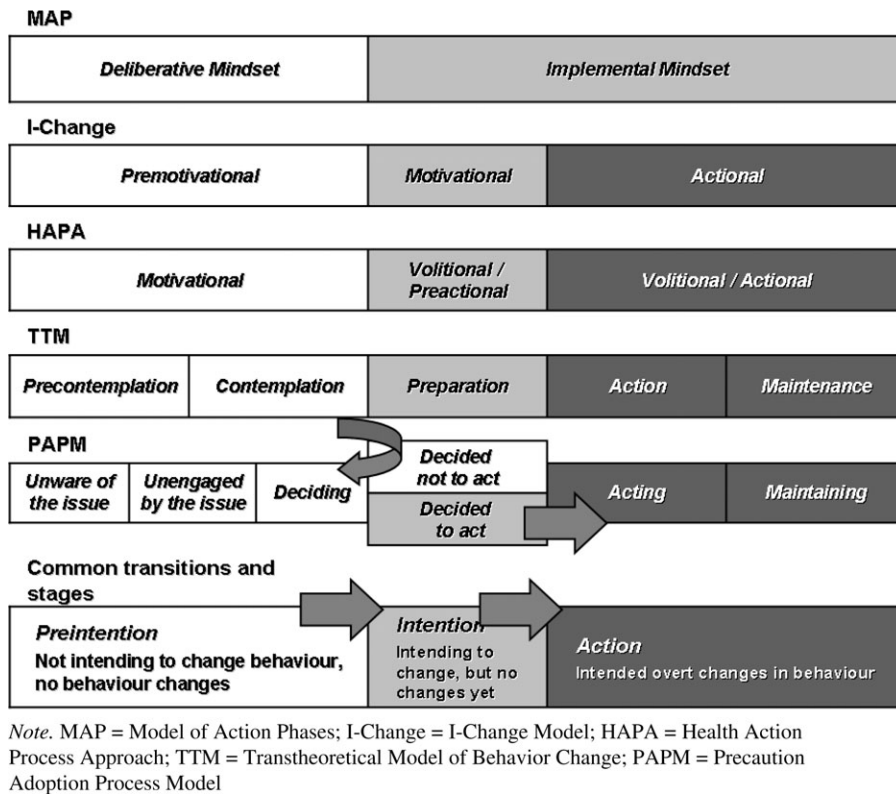


Fig. 1. Common transitions and stages in current stage theories.

overlaps between prevalent social cognition theories of behavior (TPB and its predecessor, the theory of reasoned action (TRA) [31], protection motivation theory (PMT) [32] and social cognitive theory [33]). In these theories, a parsimonious set of factors is used to predict behavioral intentions. Although named and measured differently, these factors refer to similar processes. The theories agree that expectations about consequences of behavior ('attitudes', 'subjective norms' or 'outcome expectations'), positive evaluations of personal control over behavior ('perceived behavioral control' or 'self-efficacy') and, in the case of PMT, 'risk perception' are relevant factors for the formation of behavioral intentions. Subjective norms predicting intentions in the TRA and TPB can be conceptualized as outcome expectations because they refer to expected social consequences of behavior through

approval or disapproval by others [29, 30]. In this study, we have included outcome expectations with regard to social consequences of behavior in order to assess this social dimension.

Several meta-analyses on basis of social cognition theories [34–36] indicate good evidence for the role of these factors in intention formation. They can therefore be considered potential predictors of progression from the preintention to the intention stage.

Intention stage and transitions from the intention stage

An intention stage is supported by qualitative differences between individuals who have not yet formed intentions and those who have (see above) and by evidence that the intention stage is different from an action stage. Reviews show that intentions do not fully explain behavior [37, 38]. This

phenomenon has been referred to as the ‘intention-behavior gap’. This ‘gap’ indicates qualitative differences between individuals who have decided to change behavior but do not yet act (intention stage) and those who already act on their intentions (action stage). While both hold intentions to act, intention strength does not differentiate between intenders and actors. This suggests that different factors are important in these stages.

Progression from the intention stage means initiating intended behavior. As outlined above, if-then planning processes play an important role in prompting behavior. A meta-analysis [39] found effect sizes of $d = 0.70$ in studies correlating planning measures with goal attainment. This suggests that planning processes are a crucial facilitator of translating goal intentions into actual behavior. Regression from the intention stage, on the other hand, is characterized by decreases in behavioral intentions. Thus, low levels of the predictors of intention formation (see above) should lead to regression from the intention stage to the preintention stage.

Action stage and transitions from the action stage

The differentiation between intention and action is characterized by overt changes in behavior: While individuals in the intention stage intend to act, but do not act yet, individuals in the action stage already perform the intended behavior. Differences in cognitions, such as self-efficacy, also support differences between individuals who only intend to change and those who already act [13, 40, 41].

Transitions from the action stage reflect regression to earlier stages. There is evidence that if-then planning can prevent from action lapses once behavior has been initiated [25, 39, 42, 43]. Coping planning (if-then planning for maintaining behavior in the face of barriers and difficulties) thus constitutes a potentially relevant factor preventing regression to the intention stage.

The role of self-efficacy

Self-efficacy is important for both goal setting and goal pursuit [33, 44]. In the TTM, self-efficacy is

considered important for stage transitions across all stages of change [3, 45, 46]. However, the process of changing behavior involves a series of nested tasks, e.g. initiating regular dental flossing, maintaining regular flossing and recovering from setbacks. Individuals may differ in their self-efficacy with regard to these nested tasks.

Thus, it has been suggested to differentiate self-efficacy related to the initiation of behavior from self-efficacy related to the maintenance of behavior [44] and self-efficacy related to preventing lapses and relapses [13, 40]. In this study, we therefore expect a measure of self-efficacy incorporating aspects of action initiation, maintenance and relapse prevention to be predictive of stage transitions between all three stages (preintention, intention and action).

Present study: oral self-care

The present study aims at identifying the determinants of stage transitions with regard to oral self-care behavior (interdental hygiene). Interdental hygiene provides a good means for the analysis of behavior change processes as actual prevalence is very low [47]. There is good evidence for the effectiveness of interdental hygiene (e.g. [48]). Thus, all major dental associations recommend daily interdental hygiene (e.g. [49, 50]). However, even in higher educated populations such as university students, as few as 5.1% [51] or 11.5% [52] perform daily interdental hygiene. This study therefore seeks to find factors promoting transitions between stages for an evidence-based health behavior (daily interdental hygiene).

Research aims

The present study aims at providing evidence for theoretical assumptions about stages and stage transitions shared by current stage theories. It examines stage-specific predictors of stage transitions between three common stages included in current stage theories: preintention, intention and action [1]. The predictors for these transitions were derived from evidenced social cognition theories of health behavior.

The main hypotheses of the study are outlined in Table I.

Methods

Participants and procedure

Recruitment took place in six dental practices in Berlin, Germany. Practice staff invited eligible individuals to participate in the study at the reception. Exclusion criteria were being younger than 18 years and having full dental prosthetics. Patients were then given study materials, including baseline questionnaires (Time 1) and informed consent sheets. Informed consent was obtained from 488 persons. After the dental examination, participants were given a sample of dental floss or interdental brushes, depending on the dentist's recommendation, and instructions for usage. Follow-up questionnaires (Time 2) were sent 4 weeks after the initial assessment, together with pre-paid return envelopes. Non-responding participants ($n = 272$) were reminded by telephone calls 2 weeks after sending out Time 2 questionnaires.

Time 2 questionnaires were returned by 288 (59.01%) participants, 68.2% of them being female.

Mean age was 45.03 (SD = 16.59), with a range from 18 to 83 years. With regard to subjective dental status, 7 participants (2.3%) indicated 'natural teeth', 88 (30.7%) indicated 'natural teeth with fillings', 166 (57.3%) indicated 'natural teeth with fixed dentures' and 27 (9.5%) indicated 'natural teeth with removable dentures'.

The study was conducted in accordance with the declaration of Helsinki, version VI [53].

Instruments

The Time 1 questionnaire assessed interdental hygiene behavior, subjective dental status, gender and age as well as the following potential predictors of transitions (all taken from [52] unless otherwise indicated). Risk perception was measured with three items (Cronbach's $\alpha = 0.73$) such as 'How likely is it that you will conceive caries?' Answers were given on a five-point Likert scale from 'very unlikely' (1) to 'very likely' (5). Outcome expectations were assessed with seven items (Cronbach's $\alpha = 0.71$) such as 'If I clean my interdental spaces regularly, my teeth will feel cleaner' or 'If I clean my interdental spaces regularly, my dentist will approve of it'. Action planning (Cronbach's $\alpha = 0.88$)

Table I. Main study hypotheses

Stage	Transition predictors	Transition	Non-significant factors
Preintention	Self-efficacy (+) Outcome expectations (+) Risk perception (+)	Progression	Action planning Coping planning Age Dental status
Intention	Action planning (+) Coping planning (+) Self-efficacy (+)	Progression	Outcome expectations Risk perception Age Dental status
	Outcome expectations (-) Risk perception (-) Self-efficacy (-)	Regression	Action planning Coping planning Age Dental status
Action	Action planning (-) Coping planning (-) Self-efficacy (-)	Regression	Outcome expectations Risk perception Age Dental status

(+) indicates high levels of the predictor and (-) indicates low levels of the predictor.

and coping planning (Cronbach's $\alpha = 0.89$) were measured with an adaptation of the Action Planning and Coping Planning scales [25] with five items each such as 'I have made a detailed plan when to clean my interdental spaces' (action planning) or 'I have made a detailed plan how I will deal with bleeding' (coping planning). The self-efficacy scale was adapted from [41] and comprised six items (Cronbach's $\alpha = 0.88$) such as 'I am confident that I can use dental floss in the correct manner' (related to behavior initiation), 'I am confident that I can maintain cleaning between my teeth even if I don't see immediate success' (related to maintenance) or 'I am confident that I can maintain flossing even if I have lapsed for a longer time' (related to lapse management) (principal component analysis suggested using only one scale incorporating different phase-specific self-efficacy cognitions). Intention to clean daily was measured with the item 'I intend to clean my interdental spaces daily'. The response format for all items was a four-point Likert scale with 'totally disagree' (1), 'disagree' (2), 'agree' (3) and 'completely agree' (4). Interdental hygiene behavior was assessed by asking participants 'How often have you cleaned your interdental spaces during the last week?' This self-report measure of interdental hygiene has proven valid in previous research; correlations with residual floss range between $r = 0.59$ [51], $r = 0.69$ [15] and $r = 0.80$ [54].

Behavioral stages for daily interdental hygiene at Time 1 and Time 2, 4 weeks later, were computed from the answers to the intention item 'I intend to clean my interdental spaces daily' and the behavior assessment. Participants indicating that they did not intend to clean their interdental spaces daily by ticking disagree or below were allocated to preintention (1). Participants scoring agree or above were classified to intention (2). Participants in intention who cleaned between their teeth seven or more times per week were classified to action (3).

Change of stage was assessed by subtracting Time 1 stage from the Time 2 stage measure.

Analytical procedure

Missing values on predictor variables (<5% on all variables) were imputed using the Expectation Maxi-

mization algorithm, which means that on the basis of the available observations, a mixed distribution with all parameters is estimated. These parameters are then used in a maximum likelihood (ML) estimation for the full matrix. This full matrix serves as basis for the next ML estimation. This procedure is iteratively repeated until the estimated parameters are not significantly different from those in the previous step [55]. Data were analyzed using separate discriminant function analyses for preintentional, intentional and actional participants at Time 1 with stage transitions as grouping variables and all baseline variables including age and dental status as predictors [45]. Discriminant function analysis is mathematically identical to multivariate analysis of variance (MANOVA): however, it emphasizes the prediction of group membership from a set of variables rather than analyzing whether group membership is associated with mean differences.

Predictors of group membership (i.e. stage transitions) were identified by significant reductions in Wilks's λ ($1 - \lambda$ reflects the variance accounted for). They were then evaluated with Tukey honest significant difference (HSD) *post hoc* tests, if applicable. Two effect sizes were calculated (η^2 and ω^2 to adjust for different cell sizes). All analyses were conducted using SPSS 13.0.

Results

Dropout analyses and missing values

Dropout analyses were conducted using logistic regression analysis in order to correct for correlations between predictors. Attrition versus adherence to the study was predicted from the study variables, with sex, dental status and behavioral stage Time 1 as categorical covariates. Participants continuing the study were more likely to be women (OR = 1.74; $P < 0.05$), were older (OR = 1.03; $P < 0.01$) and more self-efficacious (OR = 1.64; $P < 0.05$).

Stage distribution

At Time 1, 128 participants were in the preintention stage, 55 in the intention stage and 105 in the

action stage. At Time 2, 116 participants were in preintention, 67 in intention and 105 in action.

Longitudinal prediction of stage transitions

In order to assess stage transitions, baseline measures of stage were subtracted from Time 2 stages. Positive values (coded 1) indicate progression, zero (coded 0) indicates remaining in the same stage and negative values (coded -1) indicate regression. Table II shows stage progression/regression as a function of baseline stage. Baseline stage significantly affected the likelihood of stage transitions ($\chi^2 = 90.99$; $df = 4$; $P < 0.01$). Participants in preintention were less likely to progress than participants in the intention stage. Participants in intention were more likely to regress than participants in action. Overall, fewer participants regressed than progressed.

Stage transitions were predicted by discriminant function analyses with the three groups of participants regressing (-1), remaining static (0) and progressing (1) as grouping variables. These analyses were run separately in the three stage groups from Time 1 (see Table III).

For participants in preintention at Time 1, one factor reduced Wilks's λ to 0.93 in the first step. Pairwise F analyses contrasting progressing against static persons showed significant differences in action planning: $F(1,126) = 9.50$, $P < 0.01$ with progressors scoring significantly higher on action planning. Effect sizes (η^2 and ω^2) for action planning were in the small to medium range [56] with both η^2 and $\omega^2 = 0.07$.

In intention, two functions with a combined $\chi^2 = 21.74$; $df = 5$; $P < 0.01$ were found. Wilks's λ decreased from 0.83 in the first to 0.61 in the

second step. The functions with self-efficacy and coping planning as predictors significantly discriminated regressing from static, $F(2,52) = 13.34$; $P < 0.01$, and progressing from static participants, $F(2,52) = 5.53$; $P < 0.01$. Because of the small cell size, the prediction of stage progression was only marginally significant, $F(2,52) = 2.39$; $P < 0.10$. In order to examine the significance of mean differences between the predictors in the transition groups, a MANOVA with self-efficacy as well as coping planning as dependent variables and stage change as factor was conducted.

Tukey HSD *post hoc* tests showed that regressors scored significantly lower on self-efficacy and coping planning than those remaining static. The overall F s were only marginally significant: $F(2,52) = 2.79$ for self-efficacy and 2.48 for coping planning, respectively (both P s < 0.10). Effect sizes were in the small to medium range with $\eta^2 = 0.09$ and $\omega^2 = 0.05$ for self-efficacy and $\eta^2 = 0.10$ and $\omega^2 = 0.06$ for coping planning.

For participants in action at Time 1, one factor reduced Wilks's λ to 0.94. Pairwise F analyses contrasting progressors with static persons showed that stage regression was significantly predicted by self-efficacy $F(1,103) = 6.22$, $P < 0.01$ with regressors scoring significantly lower on self-efficacy than remainders. Effect sizes ranged between $\eta^2 = 0.06$ and $\omega^2 = 0.05$.

Discussion

Transitions from the preintentional, the intentional and the actional stage could be predicted by different

Table II. Changes of stage as a function of stage Time 1

Stage	Regress		Static		Progress		Total Time 1	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Preintention	—	—	98	76.56	30	23.44	128	44.44
Intention	18	32.73	14	25.45	23	41.82	55	19.10
Action	23	21.90	82	78.10	—	—	105	36.46
Total	41	14.24	194	67.36	53	18.40	288	100

Table III. Means, *F*s and effect sizes for variables that predict stage transitions

Predictor of stage transitions	<i>dfs</i>	Regress mean	Static mean	Progress mean	Univariate <i>F</i> s	Effect sizes η^2 (ω^2)
Preintention stage	(1,126)					
Action planning			2.87 _a	3.30 _b	9.50*	0.07 (0.07)
Intention stage	(2,52)					
Self-efficacy		3.41 _c	3.83 _d	3.69 _{c,d}	2.79**	0.09 (0.05)
Coping planning		2.72 _e	3.20 _{e,f}	3.27 _f	2.48**	0.10 (0.06)
Action stage	(1,103)					
Self-efficacy		3.73 _g	3.89 _h		6.22*	0.06 (0.05)

* $P < 0.01$; ** $P < 0.10$. Predictors derived from analyses of Wilks's λ . Variables with different subscripts indicate significant differences ($P < 0.05$) on the basis of least significant difference (LSD) tests for the preintentional as well as actional stage and Tukey's HSD *post hoc* tests for the intentional stage.

social cognition variables while controlling for sociodemographic variables. Predictors were derived from social cognition theories of health behavior, and stages were defined along common transition points in current stage theories. Action planning predicted progression from the preintentional, self-efficacy regression from the intentional and actional stages, and coping planning predicted progression from the intentional stages. The findings with regard to action planning and coping planning support the assumption of two transitions between three qualitatively different stages of behavior change. The present study also supports claims to acknowledge similarities in current health behavior theories and to integrate theoretical assumptions [20, 22].

Prediction of stage transitions

Contrary to the predictions for the transitions from the preintention stage, motivational factors such as risk perception and outcome expectancies did not promote progression to the intention or action stage. Action planning constituted the only significant predictor of stage transition. This was not expected, especially since a large body of evidence in the context of oral self-care shows the importance of motivational factors for intention formation [52, 54, 57]. Planning has rather been considered important for the translation of behavioral intentions into behavior, requiring that individuals have already formed intentions.

There are several possible explanations for this unanticipated finding. It might result from participants progressing to the action stage, thus action planning might have promoted quicker transitions as could have been assessed with our design. In fact, of those progressing from the preintention stage ($n = 30$), $n = 14$ progressed to action. Here, a tighter time frame might have been able to map these transitions. Additionally, as the behavioral criterion applied in this study ('daily' interdental hygiene) is relatively strict, some participants in the preintention stage might have been cleaning between their teeth on a more irregular basis and, thus, might have profited from action planning in terms of stage progression. However, there is also research showing that planning processes are important throughout all stages of change [58]. Similarly, previous research on if-then planning and oral self-care behaviors has found no interaction between intentions and planning [51, 52], but rather an independent main effect of planning, which means that the beneficial effects of planning might not be limited to individuals in the intention stage. Certainly, more research on the effectiveness of planning in promoting stage transitions is called for.

In the intention stage, participants low in self-efficacy were more likely to regress to the preintention stage, while participants high in coping planning were more likely to progress to the action stage. Due to small group sizes, these overall effects were only marginally significant. The effect

sizes are, however, in line with the significant predictions at the other stages. These results support previous research suggesting that self-efficacy is a crucial factor for the prevention of problems in action initiation and maintenance [41, 59, 60]. Accordingly, individuals who anticipate being capable to maintain behavior changes in the face of barriers and difficulties are less likely to regress to the intention stage. Participants scoring high on coping planning were more likely to progress to the action stage. This finding corroborates the idea that the anticipation of possible barriers and generating coping scenarios provides an effective means to maintain behavior and to prevent lapses [25].

Regression from the action stage was predicted by self-efficacy. This finding also corresponds with theoretical assumptions. Self-efficacy to overcome problems and obstacles is seen as a crucial factor for the maintenance of behavior change [41, 44]. Thus, individuals low in self-efficacy are more likely to lapse or relapse in health behavior change [13, 40].

Stages

The three stages identified in this study match those in the I-Change model [7, 8] and the HAPA model [10]. Finer-graded differentiations as, for example, in the PAPM [6], which assumes three stages (unaware, unengaged and deciding) before intention formation, can be meaningful with regard to certain behaviors but have not been examined in this study. Future studies should examine whether and for which behaviors such finer-graded differentiations are meaningful.

Although self-efficacy is predictive of more than one stage transition, the differential prediction patterns of action planning and coping planning support the assumption of stages. The finding that the stages displayed medium effect sizes of ω^2 [56] in differences in the predictors speaks in favor of qualitative differences. Nevertheless, this does not rule out that arbitrary cut-offs of an underlying non-linear intention continuum might produce similar results [1].

Limitations

There are a number of limitations to the present study. This study relied on self-reports of behavior, which might be biased. However, previous studies have shown that self-reports of dental flossing can be regarded as valid when compared against the objective measure of residual dental floss [51, 52, 54]. Second, the study faces the problem of selective dropout because more women, participants feeling confident to floss and older individuals continued the study. The rate and selectivity, however, is comparable to that in similar studies [45]. Additionally, as participation was voluntary, the sample might have been positively biased toward interdental hygiene, which is also reflected in baseline flossing rates that were higher than in similar studies.

With regard to the predictors of stage transitions, subjective norm and attitudes have not been assessed as suggested by Ajzen [4]. In this study, behavioral and social outcome expectations have been employed, which represent the behavioral and normative beliefs underlying attitudes and subjective norm. Thus, different patterns might have emerged if these predictors had been assessed differently.

Per definition, the different stages exhibit differential likelihood for remaining static versus changing stages. As has been shown in this study, baseline stage influences the likelihood of stage transition. This might bias the transition patterns. However, as no baseline likelihoods for stage transitions are available, the discriminant function analyses could not be weighed.

The behavioral criterion employed here (daily interdental hygiene) is relatively strict. Less strict criteria might have yielded different stage distributions. The strict criterion was chosen in order to demonstrate the determinants of stage transitions with regard to full adherence to evidence-based health behavior recommendations (daily interdental hygiene).

Additionally, the construction of stages from parsimonious staging algorithms might face some reliability problems. However, in order to adhere

to the correspondence principle, close correspondence between variables (in this case intentions and behavior) is warranted for. It is general practice to determine stages by the use of a staging algorithm that contains a hierarchy of single items (e.g. [61]).

Implications

This study was the first to examine commonalities in current stage theories by predicting stage transitions. The three stages—preintention, intention and action—constitute a common denominator of current stage theories. The identification of stage-specific predictors allows matching interventions to psychologically defined stages of change.

The actual differences between the predictors in individuals who moved to a different stage and those who remained static in their stages were in the small to medium range (ω^2 in Table III), thus further research is needed to test whether stage-tailored interventions produce better clinical outcomes or cost-effectiveness than interventions that are not matched to stages. The data, however, suggest that the construction of behavior change as a continuous process, as implied by social cognition models, may be an oversimplification.

The finding that progression from the preintention stage could be predicted by action planning implies that persons who have not yet formed explicit intentions might also profit from if-then planning. This contradicts the assumptions of the HAPA, but replicates findings by Armitage [58], who showed that if-then plans were also effective in promoting stage progression for participants in the precontemplation and contemplation stages. We regard this unexpected finding as being particularly noteworthy, because progression from early stages poses a challenging task for health promotion interventions. This finding also points to the need of exploring and clarifying possible differences in planning concepts between experimentally induced plans and psychometrically assessed planning processes. These concepts might depend on quality and degree of elaboration of plans, thus further comparative research is needed.

According to our findings, participants in the preintention stage would benefit from action planning interventions, whereas individuals in the intention stage should receive interventions to strengthen their perceived self-efficacy and to generate coping plans on how to overcome barriers. As a relapse prevention to help persons maintaining in the action stage, interventions fostering perceived self-efficacy are recommended.

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Conflict of interest statement

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