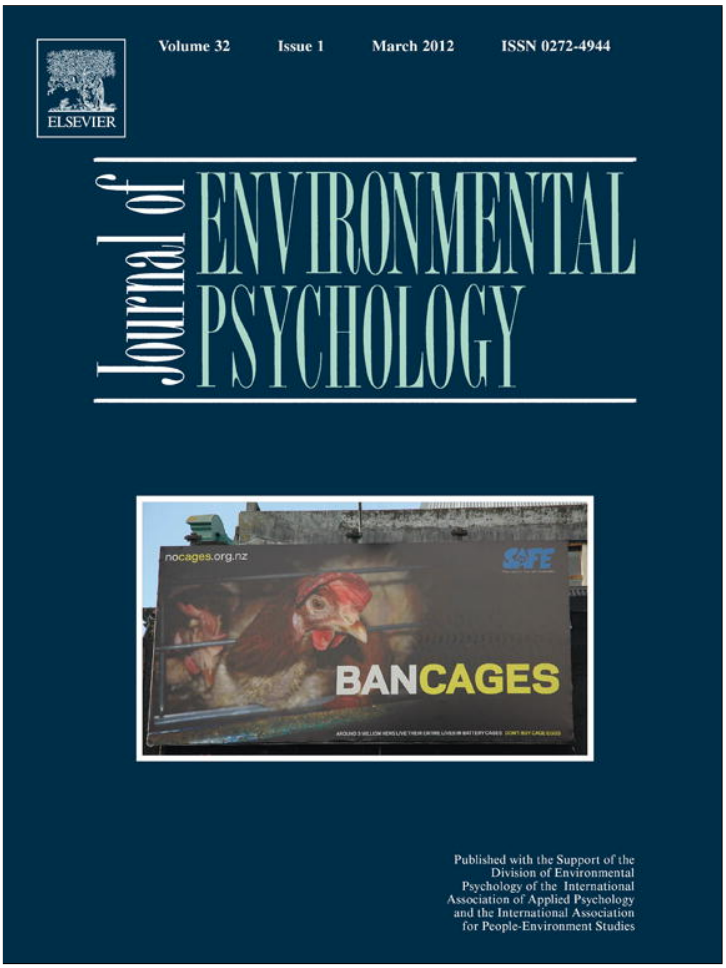

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# Changing environmentally harmful behaviors: A stage model of self-regulated behavioral change

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ABSTRACT

This article takes the model of action phases (MAP, Heckhausen & Gollwitzer, 1987) as a theoretical basis for conceptualizing behavioral change as a transition through a time-ordered sequence of four qualitatively different stages: predecisional, preactional, actional, and postactional. The constructs of goal intention, behavioral intention, and implementation intention provide the criteria for when an individual transits from one stage to the next. However, because MAP does not describe in detail psychological factors contributing to stage progression, constructs taken from the norm-activation model (Schwartz & Howard, 1981) and the theory of planned behavior (Ajzen, 1991) are integrated. Results of a first correlational study ($N = 908$) identified four homogeneous stage subgroups. As expected, the probability of stage assignment was associated significantly with the three intention types marking the transition from one stage to the next. The proposed sets of stage-specific social-cognitive variables were powerful predictors of these three intention types. Potential implications of the model for systematic intervention development are discussed.



With growing insight into the harmful impact of the lifestyles pursued in industrialized societies on the earth's ecosystems, behavioral change has become a central focus of not only environmental policy (e.g., Accountability, Net Balance Foundation, & LRQA, 2008) but also applied environmental psychology (e.g., Jackson, 2005): How can we persuade people to switch transport modes, appliance choices, eating habits, and leisure practices in ways that will reduce their damaging impact on the environment? In the last two decades much of the research trying to answer these questions was guided by two theoretical models: Whereas the theory of planned behavior (TPB, Ajzen, 1991) views pro-environmental behaviors as the consequence of a "rational choice" aiming to maximize personal benefits, the norm activation model (NAM, Schwartz & Howard, 1981) views these behaviors as pro-social acts guided by the activation of a personal moral norm. Meta-analyses (e.g., Bamberg & Möser, 2007; Gardner, 2008) indicate that constructs from both models, the TPB and the NAM, should be viewed as significant predictors of pro-environmental behaviors. As a consequence in the last years different researchers (e.g., Bamberg & Möser, 2007; Manstead, 2000) have proposed to combine TPB and NAM by including personal moral norm as another determinant of the intention to behave in a more pro-environmental way. Intention itself is viewed as the most important direct psychological determinant of observable behavioral change. Thus, within this theoretical framework, interventions aiming to promote pro-environmental behaviors should systematically target the intentional determinants attitude, personal moral norm, and PBC.

However, this assumption is challenged by the frequently low empirical intention–behavior relationship: One the average behavioral intention explains only about 30% of the variance in actual behavior (e.g., Armitage & Conner, 2001; Bamberg & Möser, 2007). This "intention–behavior gap" renders it questionable whether an intervention which successfully changes an individual's behavioral intention automatically leads to a respective change in actual behavior. Indeed, a recent meta-analysis of 53 intervention studies by Michie, Whittington, Abraham, and McAteer (2009) found that intervention techniques targeting the intention determinants attitude and PBC had negligible effects on actual behavior. As a consequence there is growing skepticism whether theoretical frameworks focusing mainly on changing a person's behavioral intention provide a sufficient basis for the development of interventions succeeding in changing actual behavior.

About 70 years ago, Kurt Lewin (e.g., Lewin, Dembo, Festinger, & Sears, 1944) was already aware of the 'intention–behavior gap'. His explanation of this phenomenon was that events like unforeseen

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barriers/temptations or simply forgetting the intention may interrupt the intention–behavior relation. As a consequence, he postulated that an individual has to pass through at least two different stages in order to successfully change behavior: a motivational stage of intention setting and a volitional stage of intention striving. Thus, a successful behavioral change requires individuals not only to form a strong behavioral intention (motivational stage) but also to develop skills and strategies that will control the temptations and barriers threatening its implementation (volitional stage).

In recent years, a number of researchers have proposed models of behavioral change that link up with Lewin's early idea. One example is Schwarzer's (2008) health action process approach (HAPA) that distinguishes explicitly between a motivational and a volitional stage of behavioral change. In the pro-environmental domain researchers (e.g., Dahlstrand & Biel, 1997; De Vries, Mesters, Van der Steeg, & Honing, 2005; Martens & Rost, 1998) have proposed to distinguish three stages of behavioral change: In the first stage, individuals are becoming aware that their current behavior may cause harmful effects; in the second stage, they form the intention to perform an alternative, less harmful behavior; and in the third stage, they implement this new intention. The transtheoretical model (TTM) proposed by Prochaska and DiClemente (1984) even conceptualizes behavioral change as a transition through five stages: Precontemplation is the stage at which individuals are not intending to take action in the foreseeable future. Contemplation is the stage at which they develop the awareness that a change may be necessary. Preparation is the stage at which individuals form the intention to take specific actions in the immediate future. Action is the stage at which they actually change their behavior. Maintenance is the stage at which individuals are working to prevent relapse.

To summarize, theoretical frameworks that focus explicitly on modeling behavioral change show a tendency to develop in the direction of a stage model. Typical for a stage model is the assumption that behavioral change is best conceptualized as a transition through a time-ordered sequence of qualitatively different stages. Simultaneously, the stage approach stresses the self-regulative nature of behavioral change. It views behavioral change as a process in which individuals actively invest effort in setting or activating goals, developing and enacting strategies to achieve these goals, appraising progress, and revising goals and strategies accordingly (Baumeister, 2005; De Ridder & de Wit, 2006).

However, the literature also reveals a controversy about both the theoretical status and the practical benefits of stage models. Because of its prominence, most of this controversy revolves around TTM (e.g., Littell & Girvin, 2002; Weinstein, Rothman, & Sutton, 1998; West, 2005; Wilson & Schlam, 2004). For example, Sutton (2000, pp. 209–211) criticizes the distinction between TTM stages as "logically flawed" and based on "arbitrary time periods." Other authors criticize the TTM assumptions about the psychological variables and processes causing stage progression for being rather vague (e.g., West, 2005). These conceptual problems may well be the reason why reviews summarizing the effectiveness of TTM-based interventions deliver no consistent picture (e.g., Adams & White, 2003; Bridle et al., 2005; Van Sluijs, Mireille, van Poppel, & van Mechelen, 2004).

## 1. The present article

If valid, with their emphasis on the dynamic and self-regulatory aspects of behavioral change stage models would also provide an attractive theoretical perspective for studying peoples' voluntary change of environmentally relevant behaviors. Furthermore, stage models would have important practical implications for the development of interventions aiming to promote such a change. Environmental psychology reveals an ongoing discussion on whether tailored interventions approaches are more effective than "one-fits-all" approaches (e.g., Abrahamse, Steg, Vlek, & Rothengatter, 2007). Stage models would offer a theoretical foundation for systematically developing such tailored intervention concepts. Because of these attractive features in the last years a growing number of studies explore the applicability of TTM within the field of environmentally relevant behaviors (Crawford, Mutrie, Carney, & Blamey, 2011; Doppelt, 2008; Fu, Mundorf, Redding, Paiva, & Prochaska, 2012; Gatersleben & Apleton, 2007; Hi, Greenberg, & Huang, 2010; Pathmanathan, 2011; Van Bekkum, 2011).

However, because it accepts the above mentioned critique of TTM as well-founded, the present article views the use of TTM for testing the potential benefit of the stage concept within the domain of pro-environmental behaviors critically. Instead it goes a step backwards and tries to develop a more consistent theoretical framework which takes into account the critique TTM is confronted with. The below presented framework was also motivated by the desire for a more cumulative theory development. For this reason it tries to integrate the stage concept with well established constructs taken from TPB and NAM. Starting point of this integrative work is the model of action phases (MAP, Gollwitzer, 1990) which provides a convincing theoretical rational for modeling behavioral change as a transition through four different stages. However, whereas MAP provides strong arguments on why and how to differentiate stages of behavioral change, it makes only general statements about the social, cognitive, and affective factors/processes promoting stage transition. To solve this deficit, TPB and NAM constructs are integrated into MAP as determinants of three intention types viewed as transition points between the postulated four stages.

The empirical part of the article presents results of a first cross-sectional study applying the stage model of self-regulated behavioral change in the domain of motor car use. Because of its correlational design, the study allows no test of causal assumptions underlying the model. However, besides the presentation of first measures for central model constructs the study allows correlational tests of the following three hypotheses derived from this stage model: (1) Within the total sample a measure assessing a person's current stage should identify four homogeneous subgroups representing the proposed four stages. (2) Measures assessing the three critical stage transition-points goal-, behavioral- and implementation intention should be systematically associated with the assignment to these four stage groups. (3) Measures of NAM constructs should be strong predictors of goal intention; and measures of TPB constructs should be strong predictors of behavioral intention.

## 2. A stage model of self-regulated behavioral change

### 2.1. Conceptualizing stages of behavioral change

The model of action phases (MAP) proposed by Heckhausen and Gollwitzer (1987) and Gollwitzer (1990) stresses the deliberative, goal-directed nature of behavioral change. As a consequence, MAP focuses on the course of action an individual has to complete in order to successfully reach an intended goal. It assumes that this course of action can be broken down into four time-ordered, qualitatively different stages each characterized by a specific *task*: In the first (predecisional) stage, an individual's task is to deliberately reflect on competing wishes (e.g., the conflict between quick and comfortable or environmentally friendly travel) and turn some of these into binding goals. The MAP assumes that this self-commitment results in a so-called *goal intention*. A goal intention has the structure "I intend to reach goal *X*!" whereby *X* relates to a certain personal goal to which an individual feels committed (e.g.,

"I intend to reduce my motor car use for daily trips"). According to Heckhausen and Gollwitzer (1987), an individual forms a goal intention by weighting the desirability and feasibility of competing goals. Simultaneously, the formation of a goal intention marks the transition into the second (preactional) stage. Because several actions could normally be used as a means to achieve the intended goal (e.g., public transport, cycling, or walking instead of the motor car), the task in this second stage is to select the most suitable behavioral strategy to achieve the desired goal. The deliberative weighting of the pros and cons of possible alternative behavioral strategies should result in a *behavioral intention* reflecting an individual's self-commitment to one of these behavioral strategies. A behavioral intention has the structure "I intend to perform behavioral option *Y*!" (e.g., "I intend to use public transport instead of the motor car for daily trips") and marks the transition point from the preactional to the third (actional) stage. In the actional stage, an individual's task is to enact the chosen behavioral strategy, that is, to initiate and implement the necessary actions. Gollwitzer (1999) assumes that the enactment of the intended new behavior is facilitated by forming an *implementation intention*. An implementation intention has the structure "If I encounter situation *S*, then I shall perform behavior *Y*!" (e.g., "Tomorrow morning at 7:30, I shall go to the bus stop 'Friedrichstraße' and take bus number 8 to 'Berliner Platz'"). The formation of an implementation intention should create a strong mental link between a specific future situation and the initiation of the intended new behavior. Once this critical situation is actually encountered, the actions specified in the implementation intention should be initiated automatically (Gollwitzer, 1999). The formation of an implementation intention marks the transition from the actional to the fourth (postactional) stage. In this stage, an individual's task is to evaluate what she or he has achieved and decide whether further action is necessary. This is done by comparing desired with actually achieved outcomes. A second important task in this stage consists in struggling with temptation, that is, in preventing a relapse into the old behavior. Fig. 1 presents the proposed four different stages of behavioral change.

### 2.2. The norm-activation model constructs as goal intention predictors

As stated above, MAP does not specify in detail the social, cognitive, and affective factors/processes underlie the formation of the three intention types. However, detailed knowledge about these factors/processes would facilitate any use of the stage model in the context of intervention development. For example, the model assumes that in the predecisional stage, behavior is performed in a habitual way, that is, without much deliberation. Thus, the model has to specify what motivates an individual in this stage to invest cognitive effort into a deliberative reflection on personal goals. This is exactly the problem addressed by NAM. NAM assumes that when an individual becomes aware that her or his current behavior has harmful consequences for other people and/or the environment (awareness of consequences) and also accepts personal responsibility for causing this harm (ascription of responsibility), this may elicit negative feelings such as guilt. These "moral" feelings are one factor activating an individual's personal norm that is the felt obligation to behave more in line with personally important moral standards (goals). Simultaneously, the internal attribution of responsibility may give rise to concerns about what important reference persons might expect the individual to do (perceived social norms). Fear of social disapproval may additionally contribute to the activation of the personal norm. NAM assumes that the activation of a personal norm leads to the anticipation of positive emotions (pride, satisfaction) associated with behaving more in line with a personal norm. Together with the personal norm, these anticipated positive emotions provide the incentive to form a goal intention. However, whether an individual actually commits her- or himself to a goal depends on perceived goal feasibility. If an individual perceives goal feasibility as low, she or he will probably choose "escape" as the best strategy to reduce negative feelings, for example, by denying personal responsibility.

### 2.3. Attitude and PBC as behavioral intention predictors

TPB assumes that attitude, perceived behavioral control (PBC), and subjective norm are central social-cognitive factors promoting the formation of a behavioral intention. Whereas the present stage model follows TPB by viewing attitude and PBC as determinants of behavioral intention, it no longer views the subjective norm as a direct behavioral intention determinant. As stated in the last section, the model assumes instead that in the predecisional stage, perceived social disapproval motivates an individual to reflect on personal goals. If the individual has formed the goal to bring behavior more in line with a personally important goal, the choice between perceived behavioral alternatives to reach this goal should be influenced mainly by the perceived pros and cons as well as the perceived difficulty of these alternatives. This view is in line with the results of meta-analytical reviews (e.g., Armitage & Conner, 2001; Bamberg & Möser, 2007) indicating that attitude, personal

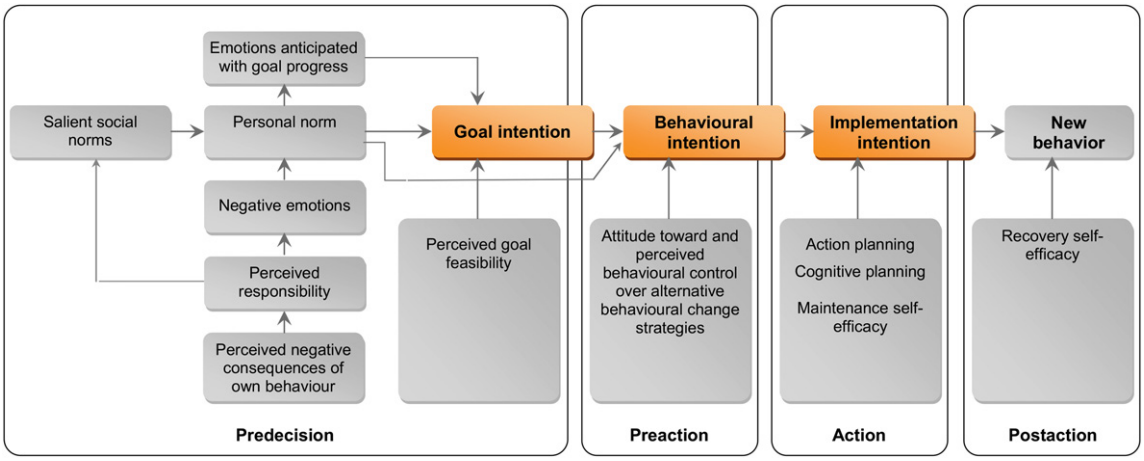


**Fig. 1.** The stage model of self-regulated behavioral change.

moral norm, and PBC but not subjective norm, are significant direct predictors of behavioral intentions.

### 2.4. Coping/action planning, coping self-efficacy, and recovery self-efficacy as implementation intention predictors

Currently, there is little empirical knowledge on which factors/processes promote the formation of an implementation intention. Gollwitzer and Sheeran (2006) assumed that the ability to engage in mental simulation (planning) might be one such factor. Schwarzer (2008) proposed distinguishing two forms of such planning: coping planning and action planning. Coping planning refers to the ability to imagine scenarios that may hinder the performance of an intended behavior, and then to develop one or more plans to cope with such a challenging situation (e.g., "If I plan to use the bicycle on Monday but the weather does not permit it, I shall use public transport instead"). Action planning refers to the specific situation parameters ("when," "where") and a sequence of action ("how"). Schwarzer (2008) assumes that an individual's confidence in being capable of maintaining a difficult behavior (so-called coping self-efficacy) may also impact on the formation of an implementation intention. He further assumes that in the postactional stage, an individual's confidence in being capable of resuming a difficult behavior after a relapse (so-called recovery self-efficacy) may increase the maintenance of the implemented new behavior. Fig. 1 presents the discussed stage framework with the four stage-specific sets of social-cognitive constructs assumed to contribute to the formation of the three critical transition points: goal intention, behavioral intention, and implementation intention.

## 3. Methods and procedure

### 3.1. Sample

The study was conducted from 2007 to 2009 within the context of the EU-MAX-Success project (EU-Max-Success, 2009). In seven European cities (Gießen, Magdeburg, Thessaloniki, Lyon, Maribor, Edinburgh, and Graz), potential participants were approached at parking slots, in shopping malls, and on university campuses. A total sample of 1815 individuals agreed to participate in the study and completed a four-page standardized questionnaire assessing their readiness to reduce their motor car use for everyday trips in favor of alternative, environmentally friendlier means of travel. Table 1 provides some sociodemographic information on the sample. Alongside its cross-sectional nature, another weakness of the study is that it did not include measures of the constructs coping/action planning, maintenance, and recovery self-efficacy (see Fig. 1). Therefore, the model assumption that these variables are strong predictors of the implementation intention could not be tested.

**Table 1**
Sociodemographic features of the sample.

| Variable | | Variable | |
|---|---|---|---|
| Female | 50.4% | Car access: always | 64.7% |
| Age | 35 | Sometimes | 18.5% |
| Household size (*Mdn*) | 3 | Seldom | 12.3% |
| Children (*Mdn*) | 1 | Never | 4.5% |
| Net income: <999 € | 21.5% | Cars in household (*Mdn*) | 1 |
| 1000–1999 € | 24.0% | Occupation: full-time | 44.4% |
| 2000–2999 € | 21.6% | Part-time | 10.5% |
| 3000–3999 € | 13.1% | Unemployed | 2.1% |
| 4000–4999 € | 6.7% | In education | 33.9% |
| 5000–6000 € | 5.9% | Retired | 7.4% |
| >6000 € | 7.3% | Home care | 1.9% |

*Note.* $N = 1815$.

### 3.2. Measures

After a short introduction to the research aims and an explanation on how to answer the questionnaire, participants had to complete a total of 44 items assessing the following theoretical constructs:

#### 3.2.1. Current stage membership

The newly developed stage measure combines information obtained from the following two item blocks: (1) Participants' self-reported motor-car-use goal for the next month. For this purpose after the introductory sentence "What is your personal motor-car-use goal for everyday trips in the next 4 weeks?" participants choose one of the following five statements: (a) "My goal is to decrease my motor car use." (b) "I would like to decrease my motor car use, but I am unable to do so at the present time." (c) "My goal is to stay at the same level of motor car use." (d) "My goal is to increase my motor car use." (e) "I have no goal regarding my motor car use." (2) The second part of the stage measure consists of assessing participants current travel behavior. For this propose participants completed for each of the transport modes motor car, bicycle, public transport the following two items (a) "In the last month how frequently have you used X for everyday trips (e.g., to the workplace, for shopping or leisure)?" Answers could be provided on a 5-point scale ranging from 0 (never) to 4 (always). (b) "On average, how many days per week did you use the motor car (public transport) for everyday trips?" Participants answered this second item by reporting the number of respective days.

It was assumed that participants who reported a high motor car and low bike/PT use for the last month and who chose goal statement (c) were in the predecisional stage. Participants reporting a high motor car and low bike/PT use for the last month who chose statement (b) should be in the preactional stage. Participants reporting a lower level of motor car and a higher level of bike/PT use for the last month compared with earlier stages and who chose statement (a) should be in the actional stage. Finally, participants reporting the lowest level of motor car and highest level of bike/PT use for the last month who chose statement (c) should be in the postactional, maintenance stage.

The three stage transition points goal-, behavioral-, and implementation intention were assessed in the following way: *Goal intention* (4 items). Example: "My intention to achieve my motor-car-use goal within the next 4 weeks is: 5-point scale ranging from 0 (very weak) to 4 (very strong)." Before answering the items used for assessing the construct behavioral intention, participants had to choose which of the following four activities they preferred most for reaching their motor-car-use goal: (a) "Walk more frequently for everyday trips under 3 km distance." (b) "Cycle more frequently for everyday trips under 5 km distance." (c) "Use public transport more frequently for everyday trips." (d) "Share a motor car with others for some (or all) of my trips." Participants could also choose combinations of the four activities or suggest a further activity of their own. The four items assessing *behavioral intention* were directly related to the activity chosen by a participant. Example: "I intend to perform my chosen activity within the next 4 weeks. 5-point scale ranging from 0 (strongly disagree) to 4 (strongly agree)." The same holds for the two items assessing *implementation intention*. Example: "I have already informed myself about the necessary details to get started on my chosen activity. 5-point scale ranging from 0 (not yet informed) to 4 (informed)."

As predictors of the goal intention, the following six constructs taken from the NAM were assessed: *Awareness of negative consequences* (2 items). Example: "In your opinion, how significantly does global motor car use contribute to the emission of climate-changing greenhouse gases? 5-point scale ranging from 0 (not

significantly) to 4 (very significantly)." *Perceived own responsibility* (2 items). Example: "It is also my personal responsibility to reduce the emission of climate-changing greenhouse gases. 5-point scale ranging from 0 (strongly disagree) to 4 (strongly agree)." *Negative emotions* (2 items). Example: "When hearing/reading news about global climate change, how strongly do you have the following feelings: anxiety, guilt? 7-point scale ranging from 0 (not at all) to 6 (very much)." *Social norm* (2 items): Example: "Most of the people who are important to me (e.g., friends/family) think that I should attain my chosen motor-car-use goal within the next 4 weeks. 5-point scale ranging from 0 (strongly disagree) to 4 (strongly agree)." *Personal norm* (2 items). Example: "Regardless of what other people do, my own values/principles oblige me to attain my chosen motor-car-use goal within the next 4 weeks. 5-point scale ranging from 0 (strongly disagree) to 4 (strongly agree)." *Positive emotions anticipated with goal achievement* (3 items). Example: "If I succeed in achieving my motor-car-use goal within the next 4 weeks, I shall feel happy. 7-point scale ranging from 0 (*not at all*) to 6 (*very much*)." *Perceived goal feasibility* (2 items). Example: "Achieving my motor-car-use goal within the next 4 weeks will be: 5-point scale ranging from 0 (*very difficult*) to 4 (*very easy*)."

As predictors of the behavioral intention, the following two constructs taken from TPB were assessed: *Attitude toward the chosen activity* (3 items). 5-point scales ranging from 0 (disadvantageous) to 4 (advantageous) and 0 (bad) to 4 (good). *Perceived behavioral control* (2 items). Example: "For me, performing my chosen activity within the next 4 weeks will be: 5-point scale ranging from 0 (very difficult) to 4 (very easy)."

### 3.3. Hypotheses

The data analysis focuses on testing the following three hypotheses:

1. *Identifying four homogeneous groups representing the different stages.* As stated above, it is assumed that the combination of a participant's self-reported motor-car-use goal and the sum scores of the two items assessing participant's current motor car, PT, and bike could be used as indicator of a participant's current stage membership. Analyzing this information with a typological statistical model should result in a four cluster solution showing the best statistical fit to the data. The indicator means of the four clusters solution should fit the theoretical criteria used for defining the four stages.
2. *Impact of the three intention types on stage assignment.* The measure of the transition point goal intention should be most strongly associated with a person's assignment to the preactional stage; the behavioral intention measure most strongly with assignment to the actional stage; and the implementation intention measure should be associated most strongly with assignment to the postactional stage.
3. *Testing the predictive power of the stage-specific sets of social cognitive variables.* The measure of the seven constructs taken from NAM should be direct and indirect predictors of goal intention. The arrows depicted in Fig. 2 represents in detail the assumed direct and indirect associations. It is further assumed that measure of the two TPB constructs attitude and PBC are strong direct predictors of the behavioral intention (see Fig. 2).

## 4. Results

### 4.1. Test of measurement instruments

Table 2 presents the results of a confirmatory factor analysis (CFA) checking the reliability of the measures developed for assessing current travel behavior, the three intention types, as well as the nine constructs taken form NAM and TPB. Because they did not complete most of the items assessing NAM and TPB constructs, participants who chose the no goal statement ($n = 698$) or the goal of increasing their motor car use ($n = 37$) were excluded. Because the present study focused on the behavioral change motivation of participants who had the choice to use a motor car, participants living in households without a motor car or who did not always have access to a motor car ($n = 110$) were also excluded. Furthermore, because the following analysis used the MLR estimator (Muthen & Muthen, 2007), which is robust to violations of multivariate normality, cases with missing values also had to be excluded ($n = 62$). This left data from 908 participants as CFA input (Mplus 5.2, covariances, MLR estimator). Overall, the CFA indicates a reasonable fit between the postulated measurement models and the observed covariances of the items. A chi-square test is significant, $\chi^2(356, n = 908) = 1021.3$, $p < .001$, but other fit indices are acceptable (RMSEA = 0.037, NNFI = 0.96, CFI = 0.96). All factor loadings are significant and above 0.66. All measures had a satisfactory reliability.

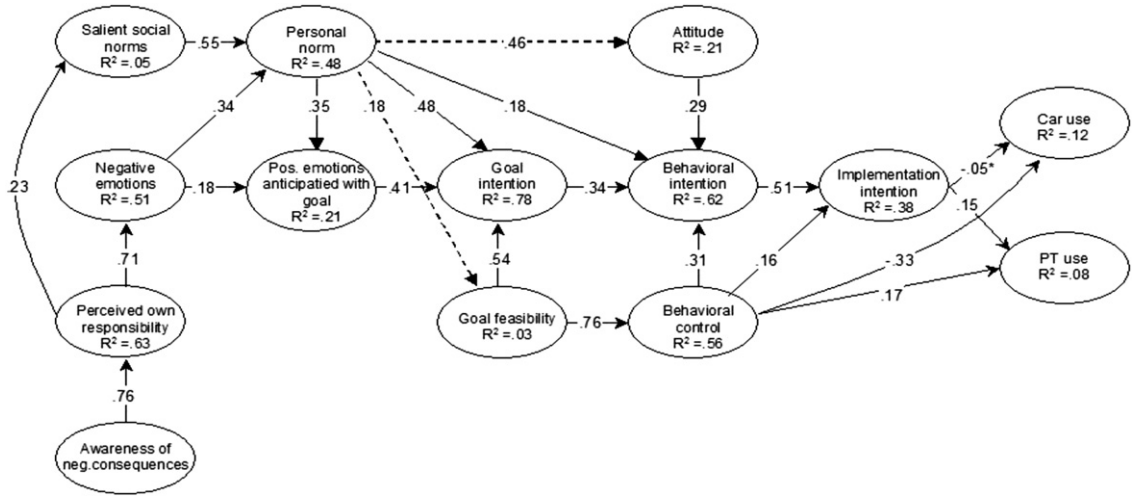


**Fig. 2.** The structural part of the SEM model (standardized path coefficients and explained variances $^*p > .05$).

**Table 2**
Factor loadings and reliabilities of measurement instruments.

| Variable | *M* | *SD* | Factor loadings | | | | Reliability[a] |
|---|---|---|---|---|---|---|---|
| | | | Indi. 1 | Indi. 2 | Indi. 3 | Indi. 4 | |
| Awareness of neg. consequ. | 2.69 | 0.91 | 0.72 | 0.78 | | | 0.70 |
| Perceived responsibility | 2.57 | 1.04 | 0.73 | 0.76 | | | 0.70 |
| Negative emotions | 2.69 | 1.29 | 0.72 | 0.79 | | | 0.70 |
| Personal norm | 2.38 | 1.10 | 0.75 | 0.75 | | | 0.73 |
| Social norm | 2.27 | 1.08 | 0.73 | 0.78 | | | 0.73 |
| Anticipated pos. emotions | 3.61 | 1.33 | 0.85 | 0.87 | 0.76 | | 0.88 |
| Goal feasibility | 2.41 | 1.16 | 0.72 | 0.78 | | | 0.70 |
| Goal intention | 2.73 | 0.81 | 0.67 | 0.81 | 0.66 | 0.81 | 0.80 |
| Attitude toward behavior | 2.69 | 0.91 | 0.72 | 0.66 | 0.78 | 0.84 | 0.79 |
| Behavioral control | 2.51 | 1.02 | 0.78 | 0.73 | | | 0.73 |
| Behavioral intention | 2.72 | 0.78 | 0.77 | 0.81 | 0.72 | 0.80 | 0.82 |
| Behavioral planning | 2.79 | 1.26 | 0.77 | 0.75 | 0.67 | | 0.74 |
| Car use | 7.81 | 2.97 | 0.84 | 0.83 | | | 0.83 |
| PT use | 2.82 | 2.98 | 0.89 | 0.88 | | | 0.88 |

*Note.* $n = 908$.
[a] Reliabilities calculated according to Bollen (1989).

### 4.2. Identification of homogeneous stage groups

Although cluster analysis is frequently used for identifying homogeneous subgroups, the literature (e.g., Vermunt & Magidson, 2002) recommends the use of the statistically more advanced latent class cluster analysis (LCCA) method. Table 3 presents the fit statistics of the one to six estimated LCCA cluster solutions. The assumption of a homogeneous group (one-cluster solution) is rejected, $L^2(206) = 1844.9$, $p < .001$. Instead, both the $L^2$ and *BIC* statistics indicate that a four-cluster solution is the most adequate model, $L^2(134) = 168.0$, $p = .81$. It delivers a 91% reduction of $L^2$ compared to the one-cluster solution. More complex models provide only very small additional $L^2$ reductions, as reflected in an increase in the *BIC* statistic taking into account model parsimony. The four-cluster solution assigns 31.3% of the participants to Cluster 1; 31.1%, to Cluster 2; 20.2%, to Cluster 3; and the remaining 17.5%, to Cluster 4.

For further validation, Table 4 presents the means of the stage indicators as well as the constructs of the stage model of self-regulated behavioral change separately for each of the four clusters. All participants assigned to Cluster 3 chose the statement "same level." They simultaneously report the highest level of current motor car use and the lowest levels of PT/bike use. Hence, these participants meet the criteria defining the predecisional stage. All participants assigned to Cluster 1 chose the statement "desire to decrease, but unable." They also show a high level of motor car use and low levels of PT/bike use and meet the criteria defining the preactional stage. All participants assigned to Cluster 2 chose the statement "decrease," show a significantly lower level of motor car use and higher levels of PT/bike use than those in Clusters 3 and 1, and meet the criteria defining the actional stage. All participants assigned to Cluster 4 chose the statement "same level."

**Table 3**
Model fit of LCCA solutions.

| | *N*par | BIC (LL) | $L^2$ | *df* | *p* | Reduction in $L^2$ |
|---|---|---|---|---|---|---|
| 1-cluster solution | 9 | 9380.8 | 1844.9 | 206 | 0.00 | |
| 2-cluster solution | 16 | 8700.6 | 1117.1 | 199 | 0.00 | 39.4% |
| 3-cluster solution | 23 | 7880.1 | 248.9 | 192 | 0.00 | 86.5% |
| 4-cluster solution | 30 | 7846.9 | 168.0 | 185 | 0.81 | 90.9% |
| 5-cluster solution | 37 | 7849.5 | 122.9 | 178 | 1.00 | 93.3% |
| 6-cluster solution | 44 | 7856.5 | 82.2 | 171 | 1.00 | 95.5% |

*Note.* $n = 908$.

**Table 4**
Validation of the 4-LCCA cluster solution.

| Construct | PreD 20.2% | PerA 31.3% | A 31.1% | PostA 17.5% | ANOVA |
|---|---|---|---|---|---|
| | *M* | *M* | *M* | *M* | *F* |
| Goal "same level" | 1.00 | 0.00 | 0.00 | 1.00 | – |
| Goal "decrease, but unable" | 0.00 | 1.00 | 0.00 | 0.00 | – |
| Goal "decrease" | 0.00 | 0.00 | 1.00 | 0.00 | – |
| Car use | 9.05 | 8.38 | 6.46 | 3.68 | 168.9*** |
| PT use | 2.15 | 2.25 | 4.10 | 5.01 | 45.1*** |
| Bike use | 0.61 | 0.80 | 1.10 | 1.38 | 14.4*** |
| Awareness of neg. consequ. | 2.62 | 2.98 | 3.05 | 3.09 | 11.9*** |
| Perceived responsibility | 2.19 | 2.83 | 2.89 | 2.84 | 21.5*** |
| Negative emotions | 2.36 | 2.84 | 3.20 | 2.84 | 16.0*** |
| Personal norm | 1.91 | 2.25 | 2.62 | 2.34 | 13.6*** |
| Social norm | 2.17 | 2.18 | 2.37 | 2.47 | 3.0* |
| Anticipated pos. emotions | 3.27 | 3.65 | 3.94 | 3.22 | 13.9*** |
| Goal feasibility | 2.84 | 1.65 | 2.49 | 2.92 | 80.8*** |
| Goal intention | 2.82 | 2.56 | 2.92 | 2.76 | 9.7*** |
| Attitude toward behavior | 2.46 | 2.64 | 2.86 | 2.77 | 6.6*** |
| Behavioral control | 2.63 | 2.28 | 2.78 | 3.05 | 23.1*** |
| Behavioral intention | 2.52 | 2.65 | 3.00 | 2.84 | 15.0*** |
| Implementation intention | 1.68 | 1.93 | 2.48 | 2.19 | 16.0*** |

*Note.* $n = 908$. PreD = predecisional stage, PreA = preactional stage, A = actional stage, PostA = postactional stage. *$p < .05$, ***$p < .001$.

Because they report the lowest level of motor car use and the highest levels of PT/bike use, they meet the criteria defining the postactional stage.

### 4.3. Association between intention types and stage assignment

Empirically, the assumed role of the three intention types as transition points between the stages (Hypothesis 2) can be tested via an ordinal logistic regression model (Hedeker, Mermelstein, & Weeks, 1999). The idea underlying ordinal logistic regression is that the response probabilities of an ordered categorical variable (in the present case, the time-ordered sequence of four stages) can be modeled via thresholds of increasing difficulty separating individuals into the ordered sequence of the values of the categorical stage variable. In the case of an ordered categorical stage variable with four values, three thresholds have to be estimated. Then, the association of the three intention types with the probability of "crossing" these three thresholds can be assessed. In this context, a proportional ordinal regression model assumes that a predictor has the same effect on all thresholds. The nonproportional ordinal logistic regression, however, allows for varying effects of a predictor on the thresholds. A $L^2$-difference test is then used to decide which model fits the data better.

In the present study, the ordinal logistic regression analysis was conducted with the MIXOR 2.0 program (Hedeker & Gibbons, 1996). Following the recommendation of Hedeker et al. (1999), the three predictor variables goal intention, behavioral intention, and implementation intention were dichotomized for this purpose (median split) before the analysis. Table 5 presents the results of the proportional versus nonproportional ordinal regression model. An $L^2$-difference test for model comparison reveals a significantly better fit for the nonproportional model, $L^2(6) = 58.14$, $p < .001$. Inspection of the logits (Column 4 in Table 5) estimated under the assumption of nonproportionality shows that goal intention was associated significantly with the probability with which an individual is assigned to the preactional stage (i.e., had crossed the predecisional–preactional threshold). A negative sign indicates a decrease of the threshold between two stages; that, is an increase in the probability of crossing that threshold. Because the size of the logits is difficult to interpret, they were transformed into odds (Table 6). The odds indicate that compared to an individual with

**Table 5**
Ordinal regression analysis: effect of the three intention types on stage thresholds.

| Variable | Parameter estimates | | | |
|---|---|---|---|---|
| | Equal effect on thresholds | | Varying effect on thresholds | |
| | Logit | *SE* | Logit | *SE* |
| Intercept[a] | −0.68*** | 0.14 | −0.85*** | 0.18 |
| Goal intention[a] | −0.71*** | 0.13 | −1.16*** | 0.17 |
| Behavioral intention[a] | −0.15 | 0.12 | 0.17 | 0.17 |
| Implementation intention[a] | −0.30* | 0.13 | 0.14 | 0.17 |
| Intercept[b] | 0.81*** | 0.08 | 0.94*** | 0.17 |
| Goal intention[b] | – | | −0.59*** | 0.14 |
| Behavioral intention[b] | – | | −0.38** | 0.14 |
| Implementation intention[b] | – | | −0.49*** | 0.14 |
| Intercept[c] | 2.35*** | 0.11 | 1.99*** | 0.23 |
| Goal intention[c] | – | | −0.12 | 0.19 |
| Behavioral intention[c] | – | | −0.03 | 0.18 |
| Implementation intention[c] | – | | −0.55*** | 0.19 |
| Model fit (−2Log*L*) | 2418.042 | | 2359.907*** | |
| Model fit (*df*) | 6 | | 12 | |

*Note.* $n = 908$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.
– = same effect as on Threshold 1.
[a] Effect on predecisional–preactional threshold.
[b] Effect on preactional–actional threshold.
[c] Effect on actional–postactional threshold.

a low goal intention, an individual with a high goal intention had a 3.2 times higher probability of crossing the respective threshold. However, goal intention is also significantly but more weakly associated with the preactional–actional threshold. As expected, behavioral intention is only associated with the probability of crossing the threshold between the preactional–actional stages. Implementation intention shows the expected significant association with the actional–postactional but also a significant association with the preactional–actional threshold.

### 4.4. Test of the structural relationships

Fig. 2 depicts the results of an SEM (Mplus 5.2, covariances, MLR estimator) simultaneously estimating the measurement models as well as the theoretically postulated structural relations between the latent variables (Hypothesis 3). The overall fit between the model-implied and observed covariances is acceptable, $\chi^2(404, n = 908) = 835.75$, $p < .001$, RMSEA = 0.038, NNFI = 0.95, CFI = 0.95. Fig. 2 presents the estimated standardized path coefficients and the variances explained by the latent constructs. The main purpose of this analysis was to check how well the sets of social-cognitive variables predicted the three intention types. In the present data set, 78% of the variance in goal intention, 62% of the variance in behavioral intention, and 38% of the variance in implementation intention could be explained. This last finding is probably due to the fact that the present study did not assess the constructs proposed in Fig. 1 as implementation intention predictors. Fig. 2 also provides information about relations between the social-cognitive variables. As expected, perceived personal responsibility seems to mediate the relation between problem awareness and feelings of guilt/anxiety. Also confirmed is the expected association between perceived responsibility and social norms, along with the association between feelings of guilt/anxiety, social norms, and personal norm. There is also a significant association between personal norm and the positive emotions anticipated from achieving one's motor-car-use goal. As postulated by the model, personal norm, anticipated positive feelings, and perceived goal feasibility are associated strongly with goal intention; goal intention, attitude, personal norm, and PBC with behavioral intention. Implementation intention is associated significantly with behavioral intention and PBC. The PBC over activities to reduce one's daily motor car use is associated significant and negative with the degree of current motor car use. The degree of planning activities for reducing daily motor car use (implementation intention) is associated significantly with current PT use. The same held true for behavioral control. However, modification indices show that including the following two additional associations (see dotted arrows in Fig. 2) significantly increased the model fit: the association between personal norm and attitude and the association between personal norm and behavioral control.

**Table 6**
Ordinal regression analysis: odds ratio (OR) estimates.

| Variable | Varying effect on thresholds | | | |
|---|---|---|---|---|
| | Preactional $OR_1$ | Actional $OR_2$ | Postactional $OR_3$ | *p* $OR_1 = OR_2 = OR_3$ |
| Low vs. high goal intention | 3.19*** | 1.80*** | | <0.001 |
| Low vs. high behavioral intention | | 1.46** | | <0.001 |
| Low vs. high implementation intention | | 1.63*** | 1.77*** | <0.001 |

*Note.* $^{**}p < .01$, $^{***}p < .001$.

## 5. Discussion

The article's main goal was to introduce the stage model of self-regulated behavioral change and to present a first correlational test of hypotheses derived from this model. In summary, the data analysis provides correlational support for all hypotheses: With the help of a measure assessing an individual's current stage membership, it was possible to identify four homogeneous subgroups in the total sample representing the theoretically expected four stage groups. Ordinal regression results provide some support for the model assumption that goal-, behavioral-, and implementation-intention mark the transition through the postulated stage sequence. The SEM results also support the assumed chain-like relation between the three intention types. These two results fit the theoretical assumption that the formation of a behavioral intention serves the realization of the goal intention, and the implementation intention serves the realization of this behavioral intention. That implementation intention mediates the association between self-reported car use reduction intention and the frequency of actual PT use underlines the significance of volitional processes for the actual performance of an intended new behavior. The SEM results also indicate that perceived behavioral control over changing current motor car use may play an important role whether a person is motivated to actually plan and implement intended motor car use reduction. Together these results support the here presented view that for successfully changing her/his behavior in a first predecision stage a person has to form a goal intention, in the second preactional stage a behavioral intention, and in the third, actional stage an implementation intention. SEM results also confirmed the hypothesis that constructs taken from NAM and TPB are strong predictors of goal- and behavioral intention.

### 5.1. Limitations

Some readers may wonder that the stage model only explains a modest amount of variance in motor car use and PT use. The low

amount of explained variance is probably a consequence of a central weakness of the present study: The use of a cross-sectional design. This design allows only correlating the perceived behavioral control over changing one's current motor car use and the plan to change one's travel behavior with the current frequency of motor car use. However, because also a person who currently reports frequent motor car use can have the plan to reduce this behavior within the next time, this association provides no adequate test of the causal relation between the current behavioral change plan and future travel behavior. Generally this limitation holds for all reported correlational tests of causal hypotheses. For an adequate empirical test of the postulated relations as well as the predictive power of the proposed stage model longitudinal data are necessary.

Another weakness of the present study relates to the measure used for assessing participants' current stage membership. This measure combines a self-selected motor car use goal with current travel behavior. The results of the LCCA provided some evidence that it may work. However, this measure also has also clear disadvantages: From a theoretical point of view, one could criticize that it has low face validity. There is some discrepancy between how the stages are theoretically conceptualized (i.e., in terms of tasks and mind sets) and how the measure operationalized stage membership (current behavior and motor car use goal). As a consequence, the interpretation of the LCCA results remains, to a certain degree, vague. In retrospect, using the "no-goal" statement as an answer option was also not a good decision. The large number of individuals choosing this statement (about 40%) suggests that many may have used it as a convenient way to save time (as with the "don't know" statement in other surveys). Thus, the "true" stage membership behind this statement remains open. The behavior reported by participants choosing this statement provides some evidence that most of them were probably in the predecisional stage.

An additional weakness of the present study consists in the above mentioned fact that the constructs coping/action planning, maintenance-, and recovery self-efficacy were not assessed. Therefore, the model assumption that these variables are additional predictors of the implementation intention could not be tested. This is probably the reason why a relatively low amount of variance in implementation intention could be explained.

From a theoretical point of view there are also some inconsistencies in the results of the correlational tests: The ordinal regression indicates a significant but theoretically unexpected association between goal-intention and the probability of "crossing" the preactional–actional threshold and between implementation intention and "crossing" the actional–postactional was unexpected. Also theoretically not expected was the SEM result that adding associations between personal norm and attitude and between personal norm and perceived goal feasibility significantly increase model fit. Because of their correlational nature, one should be cautious to interpret these findings in a substantive way. However, the last finding may indicate that the role of personal norm is more complex and influential than currently assumed by the stage model.

### 5.2. Future research

In conclusion, the present paper presents more of a starting point for a new line of research rather than any reliable final results. Further empirical research is needed to decide whether stage models present a useful approach. The first future challenge consists in developing a more theory-based stage measure. Furthermore, measures for the constructs coping/action planning, maintenance-, and recovery self-efficacy must be develop and the assumed relations between these measures and the formation of an implementation intention respectively the maintenance of the new behavior have to be studied.

Based on a reliable and valid stage measure, the second future challenge consists in conducting longitudinal studies to gain methodologically more convincing evidence on whether behavioral change can be described as a transition through four qualitatively different stages and whether this transition can be explained by the model variables. Probably experimental lab studies provide the most effective way for answering these questions. For this purpose intervention paradigms have to be developed targeting stage specific social, cognitive, or affective determinants of the three transition point. If the model is correct, such manipulations should elicit the processes promoting the formation of the respective intention type marking the transition into the next stage. The transition from earlier stages into the actional stage should be associated with behavioral change. Furthermore, because the model of self-regulated behavioral change claims to provide a general framework for understanding the processes underlying behavioral change, future studies should test whether this claim holds true by testing the model in other consumption areas like recycling, food consumption or energy use.

### 5.3. Implications for intervention development

If future, experimental lab and field studies confirm the validity of the stage model, this would have important practical implications for intervention development. Instead of a "one-size-fits-all" approach, the stage model suggests the need to develop stage-tailored intervention modules matching the specific needs of individuals in the four different stages of behavioral change. For example, for individuals in the first predecisional stage, intervention techniques are likely to be more successful if they concentrate on promoting and activating problem awareness and perceived personal responsibility. On the other hand, individuals who are in the preactional stage; that is, those who have already formed a goal intention, need interventions that support them in selecting a specific action option. Interventions that provide credible information about the availability of different behavioral alternatives as well as their pros and cons may be effective in this stage. Individuals in the action stage who have formed a behavioral intention already probably benefit most from intervention techniques supporting the initiation and implementation of the chosen behavioral strategy. Future studies have to evaluate such stage-tailored intervention modules by comparing their effectiveness with not tailored "one-size-fits-all" interventions.

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