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ORIGINAL ARTICLE

Future Time Perspective and Health Behaviors: Temporal Framing of Self-Regulatory Processes in Physical Exercise and Dietary Behaviors

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Abstract
Background Limitations in perceived lifetime can undermine long-term goal striving. Planning is supposed to translate intentions into health behaviors and to operate as a compensatory strategy to overcome goal striving deficits associated with a limited time perspective.
Purpose Two longitudinal studies were conducted examining the compensatory role of planning: an online survey on fruit and vegetable consumption (N=909; 16–78 years; follow-up at 4 months) and a questionnaire study on physical exercise in older adults (N=289; 60–95 years, over a half-year period).
Methods Intentions, planning, and behavior were measured in a behavior-specific, future time perspective in a generic manner.
Results Planning mediated between intentions and both health behaviors. Time perspective operated as a moderator, indicating that in individuals with a more limited time perspective, a stronger effect of planning on health behaviors emerged.
Conclusions Planning as a self-regulatory strategy may compensate for a limited time perspective.

Keywords Future time perspective · Planning · Self-regulation · Physical exercise · Fruit and vegetable intake

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Temporal framing of life has inevitable implications for motivation and behavioral self-regulation [1]. Although implicitly inherent in many health psychological constructs, as they are future-oriented by their nature (for example, planning, expectations, goals), there is a paucity of research on the influence of temporal representations and their possible interactions with self-regulation and health behavior [2]. Thus, the purpose of the two studies presented here is to draw on health psychological as well as life-span concepts and to examine whether future time perspective makes a difference in the interplay of self-regulatory processes. The aim is to examine whether planning can compensate for the expected negative effect of a limited future time perspective on health behaviors. When it comes to translating intentions into behaviors via planning (mediation), the effect of planning should intensify with decreasing values of future time perspective (moderation). We first examine this interplay in the domain of fruit and vegetable consumption and then try to replicate the findings in a second domain, namely physical exercise. A particular strength of this study is not only the attempt to replicate the findings across domains but also the focus on both motivation (goal setting) and volition (goal pursuit) using a longitudinal approach.

Future Time Perspective

There are several concepts of future orientation or future time perspective that incorporate slightly different aspects of future time as a motivational factor for goal selection [2]. For example, consideration of future consequences [3], delay of gratification [4], or temporal valuations [5] highlight short- versus long-term consequences of current behavior. The Zimbardo time perspectives inventory [6] is conceptualized as a broader time orientation for individual differences and partitions human experience into past, present, and future temporal frames. Yet another approach is perceived time left in life, which can be operationalized by the subjective residual life expectancy [7]. Future time perspective as outlined by socioemotional selectivity theory [1] takes an explicit life-span view and integrates perceived time left in life and lifetime-related possibilities. Both future time perspective and subjective residual life expectancy have shown to be influential in health self-regulation [8, 9].

Socioemotional selectivity theory [1, 8] assumes that people who perceive their future as being open ended should prioritize goals that optimize their future (e.g., adopting a health behavior), whereas those who have a more restricted future time perspective should maximize emotionally meaningful goals (e.g., maintaining a close relationship). Thus, a perceived limited future—due to a perception of limited possibilities in the personal future or limited time left in life—can undermine long-term health-related goal striving. This can also lead to a shift of motivational focus from health behaviors to short-term and emotion regulation goals. According to socioemotional selectivity theory, it has been shown that this shift of focus has influence on health-related information gathering, processing, and decision making [8, 10]. In a study by Löckenhoff and Carstensen [10], older and young adults reviewed choice criteria that contained positive and negative information about different physicians and health care plans using computer-based decision scenarios. As predicted, older adults reviewed and recalled a greater proportion of positive than negative information compared with young adults. Age differences were eliminated when motivational manipulations elicited information-gathering goals or when time perspective was controlled statistically. But also for health behavior itself, Ziegelmann et al. [9] could show that individuals who perceived their time as limited reported a less favorable profile on social–cognitive variables and less exercise goal attainment.

Future Time Perspective and Health Self-Regulation

An expansive future time perspective can be a major source of motivation toward adopting health behaviors. In individuals with a more limited future time perspective, however, problems can occur, when health behaviors are not linked with emotionally meaningful goals. Persons with a more limited time perspective focus on short-term consequences and prioritize emotion-regulation-oriented behaviors. Also, for persons with a limited future time perspective, self-regulatory strategies have been identified as effective tools to translate intentions into behavior [11] and to support goal engagement. A simple self-regulatory strategy is *planning* (or implementation intentions, see [12, 13]) that describes the mentally simulated link between a specific situational cue and a goal-directed behavioral response (*if* situation X, *then* response Y). Unlike intentions that merely reflect a desired goal (e.g., "I want to exercise more"), planning reflects the anticipated execution when the opportunity arises (e.g., "If the weather is fine on Sunday morning, I will run in the park for 30 min"). As people do not fully act upon their intentions ("intention–behavior gap"), it is assumed that planning as a self-regulatory strategy can help to bridge this gap, which is reflected by statistically mediating the relation between intention and actual behavior [14]. There is a great deal of evidence that planning facilitates the adoption and maintenance of health behaviors, such as fruit and vegetable consumption (e.g., [15, 16]) as well as physical activity (e.g., [14]).

Regarding the interplay of planning and future time perspective, Oettingen and Gollwitzer [17] described that contrasting the possibilities in the personal future with the present state as a self-regulatory strategy helps individual goal setting, whereas planning as a second strategy fosters goal striving. In their temporal self-regulation theory, Hall and Fong [5, 18] conceptualize temporal evaluation as an antecedent that influences behavior via intention as a mediator, whereas self-regulatory capacity moderates this. In a study by Kahana et al. [19], future time perspective was a moderator for the adoption and maintenance of physical exercise over a 4-year period of time. Planning ahead was found to play a moderating role in ameliorating adverse outcomes in late life (see [19]). Also, Ziegelmann et al. [9] investigated the relationships between social–cognitive variables and physical exercise adherence within two groups of individuals with either limited or expansive future time perspective in the context of health behavior change. The groups differed significantly (moderation effect of future time perspective) in the extent to which the relationship between intention and behavior was mediated by planning. In individuals with a limited future time perspective, the relationship between intention and physical activity was mediated by planning to a greater extent than in those with a more expansive time perspective. Reuter et al. [14] found in a healthy working population that the degree to which planning mediates the intention–behavior relation increases with age (age×planning interaction), whereas age is expected to be negatively related to future time perspective [1]. To summarize, limitations in perceived lifetime can be a challenge for motivation and for goal pursuit. Based on these studies, the use of planning to translate intentions into behavior seemed to be a compensatory strategy for individuals who have a limited future time perspective.

Future Time Perspective and Health Behaviors

There is a growing body of research showing associations between future time perspective and health behaviors, such as less substance abuse [20, 21], more safer sex behaviors [22], better coping with HIV [23], better proactive coping [2], cancer screening [24], and more sunscreen use [25].

Regarding the interplay of dietary behaviors and future time perspective, Piko and Brassai [26] found in adolescents that poor dietary control was associated with lower levels of future orientation. In a study by Luszczynska et al. [27], future time perspective was significantly related to nutrition across four samples in different countries. For physical exercise, Kahana et al. [19] found long-term positive associations between future orientation of older adults and the physical exercise level. The authors argue that future orientation represents an antecedent for engaging in preventive health behaviors in late life. In a study with orthopedic rehabilitation patients, Ziegelmann et al. [9] found lower levels of planning and exercise goal attainment in patients with a limited compared to those with an expansive future time perspective. Hall and Fong [28] found that a time perspective group after an intervention to enhance long-term thinking about physical activity reported increased physical activity levels as compared to a goal-setting group and a no-treatment group. This experimental study provides evidence of potential causal associations between time perspective and health behavior.

To summarize, as health behaviors require high levels of motivation and self-regulatory effort and coordination between short-term, long-term, and lifelong goals; costs; and benefits [29], future time perspective appears to be a promising construct to be studied in health behavior change.

Future Time Perspective and Chronological Age

Future time perspective as outlined by socioemotional selectivity theory [1] is inherently associated with chronological age. As people get older, they perceive their time as limited, whereby long-term health-related goals lose relative priority over short-term and emotionally meaningful goals. In the context of age-related motivational and health behavioral patterns, age itself does not play a direct causal role [8]. It should be replaced by other more proximal explanatory variables (mediators) because chronological age does not cause anything by itself [30]. The confounding of chronological age and future time perspective was decomposed in studies on serious medical conditions [31], sociopolitical threats [32], or students before an imminent threat [33] as these young individuals had similar future time perspective and motivational and behavioral patterns as old-aged individuals. Löckenhoff and Carstensen [8] argue that changes in time perspective and their influence on goal priorities rather than chronological age drive these changes in health behaviors. Therefore, to explain these age-related changes in health behaviors, future time perspective could function as an explanatory variable (mediator) between age and health behaviors.

While future time perspective seems to be a driving force for health behavior change, it is rarely examined across different behaviors and rarely takes into account the process of behavior change from intention via plans to action. To emphasize our perspective on the process of behavior change, we examine moderation and mediation hypotheses in the second study with three points in time, which provides a temporal lag for the associations under study.

Aims of the Two Studies

In the present two studies, we examined moderation and mediation hypotheses for two health behaviors: fruit and vegetable intake and physical exercise. We hypothesize (hypothesis 1) that planning bridges the intention–behavior gap, reflected by an indirect effect of intention on behavior via planning. Further, we hypothesize (hypothesis 2) that planning can compensate for the potential negative impact of limited future time perspective as a key motivational barrier. This should be reflected by a planning × future time perspective interaction effect (moderation): In persons with a limited future time perspective, there should be a close relationship between planning and health behavior. However, the more expanded the time perspective, the weaker the planning–behavior relation, and in persons with an expanded time perspective, there should be only a slight increase of behavior for every increase in planning. Finally, we hypothesize (hypothesis 3) that future time perspective serves as potential explanation of age effects on behavior level, reflected by an indirect effect (mediation) from age to behavior via future time perspective. As these hypotheses are behavior general, we hypothesize that they hold for different behaviors, therefore testing them for fruit and vegetable intake and physical exercise separately. Nevertheless, all hypotheses were tested simultaneously in one model for each behavior.

Two studies on the interplay of social–cognitive variables and health behaviors were conducted. Intention and planning as health behavior-related constructs were assessed behavior specific in both studies. In contrast, future time perspective, as a more distal construct, is operationalized in a behavior generic way.

Study 1: Fruit and Vegetable Intake Over a Time Span of 4 Months

Method

Participants and Procedure

Study 1 was a longitudinal online study on fruit and vegetable intake. Ethical guidelines were followed. A committee of members of the Freie Universität Berlin was responsible for the approval of the study. At time 1 (T1), N=4,152 participants were recruited via newspaper announcements, radio, newspapers, or internet (due to a rolling recruitment procedure, T1 enrolment was possible over a 1-year time period starting in June 2007). In subsequent data analyses, 1,262 cases were excluded due to complete missing values on the relevant model variables. Therefore, 2,890 participants with at least one value either on intention, planning, future time perspective, or fruit and vegetable intake constituted the T1 sample. After providing informed consent, respondents were invited to participate in an online questionnaire, unless they had a medical contraindication (such as a particular dietary regime). Four months later, they were all invited via email to answer the follow-up questionnaire, and 909 individuals participated in the second assessment wave. The mean time interval between the T1 and the time 2 (T2) assessments was 4.4 weeks (SD=1.1). The longitudinal sample comprised 737 women (81.1 %) and 172 men. The mean age was 37.81 years, SD=13.05, ranging from 16 years to 78 years. All study contents were communicated in German only. In the longitudinal sample, 35.6% were married or in a long-term relationship, 8.8% were divorced, 53.9% were singles, and 1.7% were widowed. In terms of education, 72.9% obtained a higher educational entrance qualification, 20.5% completed tenth grade, 5.8% completed ninth grade, and 0.8% did not obtain any school degree.

Dropout analyses yielded no baseline differences between participants in the longitudinal sample and those who dropped out in terms of age, marital status, educational level, intention, and planning. For baseline fruit and vegetable intake (t(2,880)=3.12, p=0.002) and for future time perspective (t(2,836)=2.07, p=0.04), a selective dropout occurred. Participants who dropped out had slightly lower baseline values for fruit and vegetable intake (T1: M=3.03, SD=1.54; T2: M=3.23, SD=1.50, d=0.13) and for future time perspective (T1: M=3.61, SD=0.83; T2: M=3.54, SD=0.84, d=0.08) than those who remained in the longitudinal sample. However, the differences corresponded to very small effect sizes. Also, men had a higher dropout rate than women ($\chi^2(1)=10.87$, p=0.004), being 1.3 times more likely to drop out than women. For those participants who were excluded because of complete missings on relevant model variables at T1 (N=1,262), as opposed to participants with values on at least one model variable (N=2,890), there were no differences in terms of sex, marital status, or educational level.

Measures

Fruit and vegetable intake was assessed at baseline (T1) and 4 months (T2) later. Participants were asked how many portions of fruit (item 1) and vegetables (item 2) they had eaten on average per day in the last week (open-end format). Items were validated in numerous previous studies (e.g., [15]). For scale intercorrelations, means, standard deviations, and internal consistencies, see Table 1.

Intention and *planning* were measured at T1, both four-point Likert scales ranging from *not at all true* [1] to *exactly true* [4]. Intention consisted of a two-item scale validated in numerous previous studies (e.g., [15]). The items are “I intend to eat fruit and vegetables on a regular basis.” and “I intend to eat fruit or vegetables with meals or between meals.”

Planning was measured with a two-item scale [34]. One item addressed the question of what to eat, when to eat, and where to eat a particular fruit or vegetable. The other item measured coping planning, referring to the anticipation of potential barriers that might hinder the participant to consume fruits or vegetables, such as: “I have made a detailed plan on how to maintain fruit and vegetable intake despite other obligations or interests.”

Future time perspective was measured at T1 with a three-item version of a validated scale (derived from socioemotional selectivity theory: [35]) in a generic manner, independent of the behaviors under study. Responses were given on five-point scales ranging from *not at all true* [1] to *exactly true* [5]. The items were: “Many opportunities await me in the future,” “My future is filled with possibilities,” and “As I get older, I begin to experience time as being limited” (last item reverse-scored). Additionally, *sociodemographic variables* (age and gender) were assessed at T1.

Data Analysis

Structural equation models were used to specify direct, indirect, and conditional associations between age, future time perspective, intention, planning, and behavior. Single

Table 1 Study 1: intercorrelations and descriptive statistics for age, social–cognitive variables, and fruit and vegetable intake

	1	2	3	4	5	6	7
1. Age, in years							
2. Future time perspective T1	−0.48***						
3. Intention T1	0.05	0.18***					
4. Planning T1	0.11***	0.12***	0.64***				
5. Interaction	−0.11***	0.50***	0.60***	0.89***			
6. FV intake T1, portions per day	−0.11***	0.15***	0.43***	0.43***	0.43***		
7. FV intake T2, portions per day	−0.01	0.11***	0.37***	0.40***	0.35***	0.57***	
Mean	37.81	3.54	2.68	1.90	6.82	3.24	3.74
Standard deviation	13.05	0.83	0.87	0.91	3.85	1.51	1.63
Cronbach's alpha[a]	–	0.74	0.50[a]	0.79[a]	–	–	–

Study 1, N=909. Age range from 16 to 78 years

T1 time 1, *T2* time 2, *FV* fruit and vegetable

***p<0.001 (two-tailed)

[a] Pearson correlation (two items indicator). The interaction is represented by the product term of future time perspective T1×planning T1 on fruit and vegetable intake T2

indicators were specified for each construct. The models were evaluated based on recommended fit indices using Mplus 5.21 [36]. We report fully standardized β coefficients (stdyx standardization, see [36]), which uses the variances of the continuous variables as well as the variances of the background and outcome variables for standardization. Intention was specified to have an indirect effect on behavior via planning that served as the mediator (hypothesis 1). The interaction (hypothesis 2) is represented by the product term of the mediator variable (planning) and the moderator (future time perspective), whereas planning and future time perspective were included in the model to control for their linear effects. These linear effects were allowed to covary with the interaction term in the model specification. For the fruit and vegetable model (study 1), also all cross-sectional T1 predictors were allowed to covary, as there were large cross-sectional correlations. To identify the regions in the range of the moderator variable (future time perspective), where the effect of the focal predictor (planning) on behavior is statistically significant, Johnson–Neyman technique was used [37]. Prior to calculating the interaction term, the interacting predictor variable and the moderator were centered [38]. For the indirect effect of age on behavior, age was specified as a predictor of future time perspective, which, in turn, is supposed to predict behavior (hypothesis 3). According to the hypotheses, we restricted the two models to have no direct paths from age and intention to the behaviors.

Behavior scores larger than three standard deviations were truncated, and missing data (<5%) were considered using the full information maximum likelihood algorithm [36]. There were no differences between individuals with and without missings in terms of gender, chronological age, physical exercise, fruit and vegetable consumption, and social–cognitive variables. For both studies, the variance inflation factors (study 1: VIF=1.01, study 2: VIF=1.13) and the tolerance statistics (study 1: 1/VIF=0.99; study 2: 1/VIF=0.88) indicate that the variance of the parameter estimates is not inflated by multicollinearity to a critical degree.

Gender was tested as a covariate in all preliminary analyses, but as there were no gender effects, it was excluded from final analyses. Also *age* was included in the analyses as a covariate, but also to constitute the indirect path to behavior via future time perspective as stated in the third hypothesis.

Results

The hypothesized model (but with restricted direct paths from age and intention to fruit and vegetable intake) fit the data well (root mean square error of approximation (RMSEA)=0.02 [90% confidence interval (CI)=0.01, 0.07], standardized root mean square residual (SRMR)=0.01, Comparative Fit Index (CFI)=0.99, Tucker–Lewis Index (TLI)=0.99, $\chi^2(2)$=3.23, p=0.20; χ^2/df=1.62). For hypotheses testing and all further analyses, we have included the direct paths from age and intention to fruit and vegetable intake into the final model. Figure 1 displays the fully standardized [36] parameter estimates for all three hypotheses tested in one model. Table 2 shows unstandardized (B), standardized (β), and bootstrapped (B_{Boot}) model parameter estimates and standard errors. Of the fruit and vegetable intake variance, 35% was explained by the predictors (16% without baseline behavior). The indirect effect of intention on fruit and vegetable intake via planning (hypothesis 1) was β=−0.09 (S.E.=0.03, p=0.005). The

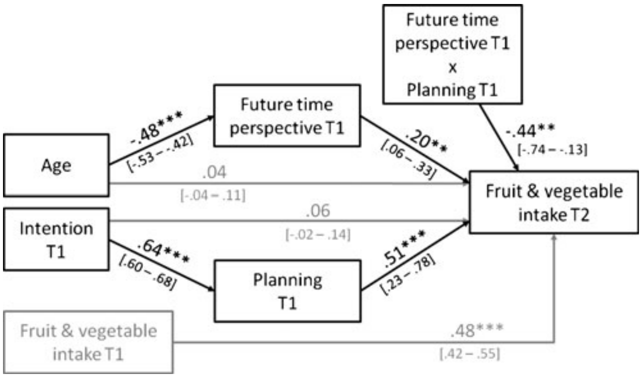

Fig. 1 Study 1: path model for predicting fruit and vegetable intake (N=909). **p<0.01; ***p<0.001. *T1* time 1, *T2* time 2. The interaction is represented by the product term of future time perspective T1×planning T1 on fruit and vegetable intake T2. Coefficients represent fully standardized values. The unstandardized interaction term coefficient is B=−0.06 (p=0.006). The indirect effect of intention is β=−0.09 (p=0.005); the indirect effect of future time perspective is β=0.32 (p< 0.001). The *numbers in brackets* represent the 95% confidence interval of the estimates

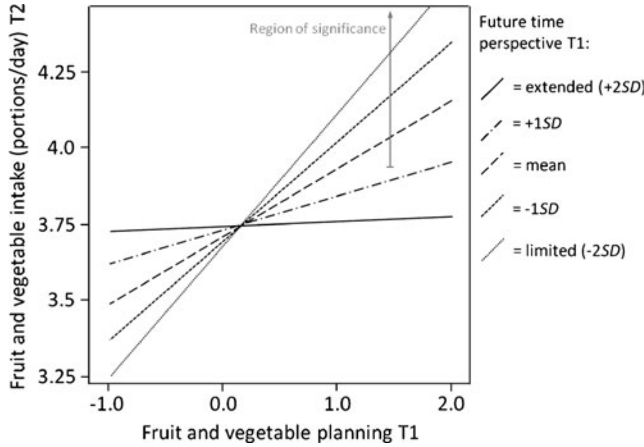

Fig. 2 Study 1: relation between fruit and vegetable specific planning and fruit and vegetable intake for three theoretical values of future time perspective (predictor variables mean centered prior to analysis). *T1* time 1, *T2* time 2. The region of significance defines the specific values of future time perspective at which the prediction of planning on fruit and vegetable intake is significant ($\alpha \leq 0.05$)

indirect effect of age on fruit and vegetable intake via future time perspective (hypothesis 3) was β=0.32 (S.E.=0.09, p< 0.001). Direct paths from age (β=0.04, S.E.=0.04, p=0.35) and from intention (β=0.06, S.E.=0.04, p=0.15) to exercise were nonsignificant. The interaction term (testing the moderation, hypothesis 2) was β=−0.44 (S.E.=0.16, p= 0.005 [B=−0.19, S.E.=0.07, p=0.005; B_{Boot}=−0.19, S.E.=0.07, p=0.006]), which is displayed in Fig. 2. The region of significance ($\alpha \leq 0.05$), where planning predicts fruit and vegetable intake significantly, ranges from future time perspective values of 1–4.01. For an extended time perspective above that value, the prediction is nonsignificant (see Fig. 2; for the mean centered scale which was used for the analyses and ranges from −2.53 to 1.47, the region of significance is −2.53–0.48). As hypothesized, the more a person's future time perspective is limited, the stronger the relation between planning and behavior. For persons with a limited time perspective, every planning increase is connected

Table 2 Study 1: unstandardized, standardized, and bootstrapped model coefficient estimates and standard errors

Path	Function	Unstandardized		Standardized		Bootstrapped[c]	
		Est.	S.E.	Est.	S.E.	Est.	S.E.
FTP T1 → FV T2	b path[a]	0.38**	0.14	0.20**	0.07	0.38**	0.14
PLA T1 → FV T2	b path[a]	0.91***	0.25	0.51***	0.14	0.91***	0.26
Inter → FV T2	Interaction effect, hypothesis 2	−0.19**	0.07	−0.44**	0.16	−0.19**	0.07
FV T1 → FV T2	Baseline control	0.52***	0.25	0.48***	0.03	0.52***	0.04
Age → FV T2	Direct effect	0.004	0.005	0.04	0.04	0.004	0.005
I T1 → FV T2	Direct effect	0.11	0.08	0.06	0.04	0.11	0.08
Age → FTP T2	a path[b]	−0.03	0.002	−0.48***	0.03	−0.03	0.002
I T1 → PLA T2	a path[b]	0.66***	0.03	0.64***	0.02	0.66***	0.03
Age → FTP T1 → FV T2	Indirect effect, hypothesis 3	−0.01**	0.004	−0.09**	0.03	−0.01**	0.004
I T1 → PLA T1 → FV T2	Indirect effect, hypothesis 1	0.60***	0.17	0.32***	0.09	0.60***	0.18

Study 2. Age range from 60 to 95 years

FV fruit and vegetable intake, *FTP* future time perspective, *PLA* planning, *I* intention, *Inter* interaction (product term of future time perspective T2×planning T2), *T1* time 1, *T2* time 2, *Est.* estimates, *S.E.* standard errors

**p<0.01; ***p<0.001 (two-tailed)

[a] Path between mediator and outcome as part of a mediation model

[b] Path between independent variable and mediator as part of a mediation model

[c] For bootstrapping estimates (resamples=5,000), unstandardized coefficients are reported

with a stronger increase in behavior than is the case in individuals with an extended future time perspective.

Study 2: Physical Exercise in Older Adults Over a Time Span of 6 Months

Method

Participants and Procedure

Study 2 focused on physical exercise in older adults over a time span of 6 months, with three measurement points in time (ethical guidelines were followed, and clearance from the ethics committee of the German Psychological Society was obtained). Inclusion criteria were being older than 60 years and not having a medical contraindication to perform physical exercise. Participants were recruited via newspaper announcements. After returning the informed consent form in June 2009, participants received questionnaires to measure social–cognitive variables as well as physical exercise levels via mail at baseline, 1 month, and 6 months later. At T1, 376 participants completed the questionnaire. The questionnaire 1 month later (T2) was answered by 304 participants (81% of baseline), whereas 289 participants completed the third questionnaire [time 3 (T3)] and constituted the longitudinal sample (77% of baseline). This sample comprised 139 women and 150 men, with a mean age of 66.6 years, SD=5.1, ranging from 60 to 95 years. A total of 94.6% had German as their mother tongue. In the longitudinal sample, 70.5% were married, 14.8% were divorced, 5.3% were single, and 9.4% were widowed. In terms of education, 65.6% had obtained a higher educational entrance qualification, 24.5% finished tenth grade, and 9.9% finished ninth grade.

Dropout analyses yielded no baseline differences between participants in the longitudinal sample and those who dropped out in terms of gender, age, marital status, educational degree, intention, planning, future time perspective, and physical exercise.

Measures

In study 2, *physical exercise* was assessed at baseline (T1) and 6 months later (T3). Based on the PAQ-50+ (adopted from [39]), participants reported the frequency and duration of physical exercise/sports over the last 7 days. Physical exercise at T1 averaged 0.65 h a day, SD=0.59 (at T3: M=0.59, SD=0.51).

Intention and planning were assessed specifically for physical exercise. Intention was measured at T1, planning at T2, with six-point Likert scales ranging from *not at all true* [1] to *exactly true* [6]. For scale intercorrelations, means, standard deviations, and internal consistencies of all variables, see Table 3.

Intention consisted of a two-item scale [40], with a mean of 5.6 (SD=0.85) and a correlation coefficient of r=0.72. An example item is “I intend to exercise on a regular basis.”

Planning was measured with a six-item scale [34], with a six-point response format, divided into action planning and coping planning. Action planning consisted of three items that asked participants when to exercise, where to exercise, and how to exercise. The other three items measured coping planning, referring to the anticipation of potential barriers that might hinder the participant to maintain physical exercise levels. An example item of coping planning is “I have made a detailed plan how to maintain physical activity despite other obligations or interests.” Factor analysis suggested a solution with one factor for all six items, collapsing action and coping planning (factor loadings between 0.78 and 0.90). Thus, all six items were used for a single aggregate score that had a mean value of 4.6 (SD=1.38) and an internal consistency of α=0.92.

Future time perspective was measured in a generic manner with the ten-item future time perspective scale (derived from socioemotional selectivity theory: [35]). Internal consistency was α=0.85, and responses were given on six-point scales with a mean value of 3.10 (SD=0.92), ranging from *not at all true* [1] to *exactly true* [6]. Sample items are “Many opportunities await me in the future,” and “As I get older, I begin to experience time as being limited (reverse-scored).”

The data analyses were done in the same way as in study 1.

Results

The hypothesized model (but with restricted direct paths from age and intention to physical exercise) fit the data well (RMSEA=0.04 [90% CI=0.01, 0.08], SRMR=0.05, CFI=0.99, TLI=0.99, $\chi^2(7)$=9.88, p=0.19, χ^2/df=1.41). For hypotheses testing and all further analyses, we have included the direct paths from age and intention to physical exercise into the final model, which fits the data equally well (RMSEA=0.05 [90% CI=0.00, 0.11], SRMR=0.04, CFI=0.99, TLI=0.99, $\chi^2(4)$=7.04, p=0.13, χ^2/df=1.76). Figure 3 displays the fully standardized [36] parameter estimates for all three hypotheses tested in one model. Table 4 shows unstandardized (B), standardized (β), and bootstrapped (B_{Boot}) model coefficient estimates and standard errors. Of the behavioral variance, 16% was explained by the predictors (7% without baseline behavior). The indirect effect of intention on physical exercise via planning (hypothesis 1) was β=0.20 (S.E.=0.10, p=0.05), whereas the indirect effect of age on physical exercise via future time perspective (hypothesis 3) was β=−0.20 (S.E.=0.09,

Table 3 Study 2: intercorrelations and descriptive statistics for age, social–cognitive variables, and physical exercise in older adults

	1	2	3	4	5	6	7
1. Age, in years							
2. Future time perspective T1	−0.31***						
3. Intention T1	0.02	0.14*					
4. Planning T1	−0.03	0.12*	0.36***				
5. Interaction	−0.19**	0.74***	0.32***	0.73***			
6. Physical exercise T1, h/day	0.16**	−0.01	0.19**	0.11*	0.09		
7. Physical exercise T3, h/day	−0.04	0.20***	0.23***	0.18**	0.22***	0.33***	
Mean	66.63	3.10	5.56	4.57	14.29	0.65	0.59
Standard deviation	5.10	0.92	0.85	1.38	6.43	0.59	0.51
Cronbach's alpha[a]	–	0.85	0.72[a]	0.92[a]	–	–	–

Study 2, N=289. Age range from 60 to 95 years. The interaction is represented by the product term of future time perspective T2×planning T2 on physical activity T3

T1 time 1, *T2* time 2, *T3* time 3

*$p<0.05$; **$p<0.01$; ***$p<0.001$ (two-tailed)

[a] Pearson correlation (two items indicator)

p=0.03). Direct paths from age (β=−0.02, S.E.=0.08, p=0.84) and from intention (β=0.11, S.E.=0.09, p=0.20) to exercise were nonsignificant. The interaction term (moderation, hypothesis 2) was β=−0.70 (S.E.=0.36, p=0.05 [B=−0.06, S.E.=0.03, p=0.05; B_{Boot}=−0.06, S.E.=0.05, p=0.21]) in the hypothesized direction (see Fig. 4). There are two regions of significance ($\alpha \leq 0.05$): Not only for a limited time perspective (values between 1 and 1.93) but also for an extended future time perspective (values between 4.71 and 6), planning predicts physical exercise significantly. For medium time perspective values (>1.93 and <4.71), the prediction is nonsignificant (see Fig. 4; for the mean centered scale which was used for the analyses and ranges from −2.07 to 2.83, the region of significance is −2.07–−1.25 and 1.54–2.83). The more an individual's future time perspective, the stronger the relation between planning and behavior. For persons with a limited time perspective, every increase in planning is connected with a strong increase in behavior. For individuals with an extended future time perspective, the level of behavioral performance is high regardless of their level of planning.

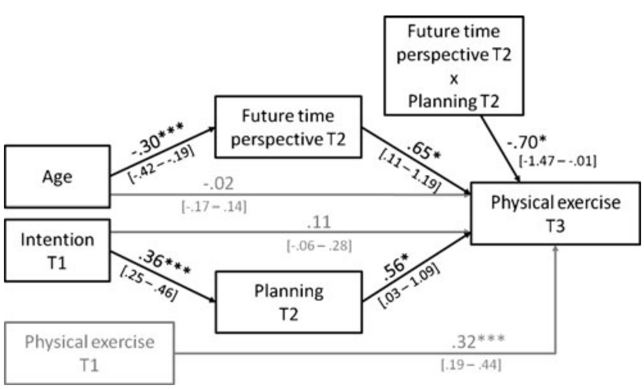

Fig. 3 Study 2: path model for predicting physical exercise (N=289). *$p<0.05$; ***$p<0.001$. *T1* time 1, *T2* time 2, *T3* time 3. The interaction is represented by the product term of future time perspective T2×planning T2 on physical activity T3. Coefficients represent fully standardized values. The unstandardized interaction term coefficient is B=−0.19 (p=0.05). The indirect effect of planning is β=0.20 (p=0.047), and the indirect effect of future time perspective is β=−0.20 (p=0.03). The *numbers in brackets* represent the 95% confidence interval of the estimates

General Discussion

The purpose of the two studies presented here was to investigate whether the self-regulatory processes for two health behaviors, namely fruit and vegetable intake and physical exercise, interact with future time perspective. The analyses have confirmed the mediation of the intention behavior relationship via planning (hypothesis 1) as found in previous studies [41]. Moreover, an interaction between future time perspective and planning emerged when predicting these health behaviors (hypothesis 2). In line with theoretical assumptions [9, 13], planning seems to compensate for a limited future time perspective. Additionally, chronological age affects health behaviors mediated by time perspective (hypothesis 3). This can help to better understand the psychological function of chronological and perceived age: In contrast to chronological age, future time perspective may be a possible target of interventions.

In both studies, intention was translated via planning into behavior. Intention and planning seem to rely on different mindsets and different levels of proximity to action, as planning is a construct with an executive character and

Table 4 Study 2: unstandardized, standardized, and bootstrapped model coefficient estimates and standard errors

Path	Function	Unstandardized		Standardized		Bootstrapped[c]	
		Est.	S.E.	Est.	S.E.	Est.	S.E.
FTP T2 → PE T3	b path[a]	0.36*	0.15	0.65*	0.27	0.36	0.24.
PLA T2 → PE T3	b path[a]	0.20*	0.10	0.56*	0.27	0.20	0.13
Inter → PE T3	Interaction effect, hypothesis 2	−0.06*	0.03	−0.70*	0.36	−0.06	0.05
PE T1 → PE T3	Baseline control	0.27***	0.05	0.32***	0.06	0.27**	0.09
Age → PE T3	Direct effect	−0.002	0.008	−0.02	0.08	−0.002	0.007
I T1 → PE T3	Direct effect	0.07	0.05	0.11	0.09	0.07	0.04
Age → FTP T2	a path[b]	−0.07***	0.01	−0.31***	0.06	−0.06***	0.01
I T1 → PLA T2	a path[b]	0.59***	0.10	0.36***	0.05	0.59***	0.14
Age → FTP T2 → PE T3	Indirect effect, hypothesis 3	−0.02*	0.009	−0.20*	0.09	−0.02	0.01
I T1 → PLA T2 → PE T3	Indirect effect, hypothesis 1	0.12*	0.06	0.20*	0.10	0.12	0.09

Study 2. Age range from 60 years to 95 years

PE physical exercise, *FTP* future time perspective, *PLA* planning, *I* intention, *Inter* interaction (product term of future time perspective T2× planning T2), *T1* time 1, *T2* time 2, *T3* time 3, *Est.* estimates, *S.E.* standard errors

*$p<0.05$; **$p<0.01$; ***$p<0.001$ (two-tailed)

[a] Path between mediator and outcome as part of a mediation model

[b] Path between independent variable and mediator as part of a mediation model

[c] For bootstrapping estimates (resamples=5,000), unstandardized coefficients are reported

more specific in linking cues to action, as opposed to intention. Studies on fruit and vegetable intake (e.g., [15, 16]) as well as on physical exercise (e.g., [14, 42]) confirmed a translation mechanism with planning as the mediator between intention and health behaviors. These studies have shown that planning is a feasible strategy to help people reach their aspired health behavioral goals [13].

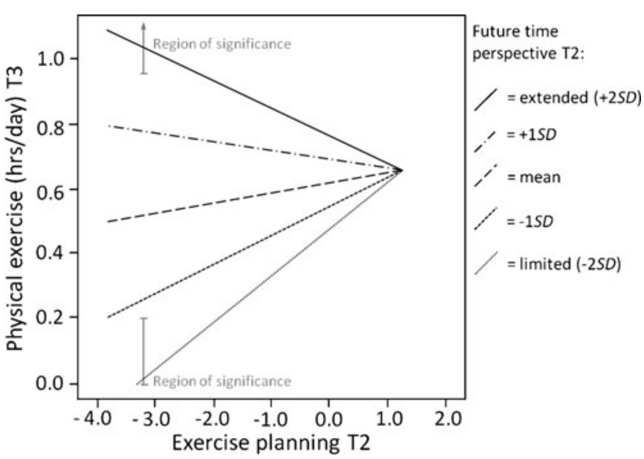

Fig. 4 Study 2: relation between exercise-specific planning and physical exercise for three theoretical values of future time perspective (predictor variables mean centered prior to analysis). *T2* time 2, *T3* time 3. The region of significance defines the specific values of future time perspective at which the prediction of planning on exercise is significant ($\alpha \leq 0.05$)

Also in line with our hypotheses is the interaction between future time perspective and planning. Planning appears to be an especially appropriate mediator for people with limited future time perspective. The more people perceive their future as being constrained, the stronger becomes the relationship between planning and behavior. In line with our theory, planning seems to operate as a compensatory strategy: It has been shown in previous studies that formation of plans can be a useful strategy to adopt and maintain a behavior, especially when deficits occur, such as in executive functioning, attention, or cognitive self-control (see [43]). In the context of physical exercise, Ziegelmann et al. [9] demonstrated the compensatory role of planning, but no equivalent findings for dietary behavior were reported so far.

One of the reasons for conducting a mediation analysis is to elucidate the mechanism by which an independent variable affects a dependent variable via a third variable [44]. In our studies, a mediation effect from chronological age on health behaviors via future time perspective transpired. With increasing age, future time perspective becomes more limited, which is negatively associated with levels of health behavior. In line with socioemotional selectivity theory [1], our studies provide evidence that differences in chronological age predict differences in future time perspective. These, in turn, predict health behaviors. Age-related changes in goal priorities (not age per se) seem to explain age-related changes in health behaviors [8].

Future time perspective by socioemotional selectivity theory is conceptualized in a broad manner that includes general possibilities of the personal future and expected time left in life. Therefore, in the current studies, time perspective is generic (conceptually and psychometrically) and serves as a more distal broad construct to different proximal and specific contexts, e.g., health self-regulation. For other research questions, different time perspective concepts that are adaptable to contexts or outcomes (e.g., exercise-specific time perspective) could constitute valuable tools to extend models of health behavior change.

A strength of our study is the derivation of hypotheses from a combination of theories of health behavior change and a lifespan approach, which constitutes not only a theoretical advance but may also have societal implications. Furthermore, we took advantage of two large longitudinal samples and were successful in replicating the evidence for two health behaviors.

Some limitations need to be addressed. First, data are based on self-reports. Although self-report measures of health behaviors are common in health behavior research, adding objective measures (as well as additional self-report variables to validate the self-report measures of behavior) in future studies would be appropriate [45]. Also, the chosen measure of future time perspective, although being common in lifespan research (e.g., [10]), is less frequently used in the context of health behavior change. Therefore, its potential limitation is less known. Second, the generalizability might be questionable due to data collection via internet and newspaper announcements. However, studies that address effects of data collection modes showed that an online questionnaire and an interview resulted in the same reports of frequencies of health behaviors [46]. As we used two samples with different age ranges and different data collection modes but received comparable results in both samples, we trust the validity of the instruments used. Third, the relationships found are based on theory or time lag. Future studies should test the findings by means of experimental manipulation.

In summary, the present research shows that future time perspective has direct mediating and moderating effects on health behaviors in a sample of older adults (i.e., 60–95 years) and in a sample with a broader range of over the lifespan (i.e., 16–78 years). This highlights that human striving toward goals and actions is temporally framed and accomplished in a temporal context [1].

Subsequent research should include explicit concepts of future time perspective. As chronological age per se is not an explanatory variable for age-related motivational changes, future time perspective could partially fill this gap. Moreover, not age itself but the psychological concept of future time perspective can be targeted by interventions [9, 28]. It also might be a fruitful approach to work out temporal facets inherent in other constructs, such as distinguishing between short- and long-term goals, plans, or outcome expectancies to refine theories and interventions. Especially in persons with a limited future time perspective, for example, older adults with physical impairments, planning could compensate for the motivational deficits that come with such conditions. Furthermore, researchers should focus on conducting interventions on future time perspective, as demonstrated by Hall and Fong [28], to examine the causal pathways and to improve current health behavior change approaches by adding temporal components.

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