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Adherence to physical and mental activity interventions: Coping plans as a mediator and prior adherence as a moderator

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Objective. Adherence to behavioural intervention programmes is a necessary condition for beneficial outcomes to be achieved. This study tested whether social cognitive variables and coping plans predict adherence.

Design and methods. Adherence was examined in a randomized controlled trial with healthy older women (age range: 70–93 years), who were randomized to a physical ($N = 86$) or a mental ($N = 85$) activity intervention. Intentions, self-efficacies, coping plans, and objectively measured adherence levels were assessed. A moderated mediation analysis evaluated the power of coping plans to translate intention into behaviour, depending on levels of prior adherence.

Results. Adherence to the physical activity programme (65%) was significantly lower than adherence to the mental activity programme (84%, $p < .001$). Intentions ($\beta = .22$) weakly predicted adherence in the initiation period of the physical activity programme (6 weeks); pre-action self-efficacy predicted adherence in the initiation period of the mental activity programme ($\beta = .35$). In both groups, coping plans predicted mid-period adherence (10 weeks) and long-term adherence (20 weeks), moderated by prior adherence (all ps $< .01$). Coping plans mediated the relationship between intentions and behaviour only in the exercise condition.

Conclusions. Instructing older individuals to generate coping plans facilitated their adherence to physical and mental activity programmes. This effect was larger for participants with lower levels of prior adherence – and may have prevented them from dropping out of the programme.

According to the health action process approach (HAPA; Schwarzer, 2008), people who are motivated to perform either physically or mentally demanding activities as part of a health promotion study are in a post-intentional volition process; they already

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have formed an intention to act. Most theories identify intentions as the immediate determinant of behaviour (Webb & Sheeran, 2006). However, intentions often fail to account for sufficient variance in behaviour, a phenomenon known as the intention–behaviour gap.

Specifying when, where, and how an action is to be performed – that is, making 'implementation intentions' (Gollwitzer, 1999) – is known to facilitate the initiation of health behaviours (Leventhal, Singer, & Jones, 1965). In randomized controlled trials (RCTs) involving standardized group training programmes, participants are necessarily given detailed instructions on *when* and *where* to perform the activities – only then are study outcomes comparable. The provision of this structured environment may help intenders to furnish their intentions with action plans on when, where, and especially on *how* to get started.

During an intervention, self-regulatory skills and strategies are needed to translate intentions into behaviour, to shield one's goal pursuit from distractions, and to maintain the desired behaviour. Perceived self-efficacy and post-intentional constructs, such as coping planning, have been identified as important mediators and moderators in bridging this intention–behaviour gap (Gutiérrez-Doña, Lippke, Renner, Kwon, & Schwarzer, 2009; Luszczynska *et al.*, 2010; Schwarzer *et al.*, 2007). Risk perception and positive outcome expectancies in concert with perceived self-efficacy contribute substantially to forming an intention. However, self-efficacy beliefs are relevant at all stages in the process of health behaviour change (Bandura, 1997). Persons high in pre-action self-efficacy (also called task or action self-efficacy) are more likely to initiate a new behaviour (Schwarzer & Luszczynska, 2008), and maintenance self-efficacy (also called coping self-efficacy) plays an important role in ensuring adherence to the new behaviour, especially when the task proves to be complex (Scholz, Sniehotta, & Schwarzer, 2005).

In a recent study with older women (Klusmann *et al.*, 2010), a 6-month physical or mental activity intervention was found to have positive effects on cognition. In this article, we analyse adherence data from this study. The participating women, who had volunteered to adopt a new behaviour, were assumed to be in a post-intentional stage. We expected that intentions and self-efficacy beliefs would be essential for the initiation and performance of the required behaviours in the initiation period of the intervention programme. Accordingly, we hypothesized:

> *Hypothesis 1*: Intention, pre-action self-efficacy, and maintenance self-efficacy predict adherence to a physical or mental activity intervention during the initiation period.

People participating in a 6-month intense intervention programme are likely to face certain obstacles and may lack confidence in persevering and completing the programme. The mental anticipation of critical situations (if-condition), combined with the preparation of detailed plans on how to cope with those obstacles (then-condition), has been found to be an effective means of facilitating goal pursuit (Scholz, Schüz, Ziegelmann, Lippke, & Schwarzer, 2008; Sniehotta, 2009). The if-condition may involve internal cues (e.g., feeling tired) or external cues (e.g., holiday plans). The subsequent then-component can take many different forms, such as ignoring the cue, planning a specific response, or suppressing responses that prevent goal attainment (Gollwitzer & Sheeran, 2006). This self-regulation strategy is known as coping planning (Sniehotta, Scholz, & Schwarzer, 2006; Sniehotta, Schwarzer, Scholz, & Schüz, 2005) or 'mental contrasting with implementation intentions (MCII)', a term recently used by Bargh,

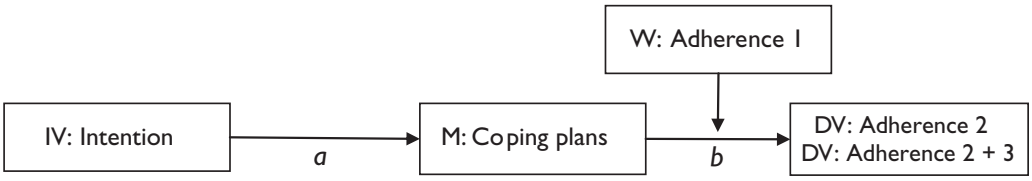

Figure 1. Hypothesized structure of the moderated mediation model. The indirect effect of intention on mid-period adherence (Adherence 2) and long-term adherence (Adherence 2 + 3) via coping plans is moderated by prior adherence (initiation period, Adherence 1).

Gollwitzer, and Oettingen (2010). Coping planning can help to further close the intention–behaviour gap (Arbour-Nicitopoulos, Ginis, & Latimer, 2009) and planning measures can be conveniently implemented in an intervention.

We expected the formulation of coping plans to have particular benefits for individuals with lower levels of initial adherence. Participants who have already performed the desired behaviour regularly in the weeks *before* the request to plan presumably do not have self-regulatory deficits and may already have developed appropriate strategies to cope with any obstacles occurring. In this case, past behaviour would have a direct effect on future behaviour (Conner & Armitage, 1998). In contrast, participants who have not yet implemented the new behaviour in their daily routine may benefit from being instructed to draw up coping plans (Ziegelmann & Lippke, 2007). In this case, past behaviour would be a moderator (Norman, Conner, & Bell, 2000) of the relationship between coping plans and future behaviour (van Osch *et al.*, 2010). Accordingly, we hypothesized:

> *Hypothesis 2*: Coping plans mediate the relationship between intention and mid-period and long-term adherence; mediation depends on prior adherence (*moderated mediation*, see Figure 1).

Method

Participants and procedure

In a study designed to improve cognitive fitness in older women, 171 German-speaking women aged 70 years or older from Berlin, Germany, participated in one of two intervention programmes. The interventions each ran for a 6-month period and involved three weekly 90-min standardized training sessions in physical exercise or computer skills (Klusmann *et al.*, 2010). Participants were recruited by advertisements in newspapers and on public transport or through flyers. Prior to randomization, participants were screened to rule out cognitive impairment, depression, or other neurological or medical diseases that would affect cognitive performance or course participation. Further eligibility criteria were exercising for less than 1 hr per week and being unfamiliar with computers. Participants in the passive control group ($N = 76$) were instructed to act as usual. Their cognitive fitness outcomes are analysed elsewhere (Evers, Klusmann, Schwarzer, & Heuser, 2011; Klusmann *et al.*, 2010).

A total of 86 women were allocated to and started the physical exercise course ($M_{age} = 73.7$ years, $SD = 4.1$, age range: 70–90) and 85 women started the computer course ($M_{age} = 73.5$ years, $SD = 4.4$, age range: 70–93). About one third of the participants in each group were widowed; 28% of the exercise group and 16% of the computer group were married.

Table 1. Means, standard deviations, and intercorrelations between study variables for the two experimental groups

	1	2	3	4	5	6	7	8	9	10	11	*M*	*SD*
Intention	–	.53***	.38***	.35**	.33**	.19	.22*	.22*	.08	−.06	−.11	6.29	1.37
Pre-action self-efficacy	.64***	–	.50***	.31**	.32**	.08	.16	.13	−.01	−.08	−.04	3.62	0.51
Maintenance self-efficacy	.32**	.46***	–	.09	.17	.10	.11	.11	.02	−.01	.03	3.68	0.41
Coping plans	−.14	.00	−.04	–	.34**	.48***	.40***	.46***	−.02	.05	−.07	1.30	1.17
Adherence 1	.22*	.33**	.10	.17	–	.67***	.63***	.69***	−.11	.04	−.00	70.6	27.1
Adherence 2	.09	.26*	.20	.33**	.57***	–	.76***	.92***	−.02	.04	−.03	66.2	32.0
Adherence 3	.03	.10	.09	.35**	.30**	.71***	–	.95***	−.05	−.02	.03	60.3	36.7
Adherence 2 + 3	.06	.19	.16	.37**	.46***	.91***	.94***	–	−.04	−.00	.01	63.2	32.4
Age	.09	−.01	−.02	−.25*	.08	.00	−.10	−.06	–	−.02	−.12	73.7	4.1
Income	.16	.17	.16	.01	.05	−.07	−.01	−.04	.08	–	.19	4.2	1.1
Years of education	−.01	.11	.05	.09	.18	.05	.03	.05	−.10	.28**	–	11.8	2.5
M	6.27	3.56	3.69	1.89	86.6	85.5	81.0	83.1	73.5	4.1	12.1		
SD	1.31	0.49	0.39	1.09	20.8	24.6	25.5	23.1	4.4	1.1	2.6		

Note. Intercorrelations for the exercise group ($N = 86$) are presented above the diagonal; intercorrelations for the computer group ($N = 85$), below the diagonal. Means and standard deviations for the exercise group are presented in the vertical columns; means and standard deviations for the computer group, in the horizontal rows. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

The standardized intervention programme was conducted in groups of about 12 women in different locations throughout Berlin, Germany. During the 26-week intervention, on average 73 course units (range 70–74 units) were offered to a total of seven groups in each condition. Participants in each group were provided with a schedule specifying exactly when and where their sessions would be held. The seven groups in each condition started the intervention successively.

Motivational and volitional variables and socio-economic status (marital status, income, education in years) were assessed prior to randomization (T1) in a face-to-face interview. Coping plans were assessed in a postal survey after 6 weeks (T2; after about 18 course units). A cover letter instructed all participants to write down up to three possible barriers that might hinder their course participation and to formulate coping plans to overcome those barriers and continue participation. Participants were asked to return the coping planning sheet in a pre-paid envelope. Additionally, they were asked to copy their anticipated barriers and plans onto an additional sheet and to keep this as a reminder. We used code numbers instead of participants' names to ensure anonymity.

After 16 weeks (T3, after about 45 course units), all active participants (i.e., those who had not withdrawn since T2: exercise group $n = 79$, computer group $n = 83$) received a standardized feedback letter to encourage their further course participation. Additionally, memory and concentration self-ratings were assessed, as reported elsewhere (Klusmann, Evers, Schwarzer, & Heuser, 2011).

Objective measures of adherence were obtained after each measurement point: at the end of the initiation period (6 weeks), the mid period (10 weeks), and the final period (10 weeks). Means, standard deviations (*SDs*), and intercorrelations for both intervention groups are displayed in Table 1.

Measures

Adherence, defined as the number of course units attended, was recorded by all trainers for each participant in each course unit. Additionally, trainers recorded reasons for non-adherence, such as illness, holidays, appointments (e.g., doctor's appointments, family commitments), or unknown reasons. The number of course units in each of the three periods (initiation, mid, and final) varied slightly across the groups due to organizational and external reasons. The variables *Adherence 1* (initiation period), *Adherence 2* (mid period), and *Adherence 3* (final period) are the ratios of course units attended to course units offered in each period in percent. *Adherence 2 + 3* is the ratio of course units attended to course units offered over the mid *and* final period (20 weeks) in percent (i.e., 'long-term adherence').

Participants were asked about their own monthly income in euro, with responses made on a five-point scale ranging from 1 = 'below €500' to 5 = 'more than €1.100'. Social cognitive variables on the basis of the HAPA model (intentions, pre-action self-efficacy, and maintenance self-efficacy) were measured prior to randomization at T1. The example items given below are translations from the German.

Intentions were measured by two items on a seven-point scale ranging from 1 (*not at all true*) to 7 (*exactly true*). The stem 'I intend to attend . . . ' was followed by (1) ' . . . the exercise programme for 90 minutes three times per week' and (2) ' . . . the computer programme for 90 minutes three times per week' ($r = .02$). Only the item consistent with the course to which the participant was allocated was included in the analyses.

Pre-action self-efficacy, referring to participants' optimistic beliefs to participate in the course and perform the required novel behaviour, was assessed using the stem 'I am confident that I can bring myself to participate in the exercise course' followed by four items such as '. . . even if I haven't done this activity before' or '. . . even if I find it exhausting' (Cronbach's $\alpha = .73$). The same four items were used with the stem 'I am confident that I can bring myself to participate in the computer course' (Cronbach's $\alpha = .80$). Only the items consistent with the course to which the participant was allocated were included in the analyses.

The *maintenance self-efficacy* items were prompted by the following introduction: 'Please imagine you have participated in the course for a certain amount of time. It is now important to continue participating regularly three times a week for 90 minutes. How confident are you that you will succeed in participating in your course three times a week for 90 minutes?' The item stem 'I am confident that I will succeed . . . ' was followed by four items such as '. . . even if I would prefer to be doing something else' or '. . . even if it costs me quite some effort every time' (Cronbach's $\alpha = .73$). Consistent with the approach taken by Scholz *et al.* (2005), responses to the self-efficacy scales were given on a four-point scale ranging from (1) *not at all true* to (4) *exactly true*. As all measurements were obtained in face-to-face assessments, there were no missing data.

Coping plans were measured as a continuous variable, with one point being awarded for each coping plan formulated. The same coping plan reported for different barriers was counted only once. Examples of coping plans are motivational self-instructions, emotional control, and use of resources (aids, skills, or persons). Women who only reported barriers or who did not return the planning sheet (exercise course: $n = 7$; computer course: $n = 4$) were coded as zero on coping plans.

Statistical analyses

All statistical analyses were conducted separately for the two groups. To test the first hypothesis (*H1*), we conducted multiple hierarchical regression analyses predicting

adherence in the initiation period (Adherence 1), with intention being entered in the first step and pre-action self-efficacy and maintenance self-efficacy in the second step.

To test the second hypothesis (*H2*) in moderated mediation analyses (Figure 1), we used an IBM-SPSS macro (MODMED macro Model 3, Version 2:2) provided by Preacher, Rucker, and Hayes (2007). The macro tested whether coping plans mediated the relationship between intention and behaviour, while, at the same time, testing for a moderated mediation path in which Adherence 1 and coping plans moderated each other's effects on Adherence 2 (Adherence 2 + 3) (moderation of path *b*).

Coefficients were estimated in two regression analyses. First, coping plans (mediator, M) were regressed on intention (IV; mediator variable model). Second, in a multiple regression, Adherence 2 (Adherence 2 + 3) (DV) was predicted from intention (IV), coping plans (M), Adherence 1 (moderator, W), and the interaction between coping plans and Adherence 1 (M × W). A significant interaction of coping plans and Adherence 1 (M × W) would indicate moderated mediation, which describes the strength of the relationship between the mediator and the dependent variable.

Predictor variables were standardized to obtain a common metric and *B* coefficients were interpreted in the analyses of moderated mediation. To verify the conditional indirect effects derived from normal-theory tests, we computed bootstrap confidence intervals from 5,000 bootstrap resamples (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2004).

Results

Social cognitive predictors and coping plans

Table 1 shows that both intervention groups reported equally strong intentions to participate regularly in the course to which they were randomized, $t(169) = .098$, $p = .922$, with mean scores of above 6 on a scale ranging from 1 to 7. Likewise, average self-efficacy beliefs in both groups were above 3.5 on a scale ranging from 1 to 4. Thus, the results indicated high positive motivation in both intervention groups.

The exercise group formulated an average of 1.3 coping plans ($SD = 1.2$, range 0–4), which was significantly fewer than the average of 1.9 plans ($M = 1.9$, $SD = 1.1$, range 0–4) formulated by the computer group, $t(169) = -3.4$, $p < .01$).

Adherence data

Average participation in the exercise course was 70.6% in the first 6 weeks (initiation period, Adherence 1), 66.2% in the following 10 weeks (mid period, Adherence 2), and 60.3% in the last 10 weeks (final period, Adherence 3). Long-term adherence (Adherence 2 + 3, 20 weeks) was 63.2%.

Average participation in the computer course was 86.6% in the initiation period, 85.5% in the mid period, and 81.0% in the final period. Long-term adherence was 83.1% (see Table 1).

For both groups, dependent *t*-tests revealed that average adherence remained stable from initiation to mid period (all *p*s > .05), but significantly decreased from mid to final period (all *p*s < .05). Overall, 26-week participation in the exercise course (65.2%, $SD = 29.3$) was significantly lower than in the computer course (83.8%, $SD = 20.7$), $t(153) = -4.79$, $p < .001$.

Participants in the exercise group missed more course units for reasons of illness (7.4 units, $SD = 12.8$, range 0–55) than did participants in the computer group

Table 2. Physical activity course adherence: regression results for the conditional indirect effect of intention on Adherence 2 (Adherence 2 + 3) via coping plans

	Mediator variable model, DV: Coping plans			
Predictor	*B*	*SE*	*t*	*p*
Constant	.00	.10	0.00	1.000
Intention[a]	.35	.10	3.41	.001
	Dependent variable model, DV: Adherence 2 (Adherence 2 + 3)			
Constant	.09 (.08)	.08 (.08)	1.14 (1.01)	.257 (.314)
Intention[a]	−.13 (−.08)	.08 (.08)	−1.64 (−1.08)	.104 (.285)
Coping plans[a]	.35 (.30)	.08 (.08)	4.31 (3.79)	<.001
Adherence 1[a]	.49 (.52)	.09 (.09)	5.56 (5.95)	<.001
Coping plans × Adherence 1	−.26 (−.23)	.09 (.09)	−3.08 (−2.73)	.003 (.008)

Note. $N = 86$. Standardized regression coefficients are reported; results for long-term adherence are presented in parentheses.
[a]Variables were standardized prior to analyses.

(1.7 course units, $SD = 5.8$, range 0–43), $t(119) = 3.8$, $p < .001$. Similarly, participants in the exercise course missed more course units due to appointments (8.4 course units, $SD = 8.0$, range 0–41) than did participants in the computer course (5.1 course units, $SD = 9.3$, range 0–64), $t(169) = 3.5$, $p < .05$. The two groups did not differ in the number of course units missed due to holidays.

Testing hypothesis 1

Physical activity course adherence

Results of multiple hierarchical regression analyses revealed that intention predicted adherence to the physical activity course during the initiation period ($\beta = .33$, $p < .01$). This relationship was slightly reduced ($\beta = .22$, $p = .075$) when pre-action self-efficacy ($\beta = .21$, $p = .12$) and maintenance self-efficacy ($\beta = -.02$, $p = .89$) were included in the analysis in the second step. Overall, the model accounted for 10% of the variance in Adherence 1.

Mental activity course adherence

Intention was again a significant predictor in the first step of the analysis ($\beta = .22$, $p = .045$). However, pre-action self-efficacy ($\beta = .35$, $p = .02$) proved to be the only significant predictor in the second step (maintenance self-efficacy: $\beta = -.07$; intention: $\beta = .13$, all ps $> .05$). Together, the three predictors accounted for 8% of the variance in Adherence 1.

Testing hypothesis 2 (moderated mediation)

Physical activity course adherence

Results of the first regression analysis showed that intention ($B = .35$, $p = .001$; Table 2, mediator variable model) predicted coping plans in the physical activity course. In the second regression analysis, coping plans significantly predicted Adherence 2

Table 3. Mental activity course adherence: regression results for the conditional indirect effect of intention on Adherence 2 (Adherence 2 + 3) via coping plans

	Mediator variable model, DV: Coping plans			
Predictor	*B*	*SE*	*t*	*p*
Constant	.00	.11	0.00	1.000
Intention[a]	−.14	.11	−1.27	.209
	Dependent variable model, DV: Adherence 2 (Adherence 2 + 3)			
Constant	.05 (.03)	.08 (.09)	0.55 (0.35)	.582 (.731)
Intention[a]	.08 (.07)	.09 (.10)	0.92 (0.71)	.360 (.480)
Coping plans[a]	.23 (.30)	.08 (.09)	2.80 (3.19)	.007 (.002)
Adherence 1[a]	.34 (.27)	.10 (.11)	3.45 (2.45)	<.001 (.016)
Coping plans × Adherence 1	−.27 (–.19)	.07 (.08)	−3.71 (−2.32)	<.001 (.023)

Note. $N = 85$. Standardized regression coefficients are reported; results for long-term adherence are presented in parentheses.
[a]Variables were standardized prior to analyses.

($B = .35$, $p < .001$), whereas intention had no direct effect on Adherence 2 ($p = .10$). In other words, the intention–adherence relationship was fully mediated by coping plans. As hypothesized, Adherence 1 also predicted Adherence 2 ($B = .49$, $p < .001$) and the interaction with coping plans was significant ($B = -.26$, $p = .003$). The full model explained about 56% of the variance in Adherence 2.

We calculated conditional indirect effects at three levels of Adherence 1 (mean and ±1 *SD*) by estimating a 95% bias-corrected bootstrap confidence interval (MacKinnon *et al.*, 2004; see Table 4). The indirect effect was positive, and its strength increased as Adherence 1 decreased, that is, the lower the level of Adherence 1, the stronger the effect of coping plans. No indirect effect was found for women in the exercise condition who were already highly adherent in the initiation period (+1 *SD*; about 98%).

Mental activity course adherence

In contrast, intention did not predict coping plans in the computer course ($B = -.14$, $p = .21$; Table 3, mediator variable model). The second regression analysis predicting Adherence 2 showed that coping plans had a significant effect on Adherence 2 ($B = .23$, $p = .007$) and that the effect of intention was non-significant. Thus, in contrast to our hypothesis, the intention–adherence relationship was not mediated by coping plans (Table 4).

As hypothesized (*H2*), Adherence 1 predicted Adherence 2 ($B = .34$, $p < .001$) and the interaction with coping plans was significant ($B = -.27$, $p < .001$). The full model explained about 45% of the variance in Adherence 2.

We probed the interaction using the Johnson–Neyman technique with an SPSS macro provided by Hayes and Matthes (2009). The conditional effect of coping plans was significant ($p < .05$) when Adherence 1 was below 91.46%.

The analyses for long-term adherence produced the same pattern of findings for *both* courses (results presented in parentheses in Tables 2, 3, and 4), although, for the mental activity group, the conditional effect of coping plans was weaker (i.e., significant when

Table 4. Estimated conditional indirect effects (point and 95% bias-corrected bootstrap confidence interval estimates with 5,000 bootstrap resamples) on Adherence 2 and Adherence 2 + 3

	Physical activity		Mental activity	
	Estimate	95% BC CI	Estimate	95% BC CI
Adherence 1				
		.120 to .346		−.194 to .028
−1 *SD*	.21* (.19*)	(.101 to .293)	−.06 (−.06)	(−.206 to .030)
		.059 to .204		−.111 to .007
Mean	.12* (.11*)	(.053 to .183)	−.03 (−.04)	(−.134 to .007)
		−.036 to .108		−.031 to .058
+ 1SD	.03 (.02)	(−.031 to .101)	.00 (−.01)	(−.107 to .015)

Note. BC CI = Bias-corrected confidence interval. Results for long-term adherence are presented in parentheses. *Different from zero, as zero is not included in the confidence interval.

Adherence 1 was below 96.98%) and less variance in long-term adherence was explained ($R^2 = .31$).[1]

Discussion

This article sought to predict the objectively measured adherence of older women to two intervention programmes – one physical and one mental – of comparable frequency and duration. Social cognitive variables and the potentially beneficial effects of coping plans were investigated.

Both interventions had beneficial effects: participants in both the computer course and the exercise course showed meaningful improvements in episodic memory (word list and story recall) and executive function (Reitan Trail Making Tests B/A) (Klusmann *et al.*, 2010). Women's individual adherence defined in terms of *the time spent on course participation* predicted cognitive performance (Evers *et al.*, 2011). This variable included time spent travelling to and from the course, which was expected to be a barrier to participation. Further obstacles were addressed in a coping planning instruction, the effect of which was analysed in this article.

Findings on adherence over 26 weeks revealed that women in the physical activity condition were significantly less adherent than were women in the mental activity condition. Analyses of social cognitive predictors showed a significant effect of intention, but only in the physical activity condition. In the mental activity programme, pre-action self-efficacy emerged as the only significant predictor when intention was controlled, but during the initiation period only. Contrary to our hypothesis, maintenance self-efficacy had no influence. Significant correlations were observed between intention and pre-action self-efficacy (.53–64), as well as between pre-action and maintenance self-efficacy (.46–.50); however, the tolerance statistics gave no cause for concern (all values above

[1] *There were seven groups in each intervention condition. With the exceptions of age and coping self-efficacy, no significant group differences were found in socio-economic status, baseline performance, or social cognitive variables. We reran the moderated mediation analyses with age and maintenance self-efficacy as covariates. The standardized regression coefficients and p values were all similar, with differences only in the second decimal. We would like to thank an anonymous reviewer for raising the issue of clustered data.*

.5). Araújo-Soares, McIntyre, and Sniehotta (2009) reported similar indications of shared variance between intention and self-efficacy beliefs.

Coping plans facilitated adherence in both conditions. The more coping plans were reported, the more likely the participant was to attend the course sessions. Likewise, Stadler, Oettingen, and Gollwitzer (2009) found a positive effect of coping planning in an intervention designed to increase physical activity in women.

How can this effect be explained? Mental contrasting with if-then statements (*if* an obstacle X occurs, *then* I'll do Y) creates a strong commitment to goal attainment and establishes a strong cue–response linkage (Bargh *et al.*, 2010). This mechanism by which implementation intentions facilitate goal attainment is explained by two simultaneously operating components: cue accessibility and the strength of the cue–response link (Webb & Sheeran, 2008).

In our study, we can assume that the anticipated obstacles were highly activated in both activity groups throughout the programme. The programme was novel and challenging to participants, and obstacles were likely to occur. The return rate of completed planning sheets was very high (94%). On average, both groups reported 2.5 barriers, indicating that obstacles were easy to detect. However, the number of coping plans differed between the two groups and accounted for the prediction of adherence. Coping plans thus presumably established a strong link between the highly accessible situation and the planned response. Based on the results of Webb and Sheeran (2008) and Bargh *et al.* (2010), we conclude that high goal commitment, easy detection of obstacles, and their strong linkage with planned responses accounted for the beneficial effect of our planning measure.

Why did women in the exercise course formulate significantly fewer coping plans than women in the computer course? Physical ailments seem to have posed a higher barrier to adherence in the exercise course than in the computer course. It seems likely that high travel activity is more challenging if the course itself is physically demanding (Evers *et al.*, 2011). Additionally, participants in the computer course generated more plans to facilitate their continuation of the programme after absences (e.g., due to illness or planned appointments), such as catching up on missed course units with the help of other participants. In contrast, participants in the physical exercise condition did not anticipate a need to catch up with other participants.

Goal contents are a another possible explanation: goal attainment is more likely if goal intentions are framed as *learning* goals, which involve acquiring new knowledge and developing new competencies, than if they take the form of *performance* goals, which focus on performing well to avoid appearing incapable (Elliott & Dweck, 1988; Latham & Brown, 2006; Locke & Latham, 2006). For people pursuing learning goals, negative outcomes provide valuable information that can offer strategies for improvement and – especially important to our study – for continued course attendance. For people pursuing performance goals, in contrast, negative feedback is likely to be interpreted as signalling failure and is more likely to be attributed to a stable factor of low abilities, resulting in withdrawal of time and effort (Grant & Dweck, 2003).

We can assume that women in the computer condition framed their intentions to participate as a learning goal. Indeed, a weekly quiz provided regular feedback on learning progress in the computer course, whereas the physical exercise course involved no such controls. We can further infer that the quizzes facilitated open communication and the exchange of valuable information with others in the computer course, as reported by Poortvliet, Janssen, Van Yperen, and Van de Vliert (2007). These authors found that people pursuing performance goals are oriented towards exploitation

(i.e., seek to enhance their status relative to others) and are less open to communication. This sharing of information may have helped women in the computer group to create more coping plans and strategies to facilitate their continued participation in the face of barriers.

Past behaviour (Adherence 1) was found to predict future behaviour (Adherence 2), as also found in the review by Conner and Armitage (1998). However, in our analyses, the key component of the HAPA model (Schwarzer, 2008) – the volitional construct of coping plans – explained variance in future behaviour over and above past behaviour. Coping plans thus positively influenced adherence to a physically or mentally demanding activity by means of the mechanism described above. In the field of physical activity, Renner, Spivak, Kwon, and Schwarzer (2007) argued that the HAPA model was especially applicable to a middle-aged adult sample. Our results extend these findings, showing that the volitional construct of coping plans explained adherence to two different health behaviours in a sample of women aged 70 years and older.

The moderating role of past behaviour has also been discussed in terms of the relationship between perceived behavioural control and behaviour, for example (Norman & Conner, 2005; Norman *et al.*, 2000). The results of van Osch *et al.* (2010), who found that planning of strategies influenced goal behaviour (here, fruit consumption) only in individuals with middle or low levels of past behaviour, are in line with our findings. In our study, coping plans preferentially benefited those participants with moderate to low adherence in the initiation period. These findings indicate that a coping plan instruction can also be used to counteract non-adherence during ongoing activity programmes.

A closing of the intention–behaviour gap was observed in the physical exercise condition only; intention had no influence on behaviour in the computer condition. Here, intention may be necessary to initiate the new behaviour, but replaced by self-efficacy beliefs when this behaviour is to be repeated. This point has also been discussed by Araújo-Soares *et al.* (2009). In our study, self-efficacy beliefs, which were assessed before the interventions started, predicted short-term adherence. We can assume that, although they were novices in the learning context, older individuals were able to draw on their lifelong experience and previous knowledge, which strengthened their self-efficacy beliefs.

Limitations

Inconsistent results have been reported by studies predicting future performance from both past performance and self-efficacy (Bandura & Locke, 2003; Heggestad & Kanfer, 2005); the predictive influence of each variable was found to increase or decrease depending on how past performance was operationalized. Wood and Bandura (1989) argued that behaviour and self-efficacy are bidirectionally related and that the prior contribution of self-efficacy to variance in past behaviour should therefore be partialled out. According to Heggestad and Kanfer (2005), applying this procedure yields results indicating an increased influence of self-efficacy on current performance. They also point out that over-adjustment is likely to occur in this 'residual past performance model'. In this article, we did not adjust past behaviour for the influence of self-efficacy. Consequently, our results of unadjusted past behaviour scores are interpretable in a straightforward manner.

In the present study, the intervention was carried out in seven groups in each condition (physical and mental). Therefore, intervention effects may be found due to reasons not experimentally controlled for, for example, seasonal effects, trainer characteristics,

or location of training sites, which increases the sample size requirements. However, a *post hoc* power analysis using G*power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) fixing $\alpha = .05$ results in an actual power of 0.95 and a calculated sample size of only 50 participants in each condition. Future research may control for levels of data clustering by analysing data, for example, within the framework of structural equation modeling (SEM).

Coping plans were examined within an RCT designed to analyse the potentially beneficial effects of two interventions (one physical and one mental) on cognitive performance. A control group within the activity groups would have been appropriate to analyse the effects of coping plans. Given that high attendance is a necessary condition for cognitive benefits, however, this approach would have run counter to the main aim of the study. Therefore, strategies to facilitate and encourage adherence had to be made available to each participant. The instruction to generate coping plans served this purpose. Our findings showed that formulation of these plans predicted course adherence, especially for those women with lower adherence in the initiation period, who might otherwise have dropped out completely.

Conclusion

Instructing older women to generate coping plans can effectively facilitate adherence to programmes of physical and mental activity. Coping plans mediated the relationship between intentions and adherent behaviour in the field of physical activity. Self-efficacy beliefs and coping plans were independent predictors of adherent behaviour in the field of mental activity.

Facilitating adherence to physical and mental intervention programmes proved to be meaningful: engagement in both activities had equally beneficial effects on cognitive performance (Evers *et al.*, 2011). Furthermore, although physical exercise is known to improve both mental and physical fitness as well as psychological well-being (Netz, Wu, Becker, & Tenenbaum, 2005), it is not a priority in the daily lives of most older people (McAuley, Kramer, & Colcombe, 2004). Hence, it warrants particular support. Underlining the positive effects on cognition (Colcombe & Kramer, 2003; Heyn, Abreu, & Ottenbacher, 2004; Klusmann *et al.*, 2010) would help older women to frame goal attainment as a learning goal. This approach would in turn facilitate the development of self-regulatory strategies such as coping planning.

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