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Do the integrated theories of self-determination and planned behavior explain the change in active life engagement following a motivational counseling intervention among older people?

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ABSTRACT

Background: An integrated model based on self-determination and planned behavior theories has been used to explain physical activity and other health-related behaviors mainly among younger populations, not older adults. The present study aimed to conduct a secondary analysis to explore whether changes in theory-based constructs explain a change in activity level (including 17 activities in essential life areas) among 75- and 80-year-old individuals.

Methods: Data came from the Promoting well-being through active aging (AGNES) study, a two-arm single-blinded randomized control trial, where participants in the intervention group (n = 101) received year-long individualized counseling between 2017–19 in Jyväskylä, Finland. Activity frequency was assessed using the University of Jyväskylä Active Aging Scale (UJACAS) activity sub-score, perceived autonomy support with the Health Climate Questionnaire, autonomous motivation with a sub-scale from the Self-Regulation Questionnaire, and attitude with three items. Subjective norm, perceived behavioral control, and intention were each assessed with one item. Change in variables between baseline and the 12-month follow-up was specified via latent factors. Various structural equation models were tested to assess whether the basic or modified model, including additional paths from baseline variables to change factors, provided a better data fit.

Results: In the modified integrated model, baseline attitude and change in attitude directly explained the change in activity frequency. Moreover, statistically significant indirect paths were observed from baseline autonomous motivation through baseline attitude, and from activity frequency through change in attitude to change in activity frequency.

Conclusions: The theoretical integrated model did not account for the change in active life engagement. The modified integrated model revealed significant change paths, highlighting autonomous motivation and attitudes as influential change constructs. For future intervention design, the modified integrated model appears useful in identifying behavior change pathways for older adults.

1. Introduction

Being active in various life domains when aging is essential for the maintenance of better well-being. Activity theory emphasizes the benefits of continuing an active life in later adulthood, especially by replacing earlier social roles and occupations with new age-appropriate roles (Havighurst and Albrecht, 1953 as cited in Lemon et al., 1972). Earlier research suggests that for example social engagement, physical activity, or participation in various community and leisure activities are associated with higher life satisfaction and fewer depressive symptoms

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(e.g., Adams et al., 2004; Choi K-S et al., 2013; Choi E et al., 2021; Li and Loo, 2017; Menec and Chipperfield, 1997; Morrow-Howell et al., 2014; Ní Mhaoláin et al., 2012). With diminishing recourses for activity, aging individuals can continue or increase their participation in activities for instance by selecting goals important to them (selection), improving and coordinating the use of personal resources to achieve the goals (optimization), and using alternative means to achieve goals and to maintain a given level of functioning (compensation) (Baltes and Baltes, 1990; Freund and Baltes, 1998). The interventions for older adults focusing on behavioral changes (e.g., balanced nutrition, physical activity, social participation, cognitive training, exploring coping styles) have resulted in improvement both in activity levels (e.g., engagement in physical, cultural, intellectual, and social activities) and health outcomes (e.g., perceived memory, emotional balance, self-efficacy, overall quality of life) (Caprara et al., 2013; Mendoza-Ruvalcaba and Arias-Merino, 2015).

The self-determination theory (SDT) posits that people are inherently active, and motivated to grow, learn, and change (Ryan and Deci, 2000; Ryan and Deci, 2017, 4). SDT differentiates types of motivation along a continuum from controlled to autonomous. Autonomously motivated individuals are active because the activity is pleasing or in line with their personal value system. Controlled motivation is driven by external prizes or demands, punishment, or feelings of guilt or shame. Social environments and support from others may strengthen or threaten the fulfillment of the needs for competence, relatedness, and autonomy, which form the basic psychological needs underlying autonomous motivation, optimal functioning, and growth (Black and Deci, 2000; Hagger and Chatzisarantis, 2009; Ryan and Deci, 2000). Autonomy support acknowledges another person's perspective and feelings and provides information, rationale, and opportunities while bringing on minimal pressure or demands (Deci and Ryan, 1985). Earlier studies suggest that perceived autonomy support is associated with autonomous motivation among older people (Chung et al., 2018; Yu et al., 2015).

The theory of planned behavior (TPB) (Ajzen, 1991) states that intentions to be active mediate the effect of three belief-based perceptions on behavior. Of these perceptions, an attitude refers to an individual's favorable or unfavorable evaluations associated with behavior. A subjective norm describes an individual's experienced social pressure to perform an activity. Perceived control refers to a person's perceived ability to perform an activity. Associations between the TPB constructs have been studied among older adults, for example, attitude and perceived behavioral control have been found to explain the intention to perform the behavior (Arnautovska et al., 2019; Chung et al., 2018; Duarte et al., 2022; Gretebeck et al., 2007; Stolte et al., 2017). Some earlier studies suggest that subjective norm is related to intention (Ahmad et al., 2014; Chung et al., 2018; Dean et al., 2006) while others have not found a statistically significant association between these theoretical constructs (Arnautovska et al., 2019; Duarte et al., 2022; Gretebeck et al., 2007). Finally, in terms of intention and behavior, some studies have (Ahmad et al., 2014; Arnautovska et al., 2019; Benjamin et al., 2005; Dean et al., 2006; Gretebeck et al., 2007), while others have not found an association (Chung et al., 2018; Duarte et al., 2022; Gellert et al., 2015; Labudek et al., 2021).

We chose the integrated model of the SDT (Ryan and Deci, 2000) and the TPB (Ajzen, 1991) as the underlying theoretical model for the intervention. Previous literature supports the SDT and TPB integration as they provide complementary explanations of the processes that underlie motivated behavior (Chatzisarantis et al., 2007; Chung et al., 2018; Hagger and Chatzisarantis, 2009). In older people, the integration of these two theories has been used, until now, to test only the use of face masks (Chung et al., 2018) and self-reported physical activity (Arnautovska et al., 2019). We chose to integrate two motivational models in the tested model. Our reason for leaving out volitional factors such as planning and implementation intentions was that previous models predicting activities in older adults did not support including them, showing either non-significant or weak prediction power (Galli et al., 2018; Hagger et al., 2017). One explanation may be that even subclinical cognitive decline accompanying aging may attenuate the importance of volitional factors in behavior change (Schnitzspahn and Kliegel, 2009).

1.1. The SDT and the TPB in the context of the AGNES-intervention

We conducted a study to promote active aging (Rantanen et al., 2019b). In a one-year two-arm single-blinded randomized controlled trial, we aimed to increase 75- and 80-year-old participants' awareness of meaningful and desirable activities, foster autonomous motivation, set new activity goals, and eventually, facilitate positive changes in self-selected valued activity (Rantanen et al., 2020). During the one-year community-based intervention, the counseling group had one face-to-face counseling session and sessions via phone calls at 1, 3, 6, and 9 months after the face-to-face counseling session. Additionally, they received an information booklet on active aging and four printed newsletters, listing activities organized for older people in our town.

An increase in self-regulated motivation (i.e., autonomous motivation) was central to the intervention. To support the experience of autonomy, we respected, listened to, and acknowledged the perspective of our participants (Souesme and Ferrand, 2019). A semi-structured protocol of questions guided the discussion topics with plenty of room and encouragement for the participants to express their thoughts. Probing questions were based on participants' answers. The participants' current activities, interests, possibilities, and needs for change were discussed and they had a key role in setting their goals, planning their actions, and monitoring their progress in changing their self-selected active life behaviors (Ekelund et al., 2014). Mainly, the participants chose one to three behavioral goals. We promoted perceived control by identifying obstacles, and ways to overcome them, providing advice for self-monitoring, and reviewing action plans. Forming if-then plans are a valid tool for improving the translation of intentions into action (Sheeran and Webb, 2016). Ideally, action plans and forming problem-solving strategies stemming from the perceived discrepancy between the current activity and the goal will propel change. A more detailed description of the integrated theoretical constructs, the behavior change techniques that have been applied, their mechanisms of action, and examples of how these techniques have been applied are shown in Supplementary Table 1 (cf. Carey et al., 2019).

World Health Organization's definition of active aging policy (World Health Organization (WHO), 2002) was in the background of the development of the University of Jyväskylä Active Aging Scale (UJACAS) (Rantanen et al., 2019a). The scale measures active aging at an individual level, and more specifically, it assesses older people's striving for well-being through activities relating to a person's goals, functional abilities, and opportunities. Selection of the 17 activities in the essential life areas (e.g., practicing memory, exercising, participating in events, helping others, advancing matters in one's own life, and doing things according to one's worldview) in the scale was based on an iterative multi-phase process including drafting by an expert panel, a pilot study for item analysis and scale validity, a feedback study with focus groups and questionnaire respondents, and a test-retest study. Since the intervention was individually tailored, i.e., the participants were able to choose behavioral goals according to their preferences, the use of this kind of scale in assessing the wider picture of activity was a rational choice.

In the randomized controlled trial, we observed an increase in the UJACAS total score and the frequency of the activity sub-score in the counseling group compared to the health information control group (group-by-time $p = .050$, effect size 0.011; $p = .007$, effect size 0.019, respectively) (Rantanen et al., 2020), and non-systematic effects on physical activity (Siltanen et al., 2020). We chose the behavioral (activity) scale as an outcome for the current study instead of the total score because the three other parts of the questionnaire (opportunities, competence, and motivation) overlapped to some extent with constructs

of the explanatory motivational models we used. The goals the participants set were mainly related to activities or behaviors. Moreover, the volume of activity is the dimension that can be influenced by the intervention at an individual level.

In the current study, we conducted a secondary analysis to explore whether the changes in theory-based constructs (integrated model based on the SDT and the TPB) explain the change in frequency of activity during 12-month follow-up among the 75- and 80-year-old participants of individualized counseling intervention. We hypothesized that the change in perceived autonomy support is associated with the change in autonomous motivation (H1). Consequently, we hypothesized that the change in autonomous motivation is related to the changes in attitude, subjective norm, and perceived behavioral control (H2). In line with the TPB (Ajzen, 1991), it was further hypothesized that these changes in belief-based cognitions explain the change in intention towards active aging (H3). Finally, we expected that the changes in active aging behaviors would be predicted by the changes in intention (H4) and perceived behavioral control (H5).

2. Methods

2.1. Study design and participants

The study protocol has been published earlier (Rantanen et al., 2019b). AGNES intervention (Promoting well-being through active aging; ISRCTN-ISRCTN16172390) was a single-blinded randomized controlled trial with two research arms. The parallel groups were the "Counseling group", serving as the intervention group, and the "Health information group", serving as the control group. In this study, we used data from the counseling group (n = 101). Only the intervention group was included because this group only received the intervention, and we aimed to address the reasons and mechanisms behind the behavioral changes that occurred because of the intervention.

We recruited participants for the AGNES intervention study from the AGNES cohort study (Rantanen et al., 2018). Participants of the AGNES cohort study were aged 75, 80, or 85 years and lived independently in the municipality of Jyväskylä, Finland. They were recruited to the cohort study from random samples drawn from the Population Information System administrated by the Population Register Center (Rantanen et al., 2020). Inclusion criteria for the AGNES intervention study were age 75 or 80 years, willingness to participate, a baseline score between 52.3 and 90.0 on the University of Alabama at Birmingham Life-Space Assessment (LSA) (Baker et al., 2003; Portegijs et al., 2016), and a score of 25 or higher on the cognitive function test Mini-Mental State Examination (MMSE) (Folstein et al., 1975). Life-space mobility composite score in the recruitment range excludes those with severely restricted and those with the most extensive mobility behavior and thus represents the "middle group" in the population who potentially have room for improvement in terms of activity. The justification for the MMSE score of 25 or higher as an inclusion criterion was that counseling requires the cognitive capability to process the topics discussed (Rantanen et al., 2020).

Recruitment occurred between October 2017 and August 2018. Of the 416 participants screened for the AGNES intervention, 204 were eligible and were randomized either to the counseling group or to the health information group (Rantanen et al., 2020). Of those non-eligible, 151 did not meet the inclusion criteria, 56 refused to participate, 4 had poor health, and 1 was not reached. Participants were interviewed face-to-face in their homes by trained interviews using computer-assisted personal interviewing and over the phone by the counselor before randomization. Follow-up face-to-face interviews were conducted mid-trial at 6 months and post-trial at 12 months. Of the counseling group participants, two did not receive any part of the intervention, seven percent discontinued the intervention, and in one case, the follow-up data was damaged. Since they did not differ in age, perceived health, depressive symptoms, activity score, or the motivational model constructs from the rest of the intervention participants, analyses were conducted with intention-to-treat principles.

The ethical committee of the Central Finland Hospital district provided an ethical statement about the AGNES cohort and intervention studies on August 23, 2017. All participants signed informed consent before the start of the study. The AGNES cohort and intervention studies followed the principles of the Declaration of Helsinki.

2.2. Measures

The main outcome measure is the *frequency of activity* sub-score from the University of Jyväskylä Active Aging Scale (UJACAS) (Rantanen et al., 2019a). The UJACAS consists of 17 items: practicing memory, using a computer, advancing matters in one's own life, exercising, enjoying the outdoors, taking care of one's appearance, crafting or DIY, maintaining social relationships, helping others, getting to know new people, balancing personal finances, making one's days interesting, making home cozy, practicing artistic hobbies, participating in events, advancing societal/communal matters, and doing things according to one's world view. For each item, participants were asked to evaluate their amount of frequency of doing the activity during the 4 weeks immediately before the measurement with the following response options: 0 = not at all, 1 = rarely than once a week/little, 2 = approximately once a week/some, 3 = 2–4 times a week/quite a lot, and 4 = daily or almost daily/very much with verbalization of rating depending on the wording of the question. Higher scores (range 0–68) reflect higher activity. The measure and its subscales have been validated previously. The results of the validation study indicated that the frequency of activity subscale correlated with active aging assessments made by the participant (r = 0.500) and occupational therapist (r = 0.549), and the participant's experience of having a special interest in his/her life (r = 0.508) (Rantanen et al., 2019a). Thus, the subscale provides a broader perspective of activities. In this data, Cronbach's alpha was 0.79 at baseline and 0.74 at the 12-month follow-up.

Theory-based variables. *Perceived autonomy* support (i.e., the degree to which participants experience their social environment as autonomy-supportive versus controlling) concerning living an active life was assessed with a modified short version of the Health Climate Questionnaire (Williams et al., 2006). Responses for the five items (e.g., "I feel other people around me have provided me with choices and options to live an active life.") are given on a Likert-type scale ranging from 1 = strongly disagree to 7 = strongly agree. An individual's score on this scale is the average of his or her responses on the five items. Cronbach's alpha was 0.83 at baseline and 0.86 at the 12-month follow-up.

Autonomous motivation is a sub-scale from the Self-Regulation Questionnaire (Levesque et al., 2007) that was adapted to meet the needs of the intervention and was used to assess individual differences in the types of motivational regulation for being more active. In the present study, 4 items were used to assess autonomous motivation given on a Likert-type scale ranging from 1 = strongly disagree to 7 = strongly agree. Participants' score was formed so that intrinsic motivation (i.e., mean of items "I enjoy living an active life" and "It is interesting to see my improvement") and identified regulation (i.e., mean of items "I believe that living an active life helps me feel better" and "Because I enjoy being an active person") were calculated first and then the final score of autonomous motivation (range 3–21) was calculated as follows: 2*intrinsic motivation + 1*identified regulation, with a higher score indicating higher autonomous motivation. Cronbach's alpha was 0.76 at baseline and 0.82 at the 12-month follow-up.

Recommendations of the manual for health services researchers (Francis et al., 2004) were used as a guide for planning the items based on the TPB. *Attitude towards living a more active life* was assessed with 3 items scored on 7-point semantic differential scales ranging from 1 to 7 ("Aiming to live a more active life during the next six months means to me … pleasant – unpleasant, difficult – easy, useful – useless"). An individual's score is the average of the participant's responses on the three

items higher scores indicate a more positive attitude. Cronbach's alpha was 0.79 at baseline and 0.75 at the 12-month follow-up. *Subjective norm of living a more active life* was measured with one item: "I feel that the people who are important to me would want/expect me to live a more active life for the next six months". *Perceived behavioral control over living a more active life* was assessed by using one item: "I am confident that I can live a more active life for the next six months". *Intention to live a more active life* was assessed with one item: "I intend to live a more active life for the next 6 months". Responses for subjective norm, perceived behavioral control, and intention are given on a 7-point scale ranging from 1 = strongly disagree to 7 = strongly agree.

Covariates. Since people in older age groups are prone to experience deterioration in their physical and mental health, and higher number of depressive symptoms and perceived poor health may be associated with lower participation in activities (Galenkamp et al., 2016; Gellert et al., 2015), we used changes in health or physical functioning and depressive symptoms as covariates. At the 6 and 12-month measurements, participants were asked if they experienced *changes in their health situation or functional or mobility ability* (i.e., the old illness had worsened, have been diagnosed with a new disease, have cognitive problems, accident, functional or mobility ability had worsened, or some other change in health situation) during the last 6 months. They scored 1 if they reported any change in either measurement point, otherwise, they scored 0. *Depressive symptoms* were assessed with the 20-item Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977) in which the participants are asked to rate the frequency of each depressive symptom during the previous week on a four-point scale ranging from zero (rarely or never) to three (almost all the time). Sum scores range from 0 to 60, with higher scores indicating more depressive symptoms. A sum score was calculated for participants with at most one missing item. Cronbach's alpha was 0.89 at baseline and 0.87 at the 12-month follow-up. For the analysis, change in depressive symptoms was calculated by subtracting the baseline CES-D score from the 12-month CES-D score.

2.3. Statistical analysis

A theory-based structural equation model (SEM) (Fig. 1 A) was estimated by using full information maximum likelihood estimator supposing missing values to be missing at random (MAR). The covariance coverage was at its smallest 0.881. The estimator in the MPLUS statistical program (version 8.6) was MLR which produces robust scale-corrected chi-square value and robust standard errors which correct the bias in the case of non-normally distributed data.

The change between the baseline and 12-month measurements was specified via latent factors setting the factor loadings at one and regressing the change factor on base measurement setting the coefficient to one. The error variance of the second measurement was set to zero (Fig. 1 B). The model was further modified with the help of the large modification indices. Each change factor was adjusted for the change score of depressive symptoms and factors describing the change in attitude, behavioral control, intention, and frequency of activity were adjusted for reported changes in health situation and/or functional or mobility ability. Additionally, baseline scores of perceived autonomy support, autonomous motivation, and frequency of activity were allowed to correlate with the change score of depressive symptoms based on bivariate correlation values.

The model fit was evaluated using chi-square test value, root mean square error of approximation (RMSEA), Tucker-Lewis index (TLI), comparative fit index (CFI), and standardized root mean residual (SRMR). According to Hu and Bentler (1999), statistically nonsignificant chi-square value, lower than .06 value in RMSEA, at least 0.95 TLI and CFI values, and lower than 0.08 value in SRMR are cut-off values for the well-fitted model.

3. Results

Of the participants, 74% were aged 75 years and 60% were women. 53% rated their health as good or very good and 47% as moderate. A bit more than half (55%) reported that they had experienced a negative change in their health situation or functional or mobility ability. The mean score of depressive symptoms was 8.12 (sd. 7.10) at baseline and 8.41 (sd. 6.18) at the 12-month follow-up. The mean of the change score of depressive symptoms during the follow-up was 0.45 (sd. 5.93). Means and standard deviations of the main studied variables at baseline and 12-

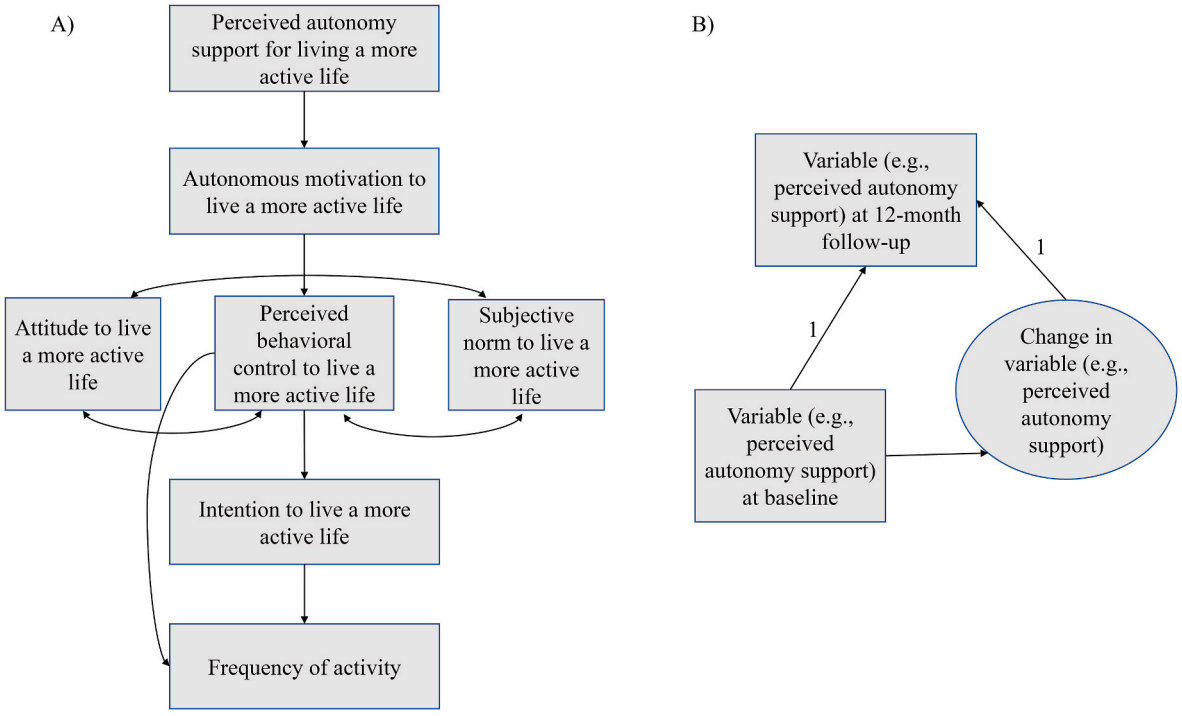

Fig. 1. Theory-based model (A) and illustration of forming latent change scores in the analysis (B).

month follow-up are shown in Table 1 and bivariate correlations between the main studied variables are shown in Table 2. Within specific UJACAS activity items, no systematic changes were visible while some participants increased and others decreased their level of activity. For instance, concerning exercising, 25% increased and 18% decreased, in practicing memory, 29% increased and 18% decreased. Regarding the maintenance of social relationships, 20% increased their activity level and 28% decreased. The highest increase in activity was observed in activity aligned with world view with a proportion of 50% increasing and 20% decreasing and advancing matters in one's own life with a proportion of 39% increasing and 17% decreasing.

Fit indexes for the SEM based on the non-modified theoretical model ($\chi^2(77) = 203.353$, $p < .001$; RMSEA: 0.132, CFI: 0.812, TLI: 0.702, and SRMR: 0.161) suggested that the model did not fit data well. Path coefficients are shown in Supplementary Fig. 1. Additionally, large modification indexes suggested that additional paths between the variables should be added to the model. The final modified model fitted data very well: the value of the $\chi^2(62)$-test for model fit was 64.006 ($p = .406$), RMSEA 0.018, CFI 0.997, TLI 0.994, and SRMR 0.076.

Path coefficients of the final modified model (Fig. 2) indicated that, at baseline, perceived autonomy support was positively associated with autonomous motivation which was further positively associated with attitude toward and perceived behavioral control to live a more active life. Intention to live a more active life was explained by higher scores in perceived behavioral control, perceived subjective norm, and perceived autonomy support. Intention and perceived behavioral control were not statistically significantly related to the frequency of activity. However, a higher score in autonomous motivation was positively associated with the frequency of activity.

The results also suggest that higher baseline autonomous motivation and higher change score in attitude were associated with higher positive change in perceived autonomy support during the intervention period. Positive change in perceived autonomy support was associated with a higher positive change score in autonomous motivation that, in turn, was related to positive changes in attitude toward and perceived behavioral control in living a more active life. However, a change in autonomous motivation was not associated with a change in the perceived subjective norm. Thus, hypothesis 1 was supported and hypothesis 2 was partially supported by the data. Additionally, higher autonomous motivation at baseline predicted higher positive changes in perceived autonomy support, attitude, and perceived behavioral control during the intervention. Change in attitude and subjective norm correlated with change in perceived behavioral control, but only change in perceived behavioral control was directly related to the change in intention to live a more active life. Therefore, hypothesis 3 was only partially supported. Furthermore, higher perceived behavioral control at baseline predicted higher positive change in intention to live a more active life. Finally, the change in the frequency of activity was not explained by changes in intention and perceived behavioral control that did not lend support for hypotheses 4 and 5. Of adjusting variables, a higher increase in depressive symptoms during the follow-up was negatively associated with changes in perceived autonomy support and active life engagement. Reported negative change in health and functional or mobility ability was negatively associated with a change in perceived behavioral control.

Whereas 60% of the variance in the latent change score in the intention was explained by the final model, the respective proportion of the variance in the latent change score in the frequency of activity was 37.7%. Both higher baseline scores in attitude and higher positive change in attitude were associated with positive changes in the frequency of activity. Additionally, indirect effects of baseline autonomous motivation on change in frequency of activity through baseline attitude (standardized estimate 0.32, $p < .001$), and of baseline perceived autonomy support on change in frequency of activity through baseline autonomous motivation and baseline attitude (est. 0.20, $p < .001$) were statistically significant. Higher baseline frequency of activity was indirectly associated with a change in frequency of activity via a change in attitude (est. 0.09, $p = .045$). However, indirect paths from a change in autonomous motivation (est. 0.09, $p = .059$) and from baseline autonomous motivation (est. 0.08, $p = .097$) to a change in frequency of activity through a change in attitude were not statistically significant. Results of the sensitivity analysis, in which we excluded those respondents who discontinued the intervention or had no data in the 12-month follow-up, indicated that attrition did not distort the results.

Table 1
Means and standard deviations (SD) of the study variables at baseline and 12-month follow-up.

	Baseline		12-month follow-up	
	Mean	SD	Mean	SD
Perceived autonomy support living an active life (1–7)	5.73	0.86	5.69	0.92
Autonomous motivation for living a more active (3–21)	18.59	2.18	18.43	2.53
Attitude towards living a more active life (1–7)	6.00	0.95	6.00	0.94
Subjective norm of living a more active life (1–7)	5.04	1.79	5.16	1.63
Perceived behavioral control over living a more active life (1–7)	5.82	1.14	5.61	1.29
Intention to live a more active life (1–7)	5.53	1.43	5.58	1.48
Frequency of activity (0–68)	42.15	8.36	44.40	7.07

4. Discussion

The findings of this study suggest that the integrated model of self-determination theory and theory of planned behavior in a counseling intervention aiming to promote striving for meaningful activity among older people was not successful. However, when the model was modified to include associations from baseline variables to change factors, its suitability improved. The modified adjusted model was able to explain 60.0% of the variance in change in intention and 37.7% of the variance in the change in activity level. Earlier meta-analytic findings have shown that averaging perceived behavioral control, subjective norms, and attitudes accounts for 39% of the variance in behavioral intentions, and behavioral intention accounts for 22–42% of the variance in behavior (depending on how intention is measured) (Armitage and Conner, 2001). Therefore, we consider that the modified model has a very good explanatory power of the variance.

From the key constructs in the integrated model, positive attitude was the only one to have direct effects on activity and thus may be considered especially meaningful for interventions aiming to change behavior. Additionally, greater autonomous motivation and higher frequency of activity before the intervention explained a positive change in frequency of activity during the intervention indirectly through baseline attitude and change in attitude. A novel feature of the current study is that it enabled us to take into consideration the longitudinal nature of the data, and it presented new knowledge on associations between the theoretical constructs of an integrated model based on the SDT and the TPB.

In line with the hypotheses, the results indicated that the paths between perceived autonomy support and autonomous motivation, autonomous motivation and attitude/perceived behavioral control, and perceived behavioral control and intention were statistically significant both at baseline situation and when investigating these associations between latent change factors. Similar results have been reported by other studies with older adults for physical activity behavior (Arnautovska et al., 2019; Duarte et al., 2022; Gretebeck et al., 2007; Stolte et al., 2017) and seasonal influence prevention (Chung et al., 2018). However, our result regarding non-significant relationships between subjective norm and intention and between attitude and intention did not confirm the results found in the aforementioned studies. In line with some studies (Ahmad et al., 2014; Chung et al., 2018; Dean et al., 2006),

Table 2
Correlations between the main study variables at baseline (0m), 12-month follow-up (12m), and between the baseline and follow-up measures.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Perceived autonomy support 0m	1													
2 Autonomous motivation 0m	0.62	1												
3 Attitude 0m	0.54	0.62	1											
4 Subjective norm 0m	0.07	−0.13	0.09	1										
5 Perceived behavioral control 0m	0.48	0.47	0.73	0.13	1									
6 Intention 0m	0.45	0.33	0.50	0.35	0.58	1								
7 Frequency of activity 0m	0.33	0.44	0.28	−0.20	0.27	0.14	1							
8 Perceived autonomy support 12m	0.62							1						
9 Autonomous motivation 12m	0.40	0.64						0.65	1					
10 Attitude 12m	0.42	0.55	0.66					0.57	0.64	1				
11 Subjective norm 12m	0.24	0.12	0.17	0.47				0.25	0.11	0.04	1			
12 Perceived behavioral control 12m	0.40	0.39	0.45	0.04	0.54			0.59	0.53	0.56	0.30	1		
13 Intention 12m	0.36	0.28	0.29	0.08	0.51	0.45		0.38	0.32	0.35	0.33	0.67	1	
14 Frequency of activity 12m	0.35	0.45	0.47	−0.11	0.36	0.31	0.73	0.37	0.40	0.60	−0.00	0.25	0.33	1

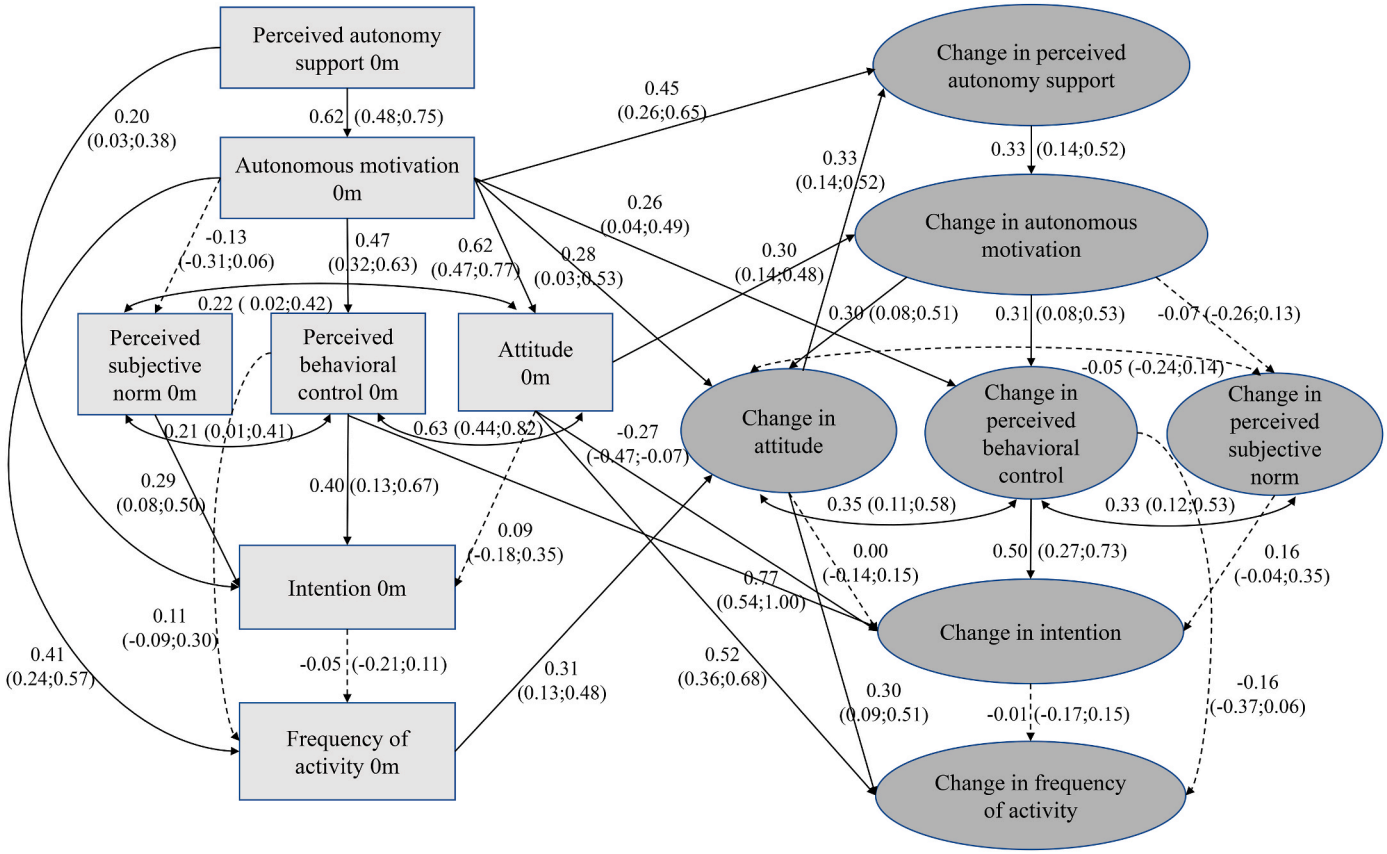

Fig. 2. Standardized path coefficients and 95% confidence intervals of the adjusted modified SEM model (n = 101).
Note. Solid arrows describe statistically significant and dashed arrows not statistically significant values.

we observed a statistically significant association between baseline perceived subjective norm and baseline intention. On the other hand, we did not find a statistically significant association between respective latent change factors (see also Arnautovska et al., 2019; Duarte et al., 2022; Gretebeck et al., 2007). However, the intervention contents focused more on supporting autonomous motivation than on increasing the perceived subjective norm to live a more active life, as can be seen in Supplementary Table 1. The finding of the positive association between baseline autonomous motivation and baseline frequency of activity was in line with previous research (Van Hoecke et al., 2014; Labudek et al., 2021).

Several previous studies indicate that intention as a proximal predictor is associated with a given behavior (Ahmad et al., 2014; Arnautovska et al., 2019; Benjamin et al., 2005; Dean et al., 2006; Gretebeck et al., 2007; Knittle et al., 2018), but we did not find a statistically significant association between these variables. In the earlier literature, the notion that all intended behavior is not translated to actual behavior is known as the intention-behavior gap (Rhodes, 2014; Sheeran and Webb, 2016). We applied behavioral change techniques that may bridge the intention-behavior gap and strengthen action planning, such as supporting participants in setting their goals, making "if-then" plans, planning problem-solving strategies, and monitoring their progress (see Hagger and Chatzisarantis, 2014; Kaushal et al., 2021). We cannot completely rule out that measuring the amount of activity with a scale including 17 essential life areas and intention with one item with the more general expression 'living a more active life' may in part be responsible for the non-significant finding between intention and frequency of activity. However, assessing theoretical constructs in some

other way than with the more general expression would have not been possible as the intervention was individualized focusing on goals and activities important to each participant. Nevertheless, our data suggest that the intention to lead a more active life and the actual increase in activity were not associated. This warrants further studies in the future.

Paths from baseline theoretical constructs to latent change factors as well as additional paths between latent change factors revealed significant additional information that can be used in designing future interventions. The results indicate a focal position of autonomous motivation in the process of supporting participating in active aging behaviors. In addition to explaining perceived behavioral control and attitude cross-sectionally, baseline autonomous motivation predicted changes in perceived autonomy support, attitude, and perceived behavioral control directly and change in frequency of activity indirectly through baseline attitude. It is likely that older people whose motivation is more self-determined, are at the upper stages of readiness to change, they see around them more opportunities and therefore, are more ready to take advantage of an intervention that aims to promote their valued behaviors (Courneya, 1995). In our study, the greatest increases in activity levels were observed in the items of aligning activities with one's worldview and advancing matters in one's own life. This observation, even though anecdotal, potentially indicates a noteworthy enhancement in participants' autonomy.

From the practical point, it is notable that the change in autonomous motivation was related to the change in two belief-based cognitions, i.e., attitude and perceived behavioral control. Thus, it may be essential to support the autonomous motivation of older people, for instance, with questions to help them strengthen their reasoning for the maintenance or increase of an important activity. However, this should be done in a respectful atmosphere and by providing interpersonal conditions that support the person's initiative, volition, and integrity (Deci and Ryan, 2012).

Results suggest the significance of perceived behavioral control and positive attitude in the process as well. Ajzen (2005, p.118) states that the relative importance of belief-based cognitions depends in part on the intention and behavior that is studied. In our data, baseline perceived behavioral control and change in perceived behavioral control were quite strongly associated with a change in intention to live a more active life. Nevertheless, there was no association between changes in attitude and perceived subjective norm and the change in intention. Since bivariate correlations between baseline attitude and intention at baseline/12-month follow-up were positive, the negative relation from baseline attitude to change in intention may be due to the quite complicated model. Indeed, the regression coefficient between baseline attitude and the change in intention the model predicts is 0.22 when considering the correlation between attitude and perceived behavioral control at baseline (est. 0.63) and associations between perceived behavioral control and the change in intention (est. 0.77) and attitude and the change in intention (est. −0.27) (i.e., 0.63*0.77–0.27 = 0.22). However, baseline attitude and change in attitude explained the change in the frequency of activity. Moreover, baseline attitude predicted positively the change in autonomous motivation, and a change in attitude was related to the change in perceived autonomy support. Hence, it may be important to enhance the positive attitude toward intended behavior that can be done, for example, by giving relevant information about health consequences to an older person and helping them in problem-solving.

Finally, when taking into consideration statistically significant additional paths, the results also revealed that those reporting more activity at baseline experienced a positive change in attitude toward living a more active life and further increased their activity. Although many participants discussed that their life is full of meaningful activities, this result may indicate that their past behaviors (both reasoned and automatic) better predict their current behavior (Brown et al., 2020).

4.1. Strengths and limitations

In the interest of keeping the participant burden reasonable, we included in some constructs a limited number of items, which could be a study limitation. With more participants, we might have been able to receive more accurate estimates (narrower 95% confidence intervals) for the studied associations and higher power to detect some associations that now may have remained too weak. In general, the participants of the intervention were relatively active. Nevertheless, they still had room for increasing their activity. Sometimes the goals and changes in the person's life although important may have been quite small.

The strengths include a low attrition rate. The use of the integrated model to build the intervention and testing the model's power to explain changes across two time points are also strengths. Since very few studies have used the integrated model in intervention studies, the results of the present study bring new knowledge on an integrated model to explain behavior change among older people. The new paths our data indicate bring plenty of new knowledge for future intervention planning for this age group for active aging. Reporting how we used the model in practice, and reporting details regarding how the behavior change techniques were used to change the theoretical constructs, allows better future replication or adaptation. The novelty of our study is that we focused on the participants' self-selected activities and assessment of active aging behaviors with a novel active aging scale including items from several life domains. Since the study lasted for one year, baseline and follow-up assessments were conducted in the same season. To better understand the social psychological process of how older people maintain and increase their active aging behaviors when resources often diminish and depressive symptoms become more prevalent, calls for further research e.g., with a more heterogenous sample and a higher number of participants.

5. Conclusions

Although the integrated model based on the SDT and the TPB did not explain the change in active life engagement among older participants of individualized counseling intervention, the emerged associations are useful for researchers of behavior change interventions for older adults. Based on the additional paths suggested by the SEM, the model was able to explain around 38% of the variance in the change in active aging behaviors. From the theory-based constructs, a positive attitude is a significant construct explaining the activity change. Autonomous motivation and perceived behavioral control also had a central role in explaining changes in intention to live a more active life and the change in frequency of activity in older people. In practice, a similar intervention conducted within the framework of screening, which could provide multifaceted support to older people, might help maintain their immediate life quality and contribute more meaning to their lives.

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Declaration of competing interest

The authors report no conflict of interest.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2023.116409.

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