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Positive Affectivity Influences Subjective Age and Daily Moving in Older Adults

RESEARCH

CLARE LOUISE RHODEN
JENNIFER JOYCE
*Author affiliations can be found in the back matter of this article

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ABSTRACT

Subjective age, positive and negative affect are individually linked to physical activity but have not been measured at the same time. The combination of high and low levels of positive affectivity (PA) and negative affectivity (NA) forming either congruent or differentiated affectivity profiles, is also under researched. This cross-sectional study examined subjective age and the combined effect of positive and negative affectivity on physical activity in 34 older adults (age 70 ± 4 years, 50% female). Exploratory regression analyses revealed significant associations between the differentiated affectivity profile, PA ascendency (where positive affectivity was higher than negative affectivity), and daily moving. Positive affectivity was consistently related to physical activity measures where subjective age and negative affectivity were not. PA ascendency predicted subjective age. Older adults with a differentiated affectivity profile felt younger than their chronological age and moved more during each day. Focusing on combined affectivity profiles and promoting positive affectivity may be a promising strategy for increasing physical activity in older adults. Future research replicating this approach with larger sample sizes is advocated.

CORRESPONDING AUTHOR:
Clare Louise Rhoden
University of Worcester, UK
c.rhoden@worc.ac.uk

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INTRODUCTION

Psychological determinants of adopting and maintaining regular physical activity are important particularly in the context of aging (Carmichael, Duberley & Szmigin 2015; Crombie et al., 2004; Wienert et al., 2017). For some older adults, internal conflict arises between understanding the benefits of exercising and the barriers to being active or choosing not to exercise (Grant 2008). Reasons for the lack of physical activity include low confidence, embarrassment, not belonging to a group (Crombie et al., 2004), identifying as frail (Warmoth et al., 2016) and feeling older (Infurna et al., 2010). These reasons may be underpinned by an individual's awareness of the aging process where perceived physical, cognitive, emotional and social losses can lead to disengagement from physical activity (Brothers et al., 2016). However, some individuals adopt or maintain physical activity in later life embracing and adapting to aging changes whilst maintaining an overall positive approach to life (Brothers et al., 2016; Hudson, Day & Oliver 2015). In this article we examine two psychological constructs associated with aging – subjective age and affective feelings and examine the extent to which these factors predict physical activity levels of older adults.

Subjective age, the concept of feeling older or younger than one's chronological age, influences thoughts and behaviors associated with physical activity as well as physical function and performance. A younger subjective age increased levels of physical activity in adults aged 25–78 years (Wienert et al., 2017) and predicted successful aging, longevity, physical health and functioning (Kotter-Grühn, Kornadt & Stephan 2016). In addition, experimental manipulation of older adults subjective age through social comparisons has been shown to increase grip strength (Stephan et al., 2013) and more recently, muscular strength, body balance and muscular endurance were found to be higher in adults over 65 years who felt younger, compared to those who felt the same age or older than their chronological age (Wang, Yu & Zhao 2022). Together, these studies indicate that subjective age is clearly linked with physical activity engagement, physical fitness and health.

The psychological construct 'affect' is another significant factor associated with physical activity engagement. Positive affect is characterised by feeling states such as "lively", "energetic", "active", "alert", "interested" and "enthusiastic" (Watson 2000) and has been correlated with optimism and mindfulness in older adults (Zeng & Gu 2017). In contrast negative affect encompasses feelings of being "distressed", "upset", "nervous" and "scared" (Watson 2000). State positive and negative affect can influence exercise behavior and health. Negative affect reduced the likelihood of exercise engagement (Allen Catellier & Yang 2013) whilst positive feelings about physical activity influenced individuals perceived benefits of, and barriers to, physical activity and their perceived behavioral control, ultimately increasing their overall level of physical activity (Kiviniemi, Voss-Humke & Seifert 2007). Meta-analyses of three studies by Plys and Desrichard (2020) revealed that people perceived health goals (for example, eat healthy and exercise, stop or reduce smoking) and their means of attaining these goals in a mood-congruent way. Individuals high in state negative affect perceived their health goals as more difficult and less attainable than people with high positive affect. Together these studies reveal how feelings are central to the physical activity and health decision making processes. When people are feeling more positive about physical activity, their attitudes are more positive, they feel more able, they have greater intentions and are more likely to direct resources towards health behaviours and physical activity.

The contribution of positive affect to the initiation of, and long-term adherence to physical activity is evidenced within the upward spiral theory of lifestyle change proposed by Van Cappellen et al. (2018), an off shoot of the broaden-and-build theory of positive emotions (Fredrickson 2013). Within the theory, positive affect experienced during health behaviors, for example physical activity, leads to increased nonconscious motives for that behavior which increases the likelihood that an individual will seek out more opportunities for that behavior in the future. As more positive experiences occur, the motivation to seek out the health behavior grows leading to the development of a positive upward spiral. In addition, changes in an individual's biological and psychological resources (for example, resilience, mindfulness, self-belief, openness) occur over time as a direct result of experiencing positive affect; the broaden-and-build component of this theory (Fredrickson 2013; Van Cappellen et al., 2018). Such psychological resources result in people being more sensitive and open to subsequent

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positive experiences. Being more open to positive experiences leads to an incremental build-up of such experiences and supports further development of a positive upward spiral increasing the likelihood people will engage in the health behaviors (Van Cappellen et al., 2018). The upward spiral theory of lifestyle change demonstrates the role positive affect plays in physical activity engagement. Not only can positive affect foster motivation, intention, openness to more opportunities, physical activity engagement and adherence, but the very process of becoming more positive and open encapsulated through the broaden-and-build component of the model, can generate a more positive disposition and approach to life (Fredrickson 2013).

The potential effects of a positive disposition and approach to life highlights a limitation of the studies reviewed thus far. Their focus is on state affect. Examining the contribution of trait affect or affectivity may enhance our understanding of individuals' intentions for, and engagement in, physical activity. In the hierarchical structure of affectivity, Watson (2000) emphasised that long-term, stable and broad dimensions of affectivity shape our short-term feeling states. Negative affectivity causes significant individual differences in mood increasing feelings such as distress, nervousness, anger and guilt experienced by individuals over time and in different situations even in the absence of objective sources of stress (Watson & Clark 1984; Watson & Narragon 2009). Positive affectivity reflects an individual's propensity for feeling happy, optimistic, and enthusiastic predisposing people to be more enthusiastic, confident and happy on a day-to-day basis and satisfied with aspects of their lives (Watson 2000).

A number of studies evidence the association between affectivity, health and physical activity. Negative affectivity was linked with more health complaints whereas positive affectivity led to increased exercise (Watson 1988; 2000). Wurm and Benyamini (2014) examined physical functioning and optimism, measured using the affective valence of future time perspective scale. Although positive affectivity was not measured directly here, the characteristics of optimism – being more proactive towards protecting one's health, more persistent in one's efforts to attain goals and a more positive approach to coping with challenges – align with the approach-oriented elements of the behavioral facilitation system to which positive affectivity is identified as a component (Watson & Narragon 2009). Greater optimism has been associated with enhanced positive affect in older adults (Zeng & Gu 2017) and Wurm and Benyamini's research identified that if older adults were optimistic, even when they had negative self-perceptions associated with the physical losses experienced through aging, they remained in better health, displayed increased physical functioning and experienced lower depressive symptoms. Optimism buffered the detrimental effects of negative self-perceptions of aging. The change in self-perceptions of aging can be explained by the awareness of aging (AoA) framework in the context of life span development where psychological resources influence awareness of aging and concomitant self-perceptions of aging and ultimately developmental outcomes such as functional health, psychological wellbeing and engagement with physical activity (Diehl et al., 2014; Diehl et al., 2015). For example, a more positive and optimistic mindset is more likely to lead to a positive interpretation of aging with older adults recognising the physical, emotional and social gains associated with getting older as opposed to the losses (Diehl & Wahl 2010; Kaspar et al., 2018). In turn this is likely to lead to engagement in healthier lifestyle behaviors such as physical activity.

Revisiting Plys and Desrichard's (2020) analyses, trait negative affect was positively associated with the perceived difficulty of health goals although clarifications of the extent of this association in comparison to state affect was advocated. In contrast, a comprehensive review by Pressman and Cohen (2005) covering a range of ages and length of time to follow up, revealed consistent associations between trait positive affect and lower morbidity, fewer and less severe symptoms associated with illnesses or diseases, less pain, better health behaviors including more exercise and increased longevity. In a qualitative investigation, older adults (M_{age} = 63.1 years) identified that specific positive psychological constructs including positive affect, being energised, determined and optimistic helped them to initiate and maintain physical activity (Millstein et al., 2020). Additionally, Pasco et al. (2011) reported positive associations between positive affect and habitual physical activity in adult women. Both Millstein's and Pasco's findings provide evidence of the direct link between positivity and physical activity although in both pieces of research positive affect was measured as how participants felt in the last week. Positive affectivity could thus be an important factor in the process of engaging people in physical activity by increasing their enthusiasm and interest, enabling them to prepare for and persevere with challenges and cope with potential barriers to exercise they face.

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Another significant aspect of affectivity to consider is the combination of positive and negative valence. Positive and negative affectivity are independent yet related (Watson 2000) and it is possible for individuals to experience varying positive and negative affect which combine to affect physical activity behavior. To the authors knowledge no research has yet examined the combined effect of positive and negative affectivity on physical activity behavior although we can draw some understanding from research in other contexts. Van Yperen et al., (2003) combined positive and negative affectivity to analyse their relationship to job performance. Findings revealed a significant interaction with negative affectivity only affecting job performance when employee's positive affectivity was low. Although highlighting the important interaction between positive and negative affectivity, one potential drawback of the analysis in this paper is the creation of the interaction variable by multiplying the positive and negative affectivity scores. By doing this, regression analyses did not assess congruent affectivity profiles and their contribution to job performance. Pierce, Zhdanova & Lucas (2018) encompass affective congruence in their analyses of positive and negative affectivity on undergraduates' wellbeing. Individual affective profiles were identified as congruent with convergence between positive and negativity affectivity scores, or lacking congruence with differentiation between the two dimensions. Differentiated profiles were either high in positive affectivity and low in negative affectivity, termed positive affectivity ascendency (PA ascendency) or conversely, low in positive affectivity yet high in negative affectivity, termed negative affectivity ascendency (NA ascendency). Differentiation between the two affectivity dimensions significantly impacted well-being with PA ascendency being more associated with greater life satisfaction, lower perceived stress and lower levels of depression and cortisol activation. Furthermore, both Pressman and Cohen (2005) and Watson and Narragon (2009) emphasise that future research needs to consider the joint effects of positive and negative affectivity to aid our understanding of how affective valence affects physical and psychological health. The current research adopts the categorisation of convergence and differentiated affectivity profiles along with separate affectivity dimensions to enable a fuller analysis in relation to physical activity behaviors.

We suggest the concepts of subjective age, separate and combined effects of positive and negativity affectivity are central to the process of self-perceptions of aging and the decision to be physically active. However, a search of literature revealed no studies which examine these concepts together in a physical activity or exercise context. Understanding the association between positive and negative affectivity, subjective age and physical activity engagement will evidence the extent to which psychological factors proposed in the AoA model are related. Furthermore, the broaden-and-build theory of positive emotions indicates how positive dispositionality can be developed through small cumulative positive emotional experiences (Fredrickson 2013) and Kotter-Grühn (2015) suggest potential ways to change negative self-perceptions of aging. As both affectivity and self-perceptions are malleable, they can be targeted in interventions for older adults to increase physical activity and optimise health and well-being. There are three aims of this exploratory research. Firstly, to assess the relationships between subjective age, affectivity and physical activity levels in older adults. Secondly, to clarify the extent to which positive or negative affectivity are related to physical activity engagement and thirdly, to analyse the effect of joint positive and negative affectivity profiles on physical activity levels in comparison to separate affectivity dimensions. Based on the previous research the following hypotheses are proposed.

H_1 – Subjective age and positive affectivity will be positively related to physical activity and negative affectivity will be negatively related to physical activity

H_2 – Positive affectivity will predict physical activity more than negative affect

H_3 – Combined affectivity profiles will predict subjective age and physical activity more than separate positive and negative affectivity.

METHOD

SAMPLE AND STUDY DESIGN

Thirty-four older adults (17 women, $M_{age} = 70 \pm 4$ years, age range: 65 – 78 years) volunteered to participate. Participants were recruited through Active Aging festivals, verbal announcements at seniors' physical activity sessions, established networks and advertisements in University

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of the Third Age (U3A) electronic newsletters. Inclusion criteria required participants to live independently in the community and walk without assistance.

Using a cross-sectional design, participants completed self-report measures and took part in an interview-administered physical activity survey. Data collection was conducted in quiet neutral locations or in the participants own home. Institutional ethics approval was obtained, and participants completed written informed consent prior to participating (Ethics committee reference number: ISES2016CR1).

MEASURES

Physical activity

The Yale Physical Activity Survey (YPAS; Dipietro et al. 1993) assesses a broad range of physical activities in older adults and was administered in an interview format minimising under or over reporting of activities associated with subjective retrospective recall methods (Washburn, 2000). Interviews lasted between 30–40 minutes. Participants reported the number of hours per week they engaged in household work, yard work, caring for others, exercise and recreational activities along with reports of current participation in different intensities of activity yielding eight YPAS indices. The YPAS is validated with objective physical activity methods including accelerometers and VO_{2max} and demonstrates reliability in older adult samples (Król-Zielińska & Ciekot 2015). A seasonal adjustment score was applied to YPAS data to account for the differences in physical activity levels reported during interviews in different seasons (Dipietro et al., 1993; Ribeiro et al., 2016). The indices used in the present research are outlined.

Physical Activity Total Time: adapted from the YPAS total time index, time spent in activities relating to sport, exercise and physically active recreation during a typical week in the last month were summed to create the physical activity total time expressed in hours per week.

Physical Activity Energy Expenditure: time spent on each sport, exercise and physically active recreation activity was multiplied by an intensity weight (kcal per min; Ainsworth et al., 2011; Dipietro et al., 1993) and then summed to create physical activity energy expenditure expressed in kcal per week. Intensity weights are based upon standard resting metabolic rate of 60 kcal per min and are independent of individual body weight and resting metabolic rate variation.

Activity Indices: four YPAS activity indices were used. Total summary index was derived from summation of five YPAS indices reflecting an individual's current participation in different intensity activities: vigorous activity (units per month), leisurely walking (units per month), moving (hours per day), standing (hours per day) and sitting (hours per day). Based upon responses to categorical questions, scores for each index were calculated by multiplying a frequency score (the number of times activities of each intensity were performed in the last month/day) by a duration score for each activity (minutes) and by a weighting factor based upon the intensity of the activity (vigorous intensity = 5, walking intensity = 4, moving = 3, standing = 2, sitting = 1). The total summary index ranges from 0–137 with higher levels of physical activity as scores increase (Dipietro et al., 1993; Donaire-Gonzalez et al., 2011). In addition, vigorous activity, walking and moving indices were analysed separately to examine the differences in physical activity levels in each specific intensity category.

Age, felt age and proportional discrepancy subjective age

Participants were asked to report their chronological age (years). Felt age (years) was measured by asking participants to respond to the question "How old do you feel most of the time?". A proportional discrepancy subjective age was then calculated ([felt age – chronological age]/chronological age) following the method by Kotter-Gruhn et al. (2016) to control for the potentially different meanings associated with discrepancy scores at different ages. The proportional discrepancy subjective age score ranges from –1 to 0 with lower scores interpreted as participants feeling younger than their chronological age. Proportional discrepancy subjective age scores can be reported as percentages and reflect an individual feeling X% younger. For example, a score of –0.26 equates to feeling 26% younger than their chronological age. For ease in reporting, proportional discrepancy subjective age is referred to from here on as subjective age and expressed as a percentage.

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Positive and negative affectivity

The Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen 1988) measures the independent constructs of dispositional positive and negative affect via two subscales comprising 10 adjectives each (e.g. 'interested'; 'distressed'). Participants reported the extent to which they generally felt each adjective using a 5-point Likert scale from 1 (*not at all*) to 5 (*extremely*) and ratings were summed giving separate scores for positive affectivity and negative affectivity each ranging from 10 to 50. Larger scores represent higher levels of affectivity. Individuals high in positive affectivity experience pleasurable moods more frequently whereas those higher in negative affectivity are prone to experience negative mood states including anxiety, distress and guilt in a range of situations. Cronbach alpha's showed acceptable internal consistency for both positive and negative affectivity (.92 and .78 respectively; Watson et al., 1988) and in this current sample (.86 and .86 respectively).

ANALYSES

Pearson correlations were used to examine relationships between subjective age, affectivity and physical activity indices. To examine the effects of subjective age, positive and negativity affectivity or combined positive and negative affectivity profiles on physical activity indices six exploratory hierarchical multiple regressions were performed. For each dependent variable, physical activity total time, physical activity energy expenditure, total activity summary index, vigorous activity, walking index and moving index, we tested two separate regression models. The first regression model tested the separate effects of positive and negative affectivity along with subjective age. Predictor variables were entered in separate blocks; step 1, subjective age followed by step 2, positive affectivity and negative affectivity. The second regression model tested the combined effect of positive and negative affectivity along with subjective age. Following the method by Pierce et al. (2018), the difference in *z* scores for positive affectivity and negative affectivity were examined and three groups were created. Group 1, PA ascendency, where the individual's positive affectivity was higher than their negative affectivity (PA higher than NA). In this group, participants positive affectivity score was 0.5 *SD* above their negative affectivity score showing discrepancy between positive and negative affectivity. Group 2, PA-NA convergence, where the individual's positive and negative affectivity levels were similar (PA in agreement with NA). In this group, there was less than 0.5 *SD* between the participants positive affectivity and negative affectivity scores, demonstrating convergence between affectivity variables. Finally Group 3, NA ascendency (PA lower than NA), where the individual's positive affectivity was lower than their negative affectivity. Participants whose positive affectivity score was 0.5 *SD* below their negative affectivity were allocated to this group, again a profile showing discrepancy between affect variables. Regression model 2 was a mixed regression model where step 1 entered subjective age (continuous variable) followed by step 2, the categorical variable of combined affectivity profiles. The three affectivity groups were dummy coded and two of the new dummy coded variables *PA ascendency compared to NA ascendency* and *PA-NA convergence compared to NA ascendency* were entered into regression model 2 with NA ascendency used as the reference group. To examine the effects of positive and negative affectivity on subjective age two regression models were compared. Initially subjective age was regressed on separate positive and negative affectivity (Model 1). The second regression model (Model 2) tested the combined effects of positive and negative affectivity previously described. Hierarchical multiple regression assumptions were assessed to ensure robust model fit. Cook's distance, Mahalanobis distance, deviation from average Leverage values, covariance ratio, standardised DFBeta and DFFit values were explored to assess residuals and outliers for influential cases. No outliers were found. Multicollinearity was assessed using intercorrelations between predictor variables, average variance inflation factor (VIF), individual VIF, tolerance (1/VIF) and examination of covariance matrices. Data were scrutinised for homoscedasticity and normal distribution using residual plots and normal P-P plots. IBM SPSS Statistics for Windows (version 27, IBM Corp., Armonk, NY) as used with alpha set at 0.05 was used for all analyses.

RESULTS

Descriptive statistics and intercorrelations between study variables can be found in Table 1. Felt age was significantly lower than chronological with 94% of participants reporting feeling younger than they actually were ($M_{felt\ age}$ = 51 ± 12 years, $M_{chronological\ age}$ = 70 ± 4 years, t = 9.29,

$p = 0.001$). Felt age did not differ between females and males ($M_{females} = 52 \pm 13$, $M_{males} = 50 \pm 12$, $t = -0.48$, $p = 0.64$) and consequently no further analyses with gender were performed. Physical activity duration in a typical week varied substantially ranging from 1.73 to 22 hours. Six participants (17%) did not meet UK national guidelines of at least 150 minutes of moderate intensity activity per week.

Positive affectivity was related to the most physical activity variables out of the three predictor variables in this research. Higher levels of positive affectivity were associated with higher levels of physical activity, physical energy expenditure and total activity in a typical week as well as increased number of hours moving per day. Contrary to hypothesis one, subjective age was weakly correlated with the physical activity variables which were not significant. Subjective age was however negatively related to positive affectivity indicating participants who reported feeling younger than their chronological age also reported higher levels of positive affectivity. Participants age was positively and moderately related to negative affectivity and negatively related to the moving index. In addition, negative affectivity was only significantly correlated with moving whilst all other variables were weak and non-significant. Older adults in this sample who were reporting more general negative dispositions were also moving less during the day. Overall partial support for hypothesis one was obtained.

VARIABLE		*M*	*SD*	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1.	Age	70	4	–										
2.	Felt age	51	12	.39*	–									
3.	Subjective age	−26	17	.15	.99***	–								
4.	Positive affectivity	40.7	5.2	−.20	−.39*	−.36*	–							
5.	Negative affectivity	15.1	3.7	.34*	.28	.20	−.29	–						
6.	Physical activity total time	10.26	6.49	−.12	−.21	−.19	.44**	−.13	–					
7.	Physical activity EE	2914	2271	−.05	−.23	−.24	.36*	−.16	.89***	–				
8.	Total activity summary index	66.85	25.80	−.20	−.16	−.11	.34*	.07	.43*	.35*	–			
9.	Vigorous activity index	26.65	20.41	−.19	−.11	−.07	.30	−.04	.31	.36*	.82***	–		
10.	Walking index	21.35	13.96	−.01	−.07	−.07	.13	.28	.28	.06	.56**	.01	–	
11.	Moving index	12.13	2.83	−.36*	−.28	−.21	.46**	−.42*	.29	.24	.29	.17	.09	–

Table 1 Intercorrelations and Descriptive Statistics for Age, Subjective Age, Affectivity and Physical Activity.

Note. Total time is measured in hours per week, EE = Energy expenditure (kcal per week), vigorous and walking index are measured in units per month, moving index is measured in hours per day. Subjective age is the proportional discrepancy age as a percentage with more negative values equating to a younger perceived felt age. Physical activity includes sport, exercise and physically active recreation activities.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Regression analyses tested two regression models. Firstly, the separate effects and secondly the combined effects of positive and negativity affectivity. Table 2 shows subjective age and levels of positive and negative affectivity for each of the three new groups examined in Model 2; two for differentiated affectivity, PA ascendency and NA ascendency and one for convergent affectivity profiles. Subjective age scores were lower for PA ascendency indicating participants in this new group felt on average 33% younger than their actual age. Where positive and negative affectivity were congruent, participants reported feeling on average 24% younger, whereas those in the NA ascendency group felt closer in age to their actual age (16% younger). To illustrate this, a participant in the PA ascendency group with an actual age of 65 would report feeling about 44 years. A 65 year old with congruence between their positive and negative affectivity would report feeling 55 years old or about 50 years old if they exhibited an NA ascendency profile. Positive affectivity scores were dominant in the PA ascendency group and reduced across the groups to NA ascendancy whilst negative affectivity scores are highest in the NA ascendency groups as expected.

Regression analyses examined physical activity behavior from subjective age and affectivity. Physical activity total time was not predicted by either regression model 1 (subjective age, positive and negative affectivity, $R^2 = .2$, $p > 0.05$) or model 2 (subjective age, PA ascendency, PA-NA convergence and NA ascendency, $R^2 = .13$, $p > 0.05$). Similar non-significant regression models were obtained for physical activity expenditure ($R^2_{\text{Model 1}} = .14$, $p > 0.05$, $R^2_{\text{Model 2}} = .10$, $p > 0.05$), total activity summary index ($R^2_{\text{Model 1}} = .15$, $p > 0.05$, $R^2_{\text{Model 2}} = .10$, $p > 0.05$), vigorous activity ($R^2_{\text{Model 1}} = .01$, $p > 0.05$, $R^2_{\text{Model 2}} = .10$, $p > 0.05$) and walking index ($R^2_{\text{Model 1}} = .13$, $p > 0.05$, $R^2_{\text{Model 2}} = .02$, $p > 0.05$).

	SUBSAMPLE *n* (%)	SUBJECTIVE AGE *M* (*SD*)	AFFECTIVITY SCORE *M* (*SD*)	
AFFECTIVITY GROUPS			**PA**	**NA**
PA ascendency	17 (50)	−33 (16)	44.1 (2.5)	12.7 (1.8)
PA-NA convergence	7 (21)	−24 (16)	40.1 (2.9)	14.9 (2.1)
NA ascendency	10 (29)	−16 (15)	35.3 (5.5)	19.3 (3.4)

Table 2 Subsamples, Subjective Age and Affectivity Scores for Affectivity Groups.

Note. PA = Positive Affectivity, NA = Negative Affectivity. Subsamples were derived from the comparison of standardised scores for PANAS positive and negative affectivity where PA ascendency includes participants with a PA score >0.5 *SD* above NA, PA-NA convergence includes participants with <0.5 *SD* between their PA and NA scores and NA ascendency includes participants with a PA score >0.5 *SD* below their NA score. Affectivity scores for each new group were derived from PANAS. Subjective age is the proportional discrepancy age as a percentage with more negative values equating to a younger perceived felt age.

Both regression models for moving index, hours moving per day, were significant (see Table 3). In model 1, which accounted for 30% of variance, only positive affect was a significant predictor of daily moving (ß = .36, *B* = .20, SE = .09, *p* = 0.039) indicating that increases in positive affectivity could result in 1 hour more moving per day. Negative affectivity did not predict daily moving although this would need verification in further studies due to possible heteroscedasticity for this predictor. In model 2, which demonstrated good model fit, PA ascendency was the largest and only significant predictor of daily moving (ß = .67, *B* = 3.75, SE = 1.1, *p* = 0.002) with the overall regression model accounting for 31% of variance in moving index. Interpreting the standardised regression weights, a participant with a PA ascendency profile was significantly likely to spend approximately 2 hours more moving around during the day than a participant with a NA ascendency profile. In both models 1 and 2 subjective age and negative affect were not predictors of daily moving index and the PA-NA convergence profile had only a slightly greater and non-significant effect on daily moving compared to the NA ascendency profile.

VARIABLE	*B*	95% CI FOR *B*		*SE B*	ß	R^2	ΔR^2
		LL	*UL*				
Model 1							
Step 1						.04	.04
Constant	11.21**	9.37	13.05	0.90			
Subjective age	−0.04	−0.09	0.02	0.03	−.21		
Step 2						.30	.25**
Constant	7.62	−1.42	16.65	4.43			
Subjective age	0.00	−0.06	0.05	0.03	−.02		
Positive affect	0.20*	0.01	0.38	0.09	.36*		
Negative affect	−0.23	−0.48	0.02	0.12	−.31		
Model 2							
Step 1						.04	.04
Constant	11.21**	9.37	13.05	0.90			
Subjective age	−0.04	−0.09	0.02	0.03	−.21		
Step 2						.31	.27**
Constant	10.05**	8.21	11.89	0.90			
Subjective age	0.01	−0.05	0.07	0.03	.05		
PA ascendency compared to NA ascendency	3.75**	1.51	5.98	1.10	.67**		
PA-NA convergence compared to NA ascendency	2.13	−0.39	4.64	1.23	.31		

Table 3 Multiple Regression Analyses for Moving Index.

Note. CI = confidence interval; *LL* = lower limit; *UL* = upper limit. In Model 1, we entered subjective age followed by positive and negative affectivity as separate predictor variables. In Model 2, we entered subjective age followed by the combined affectivity profiles of PA ascendency, PA-NA convergence and NA ascendency. In Model 2, the dummy coded reference variable is NA ascendency. ΔR^2 = change in R^2.

*$p < .05$, **$p < .01$.

The regression analyses to assess whether subjective age was predicted by separate or combined affectivity dimensions are reported in Table 4. The separate dimensions of positive and negative affectivity did not predict subjective age ($F_{change\ (2,\ 31)} = 2.5$, $p > 0.05$). In addition, the intercept for this model was also non-significant indicating insufficient statistical evidence to reject the null hypothesis. This model had poor model fit with possible heteroscedasticity for negative affectivity and re-analysing with another sample would be necessary. The combined

affectivity dimensions in model 2 significantly accounted for 20% of the variance in subjective age. PA ascendency significantly predicted subjective age (ß = −.52, *B* = −17.25, SE = 6.20, *p* = 0.009). Participants demonstrating a PA ascendency profile were significantly more likely to feel approximately 17 years younger than participants in the NA ascendency group. Model 2 must be considered with caution however with possible multicollinearity between PA ascendancy and PA-NA convergence predictors.

VARIABLE	MODEL 1			MODEL 2		
	B	ß	*SE B*	*B*	ß	*SE B*
Constant	9.12		28.77	−16.1**		4.92
Positive affect	−1.10	−.33	0.56			
Negative affect	0.49	.11	0.79			
PA ascendency compared to NA ascendency				−17.25**	−.52	6.20
PA-NA convergence compared to NA ascendency				−8.04	−.20	7.67
R^2	.14			.20*		

Table 4 Multiple Regression Analyses for Subjective Age.

Note. CI = confidence interval; *LL* = lower limit; *UL* = upper limit. In Model 1, we entered subjective age followed by positive and negative affectivity as separate predictor variables. In Model 2, we entered subjective age followed by the combined affectivity profiles of PA ascendency, PA-NA convergence and NA ascendency. In Model 2, the dummy coded reference variable is NA ascendency.

*$p < .05$, **$p < .01$.

Taken together, these findings provide partial support for hypothesis two with positive affectivity predicting physical activity above and beyond negative affect however this only occurred for the moving index. For hypothesis three we proposed combined positive and negativity affectivity would predict outcome variables more than separate positive and negative affectivity. Combined affectivity profiles predicted subjective age but separate affectivity dimensions did not. A PA ascendency profile led to participants feeling younger than a NA ascendency profile. In relation to physical activity outcome variables, both positive affectivity and PA ascendency were significant positive predictors but only for the moving index. Both models accounted for similar variances (30% and 31%) it is difficult to identify whether the separate or combined affectivity profile is better. The standardised beta weights for PA ascendency were slightly higher than for positive affect alone (ß = .67 and ß = .36 respectively) suggesting the combined profile of PA ascendency is a slightly more accurate predictor of moving index although this needs further verification.

DISCUSSION

No previous research has investigated the associations between both subjective age and affectivity with physical activity. This research addressed this gap whilst also examining the conjoint effects of positive and negative affectivity on both subjective age and physical activity. A key finding of this research is that positive affectivity showed more significant positive correlations with physical activity than either subjective age or negative affectivity providing partial support for hypothesis one. In this sample of older adults, higher levels of positive affectivity were associated with more hours per week engaging in physical activity and concomitant increases in energy expenditure. In addition, participants reported more daily moving with higher levels of positivity which supports previous research findings linking positive affectivity with physical activity engagement (Pressman & Cohen 2005; Millstein et al., 2020; Watson 2000). Although negative affectivity was significantly and negatively related to moving it did not predict the moving index with positive affectivity the only significant variable in the regression model accounting for 30% of variance in moving and providing partial support for hypothesis two. The lack of significant relationships with physical activity variables suggests that negative affectivity was less influential on physical activity behaviors than positive affectivity in this study. This outcome is contradictory to Plys and Desrichard (2020) who found trait negative affect to be more related to the perceived difficulty of health goals than positive affect.

Possible explanations for the greater role of positive affectivity in comparison to negative affectivity in this study revolve around the beneficial effects of positive emotions leading to individuals engaging in more health behaviors. The broaden-and-build theory of positive emotions and its related upward spiral theory of lifestyle change and the hierarchical structure of positive affectivity can aid our explanation of these effects. Positive emotions broaden peoples' thoughts and actions (Fredrickson 2013) making them more open to the physical, emotional

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and social benefits of physical activity in turn causing them to seek out these activities more often in the future (Van Cappellen et al., 2018). Discrete positive emotions are also suggested to cumulatively develop over time building psychological resilience and well-being and countering downward negative emotional spirals. Actively cultivating daily positive emotions can eventually lead to human flourishing, a more positive disposition and positive emotionality and a healthy, long, meaningful life (Fredrickson 2004; 2013). The hierarchical structure of affect reinforces these processes as positive affectivity directs individuals towards situations that potentially yield pleasure and reward as part of the behavioral facilitation system (Watson & Narragon 2009). Individuals high in positive affectivity are more predisposed to positive state affect experiencing confidence, enthusiasm, attentiveness and determination and importantly there is the potential to raise positive affectivity significantly (Plys & Desrichard 2020; Watson & Narragon 2009). The more predictive effects of positive affectivity in comparison to negative affectivity in the older adults in this sample may explain the associated increased physical activity levels. The older adults were more approach oriented, more likely to seek out activities they enjoyed, or which positively influenced their health. In turn, it is possible the positive emotions experienced during these physical activities broadened their positive outlook and developed motivation and intention to seek out physical activities more in the future.

Although we cannot identify whether our older adults developed a more positive resilient outlook on life over time or had higher levels of positive affectivity to begin with, our findings suggest that positive affectivity is important in demonstrating links between affect and health behaviors. As the psychological processes outlined here show how positive affect(ivity) can lead to further engagement in physical activity, the starting point of this process does require an individual to feel good about the activity and experience positive affect or have a high level of positive affectivity initially. State positive affect can be optimised in numerous ways including downward social comparisons regarding physical performance (Stephan et al., 2013), manipulating exercise intensity to reduce physiological distress and create a positive subjective experience to exercise (Bryan et al., 2007) and positive experience inducing video interventions (Allen Catellier et al., 2013) all leading to improved performance, increased physical activity levels or increased intention to engage in physical activity. Positive affectivity may also be influenced via repeated positive experiences inducing the build effect of the broaden-and-build theory (Fredrickson 2004; 2013; Millstein et al., 2020) and potentially changing negative age stereotypes leading to more positive self-perceptions and a positive approach to aging and physical activity engagement (Kotter-Grühn 2015). The ability to alter positive feelings and their connection to physical activity renders them worthy of consideration for future physical activity promotion initiatives.

Another key finding of this paper relates to our proposition that conjoint, more so than separate, positive and negativity affectivity may help us understand physical activity levels in older adults. PA ascendency, where an individual's positive affectivity levels were higher than negative affectivity levels, significantly predicted daily moving, with the model fit and individual contribution of PA ascendency being slightly greater than the separate effect of positive affectivity alone. Older adults demonstrating a PA ascendency profile, would generally move more during each day by approximately 2 hours in comparison to someone with a NA ascendency profile, where their negative affectivity was higher than their positive affectivity. Although previously separate effects of positive and negative affect have been shown to predict physical activity levels, health and longevity (Pressman & Cohen 2005), there is partial evidence within this study to give further consideration to the joint effects of positive and negative affectivity. Our findings support previous research demonstrating the overriding effect positive affectivity has when examined in comparison to changing negative affectivity. Higher levels of positivity compared to negativity (positivity ratio) underpins flourishing mental health, feeling happy and doing good, life satisfaction and adjustment (Fredrickson 2013) and PA ascendency led to greater life satisfaction, lower perceived stress, depression and cortisol activation (Pierce et al., 2018). It seems plausible then that a higher ratio of positive affectivity to negative affectivity in these older adults could also initiate and maintain levels of physical activity. Positive individuals are more approach oriented, confident and open to new experiences leading to them adopting physical activity particularly given the link between positivity and health behaviors (Pressman & Cohen 2005). Conversely, negativity narrows attention with individuals more likely to experience distress, nervousness or fear, creating

barriers to physical activity (Fredrickson 2013; Hudson et al., 2015; Plys & Desrichard 2020; Millstein et al., 2020). In addition, the higher levels of positivity may buffer against the negative perceptions of aging similar to the effects of optimism found by Wurm and Benyamini (2014) particularly as extensive evidence shows positive affectivity and optimism are highly correlated (Watson 2000; Zeng & Gu 2017). Although not conclusive, our findings offer partial evidence that combined affectivity profiles might be worth considering in future research to help explain why some people engage in physical activity and others do not.

The important role of positive affectivity in this study is further strengthened by the surprising lack of significant relationships between subjective age and any of the physical activity variables found in this study. Based upon previous research we proposed that subjective age would be associated with higher physical activity levels in our older adults, as feeling younger was frequently shown to lead to more regular exercise and better physical fitness in older adults (Wang et al., 2022; Wienert et al., 2017). Our results differed from the previous research as subjective age consistently lacked significant associations or predictive ability for physical activity in all regression analyses in this current study, indicating that positive affectivity was more important than subjective age in physical activity prediction. In this sample, older adults with more energy, interest, enthusiasm and activity had higher levels of daily moving but their perceptions of feeling younger had no effect.

The awareness of aging framework proposes how psychological resources, including personality, influence an individual's self-perceptions of aging which subsequently alter self-regulation processes and developmental outcomes such as functional health and physical activity levels (Diehl et al., 2014). Our findings were not able to support the latter proposals of this theory, but we can offer preliminary support for the former. PA ascendency significantly predicted subjective age with older adults displaying this affectivity profile feeling approximately 17 years younger than someone displaying a NA ascendency profile. Therefore, positive affectivity, reflecting an individual feeling cheerful, enthusiastic and high in energy more so than someone with low positivity, coupled with a lower predisposition to feel distress and worry led to individuals feeling younger than their chronological age.

Although not evidenced in the current findings we also suggest that a positive affectivity profile with high positivity and low negativity creates a scenario where individuals feel younger and are then more likely to perceive aging as a process of gains rather than losses. Biological aging leads to physical, emotional, social and cognitive decline yet it can also lead to individuals paying more attention to their health due to this physical decline, celebrating their expertise and world knowledge rather than the inevitable declining mental capacity, appreciating relationships more and having better coping skills rather than the feelings of dependency and finding freedom to prioritise activities related to enjoyment and personal fulfilment (Brothers et al., 2019; Diehl & Wahl 2010). Positive affectivity changes how people perceive their health and their bodies. Individuals with more positive perceptions of aging have increased feelings of control over their aging bodies, an awareness of the alternatives to the potential physical decline and an increased responsibility for health (Hudson et al., 2015). Certainly, having the predisposition for a positive optimistic outlook renders more positive self-perceptions of aging which are more likely to lead to someone engaging in positive behaviors for health (Kotter-Grühn et al., 2016; Stephan et al., 2013; Wienert et al., 2017). It is possible that subjective age mediates or moderates the relationship between positive affectivity and physical activity, however such analysis was not within the scope of this current research and would be an area for future research.

Limitations in this research which require consideration include the low sample size rendering analyses more exploratory than explanatory. Whilst model fit was achieved for model 2, the effect of combined affectivity profiles on daily moving, the low sample size for comparison of the subgroups within this analysis limits the generalisability of the findings. However, we feel our exploratory approach examining the combined affectivity profiles is worthy and offers an insight into a promising area for future research. This pilot study suggests a feasible new methodological approach to examine affect-physical activity relationships in older adults. With the additional evidence from Model 1 with a larger sample size, the findings suggest that positive affectivity does influence daily moving above and beyond subjective age. As well as increasing the sample size in future studies, using a longitudinal design would allow testing of

mediation and moderation, assessment of the proposed paths of the AoA framework and allow confirmation of whether combined profiles of affectivity remain better predictors of physical activity than separate positive and negative affect together with clarifying whether positive affectivity rather than negativity affectivity is the dominant construct. Only the YPAS moving index was accounted for in this research with no relationships with other indices such as activity hours per week or vigorous or walking activity intensities. This is unusual and may suggest lack of accuracy in measuring physical activity through the interview based YPAS measurement despite its reliability and validity to objective physical activity measures reported in a variety of large-scale research studies (Król-Zielińska & Ciekot 2015; Ribeiro et al., 2016). There were large variations in physical activity reported across the group particularly for physical activity indices that required participants to recall hours of activity across a typical week in comparison to the moving index which recalls typical hours per day which was easier to recall and average. This may account for the lack of significant relationships between physical activity measures per week compared to per day. Additional research with increased samples would confirm the accuracy of physical activity measurement.

CONCLUSION

To the best of our knowledge, this is the first cross-sectional study to examine the influence of subjective age, affectivity and physical activity levels. The results suggest the importance of positive affectivity and in particular, the conjoint effects of high positive affectivity with low negative affectivity, although this was limited to one particular element of physical activity indices measured. The study has also shown that PA ascendency predicted subjective age. In addition, these findings extend the evidence of dispositional affect influencing some physical activity levels. These findings, whilst preliminary, shed new light on the psychological processes leading to physical activity engagement and as such have important implications for public health and behavior change for sedentary or low active older adults. Positive affectivity leads to daily levels of positive affect which are important in decision making, persistence and maintaining regular physical activity and if we can influence this process, through reducing stereotypes, cultivating positive experiences or optimising positivity ratios, we have the possibility to shape health behavior. Considerably more work will need to be done to confirm these proposed effects and the AoA model provides us with a framework to do this.

ETHICS AND CONSENT

Institutional ethics approval was obtained, and participants completed written informed consent prior to participating (Ethics committee reference number: ISES2016CR1).

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

The conception of study idea, design and data collection was undertaken by both CR and JJ. Analyses, interpretation and results as well as writing of the study were completed by CR. Both authors read and approved the final manuscript.

AUTHOR AFFILIATIONS

Clare Louise Rhoden orcid.org/0000-0001-9126-9483
University of Worcester, UK

Jennifer Joyce
University of Worcester, UK

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