

Exploring the happiness and sense of purpose associated with older peoples' activities using ecological momentary analysis: an observational study

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Abstract

Background

Older people have more leisure time, but many are physically inactive. Momentary feelings of pleasure or happiness and sense of purpose can be sources of intrinsic motivation. This study's objective was to investigate how the type (sedentary, active) and context (social and environmental) of older peoples' activities relate to momentary feelings of happiness and purpose.

Methods

Details of activities, contexts and feelings of retired or semi-retired adults (n=67, aged 50-78y) were captured over 7 days using ecological momentary assessment (EMA) via a smart phone app. Participants were prompted on their smart phone six times at random per day, resulting in 2,065 valid prompts. They wore an Actigraph accelerometer on the waist for 7 days to measure physical activity. Happiness and sense of purpose outcome variables were regressed on activities, context and potential confounding variables (e.g. age, gender, physical activity). Regression standard errors were clustered on participants to account for the hierarchically structured data. Interactions between activities and contexts were explored.

Results

Participants were highly active: 98.5% met physical activity guidelines. Sedentary activities were negatively associated with sense of purpose, especially when indoors. Social sedentary activities (e.g. visiting friends and family) were, however, positively associated with feelings of happiness. Active, social outdoor activities were positively associated with both outcomes. Less sedentary participants experienced higher happiness and sense of purpose during all their activities: each 1 percentage point increase in percentage time sedentary was associated with a reduction of 2.78-points on the happiness scale and 3.34 on the purpose scale ($p < 0.05$).

Conclusions

Context is important for happiness and purpose, with social and outdoor activities likely to have the widest appeal for older adults. The study needs to be replicated in larger and more representative samples of older adults.

Background And Rationale

The benefits of physical activity for slowing the ageing process and improving quality and length of life are well-known (Bangsbo et al., 2019), yet > 25% of adults 55-64y in England report fewer than 30 minutes per week at health-improving moderate-vigorous intensity. The percentage inactive rises to almost 70% for those aged 85+ (Sport England, 2019).

Sense of purpose and pleasure are sources of intrinsic motivation identified in self-determination theory (Ryan and Deci, 2001), which underpins many health-related behaviour change interventions (Patrick and Williams, 2012), and could be leveraged to promote physical activity among older people (Cabrita et al., 2017) who try to balance feelings of pleasure- (i.e. happiness - and purpose) from moment to moment in everyday life (Dolan, 2014). Understanding how older peoples' activities relate to momentary feelings of happiness and/or purpose would help to inform the design of effective interventions and policies to increase physical activity and reduce sedentary behaviour among older people, which is a public health priority (Public Health England, 2014).

Previous studies of older peoples' activities and their relationship to experiential feelings use retrospective evaluations (Oerlemans, Bakker and Veenhoven, 2011; Kavčič and Avsec, 2018; Stone et al., 2018). A recent study of older adults sampled using the American Time-Use Survey (ATUS) found 'active leisure (e.g. sports, exercise and recreation) was associated with greater

'happiness' and 'meaningfulness' when compared with passive (sedentary) leisure (e.g. screen time) (Yamashita, Bardo and Liu, 2018). However, this study did not consider activities' social and environmental contexts, which are important among older people (Finlay et al., 2015; Boulton, Home and Todd, 2018). Furthermore, activities were classified as active or passive retrospectively by the researchers, which risked misclassifications. Moreover, memories of feelings experienced yesterday - as collected by the ATUS - are less reliable than immediate recall, particularly for older adults (Galenkamp et al., 2016), who may be experiencing decline in short-term memory (Verhaeghen, 2013).

A more accurate method of capturing behaviour, feelings and contexts simultaneously is via prompted, frequent, real-time self-reports known as ecological momentary assessments (EMA) (Shiffman, Stone and Hufford, 2008). A study using smartphone-delivered EMA over 30 days in a small sample (n = 10) of older adults (65-83y), found that social, outdoor leisure activities were associated with higher experiential pleasure than non-leisure activities performed alone or indoors (Cabrita et al., 2017). Experiential feelings of purpose were not considered in this study.

The objective of this study, therefore, was to investigate how the type (sedentary, active), social (alone or with others) and environmental (indoors or outdoors) contexts of activities relate to momentary feelings of happiness and purpose assessed using EMA methods in a sample of retired or semi-retired, community-living older adults.

Methods

Study Design, Participants And Setting

A cross-sectional observational design was adopted. Participants were recruited via responses to messages posted on social media groups (e.g. Facebook sports club groups), forums (e.g. London School of Economics Alumni) and personal contacts. Participants were eligible if ≥ 50 years, fully or semi-retired, owned a smart-phone, and able to attend an enrolment meeting in London or Loughborough, East Midlands (UK). Seventy-three adults met the inclusion criteria and consented to take part. Recruitment spanned February to December 2019. During their enrolment meeting, eligible participants provided informed consent, were familiarised with study procedures and equipment, assigned an initialised Actigraph activity monitor, shown how to download and login to the EMA app and asked to complete a survey.

Measurements and procedures

Ecological Momentary Assessment

Details of activities, contexts and feelings were captured using EMA (Shiffman, Stone and Hufford, 2008). Several studies have demonstrated the feasibility, acceptability, reliability and validity of smartphone-based EMA to measure behaviours and feelings in a variety of older populations (Maher, Rebar and Dunton, 2018; Paolillo et al., 2018; Liu and Lou, 2018). Ethica software (www.ethicadata.com) was selected because it had both Android and IOS versions, making it compatible with most mobile phones. The EMA protocol was piloted in six smartphone users aged 50+ and modifications made.

At the initial meeting participants completed a survey through the Ethica app which asked about age, gender, ethnicity, religion, self-assessed health, highest educational level achieved, whether living alone, whether working part-time or not, number of adults in household, and overall life satisfaction and worthwhileness of life, all of which have been previously identified as confounding factors in analyses of subjective wellbeing (Dolan, Kudrna and Stone, 2017), or associated with choice of leisure-time activities (Galenkamp et al., 2016). Principal sources for question wordings included the Office for National Statistics harmonised wordings for the 2011 Census and the Taking Part Survey questions (Ipsos MORI, 2018)

Over the seven days of monitoring, participants received six prompts at random within 150-minute windows between 06:30 and 21:30 to complete 6 questions about their main activity in the last hour and their feelings of happiness and sense of purpose during that activity. They were instructed to answer prompts immediately but only when safe and convenient. Participants were asked: *What was your main activity in the last hour?* (21 activities, grouped into six higher-level categories (physical, mental, social, recreational, travel and resting), similar to those used in previous studies of older peoples' activities (Chang, Wray and Lin, 2014); Galenkamp et al., 2016; Yamashita, Bardo and Liu, 2018)). They were then asked to rate their happiness and sense of purpose on a visual analogue scale by moving a slider from the default setting of 5 to a number between 0 (*not at all*) and 10 (*totally/wholly*) (Office for National Statistics, 2015; Cabrita et al., 2017). Participants were then asked: *What was your posture while carrying out this activity?* (*Standing/Sitting/Lying Down/Moving about*). *Were you indoors or outdoors while doing it?* (*Indoors at home/ Indoors another venue/In a vehicle/ Outdoors/Mix of the above*). *Who were you doing it with?* (*Alone/With a pet/With people I don't know/With people I met through this activity/With friends/family/With a service provider (e.g. doctor; shop assistant)*).

Accelerometry

Participants were asked to wear an Actigraph accelerometer, either GT3x or wGT3X- BT (Actigraph, 2013) over the right hip using an elasticated waist band during waking hours for seven consecutive days. These devices have been identified as having acceptable validity and reliability in older adults (Copeland and Esliger, 2009). Data were collected at a sampling rate of 100 Hz and downloaded in epochs of 60 seconds for analysis using Actilife software. Raw Actigraph data files were reprocessed to derive outcome variables, using custom data reduction software (KineSoft, V.3.3.67, Loughborough, UK). Non-wear time was defined as ≥ 60 minutes of consecutive zero counts, allowing for 2 minutes of non-zero interruptions (Tay, Chan and Diener, 2014). Participants' accelerometer data was considered valid if they had ≥ 5 days with ≥ 10 hours of valid accelerometer wear (Pruitt et al., 2008). Vertical axis intensity cut-points derived for use in older participants were adopted (Copeland and Esliger, 2009).

Statistical Methods

The unit of analysis is a single response to an EMA prompt. Happiness and purpose outcome measures were regressed on activities undertaken, controlling for confounding influences from the social and environmental context (e.g. where they took place), accelerometer assessed physical activity/time spent sedentary, and participant characteristics. Given the use of multiple regression methods, a key consideration governing sample size was degrees of freedom. Using a two-tailed test and 95% confidence level, assuming 20 independent variables, a sample size of 1,302 responses was sufficient to detect a very small effect size of 0.01 (Faul, F., Erdfelder, E., Lang, A.-G. & Buchner, 2007). To account for the hierarchically-structured the data, the errors of the regressions were clustered on individuals. Given the number of independent variables that could potentially be included in the regressions, multicollinearity was likely. To preserve degrees of freedom, a pragmatic approach was adopted. Accordingly, backwards elimination was used to derive parsimonious estimates, and further independent variables were removed where variance inflation factors exceeded 10, which eliminated most of the confounding variables except for accelerometer assessed sedentary time. All analyses were conducted using Stata version 14.2 (StataCorp, 2018) and statistical significance was set at $p < 0.05$.

Results

Six participants were removed as they did not meet the criteria for valid accelerometer data. Data on 67 (92%) participants were retained for analysis. The maximum number of responses per participant was 42 (i.e. 6 per day). Owing to missing data, 560 EMA responses were removed, leaving 2,065 from 67 participants – an average of 4.4 per participant per day: a response rate of 73.3%. Sample characteristics are presented in Table 1. Participants ranged from 50–78 years of age, were predominantly white British, had at least degree-level education, mainly resident in London, in good or better self-assessed health, and all except one met the current physical activity guidelines (≥ 150 minutes of MVPA weekly (Public Health England, 2014)). Mean values for feelings of momentary happiness and sense of purpose were in line with those found for measures of wellbeing in other surveys using the same scale, e.g. Office for National Statistics, (2020).

Table 1
Participant characteristics

Characteristic		Frequency/Mean*	% (sd*)
Age (y)		64.1*	5.92*
Gender	Male	29	43.3
	Female	38	56.7
Ethnicity	White British	63	94.1
	Other	4	5.9
Relationship status	Living in a couple	44	65.7
	Living alone	23	34.3
Highest educational level	Degree or above	48	71.0
	No degree	19	29.0
Location	London zones 1-6	52	77.6
	Not London	17	22.4
Self-Assessed Health	'Very Good' or 'Good'	65	97.0
	'Fair' or 'Poor'	2	3.0
Met MVPA guidelines ¹		66	98.6
% of wear time spent in MVPA		9.9*	5.7*
% of wear time spent sedentary		62.5*	7.9*
Happiness score		7.2	1.65*
Sense of purpose score		7.3	1.73*
N		67	
¹ MVPA = moderate-to-vigorous physical activity guideline \geq 150 mins MVPA per week			
sd = standard deviation			

[Table 1 here]

Table 2 shows the categorisations and frequencies of participation in different activities. The most reported activity was physical with moderate intensity sport/exercise being the most common (22%). Mental activities were the next most common, with screen time being the most frequent (9.5%). For the regression analyses, the 22 individual activities were reduced to 13 by combining similar

activities (e.g. moderate and vigorous sport/exercise both count towards meeting the current physical activity guidelines) and merging low-frequency activities into larger categories. Light sport/exercise was retained as a separate category because it does not count towards the recommended 150 minutes a week of physical activity.

Table 2
Categories and frequencies of activities

	Frequency	(%)		Frequency	(%)	Final analytical categories (13)	Frequency	(%)
Physical activities	744	36.0	Light sport or exercise	118	5.7	Light sport or exercise	118	5.7
			Moderate sport or exercise	363	17.6	Moderate or vigorous sport or exercise	458	22.2
			Vigorous sport or exercise	95	4.6			
			Domestic tasks	71	3.4	Domestic tasks or errands	123	5.9
			Shopping, errands or queuing	52	2.5			
			DIY/Gardening	45	2.2			
Mental Activities	432	20.9	Screen time	196	9.5	Mentally passive activities	271	13.1
			Reading/listening for pleasure ⁴	75	3.6			
			Studying/learning a new skill	24	1.2	Mentally active activities	161	7.8
			Games or puzzles	16	0.8			
			Planning/organising or admin tasks	115	5.5			
			Praying or meditating	6	0.3			
Social Activities	299	14.5	Visiting/entertaining friends or family	135	6.5	Visiting/entertaining friends or family	135	6.5
			Going to pub, club, café or restaurant	95	4.6	Going to pub, club, café or restaurant	95	4.6
			Volunteering	24	1.2	Volunteering or caring for someone	69	3.4
			Caring for or helping someone	45	2.2			
Recreational activities	109	5.3	Attending concert, film, theatre or sporting event	40	2.0	Attending cultural or sporting event or visiting a cultural attraction	53	2.6
			Visiting museum, gallery or other cultural attraction	13	0.6			
			Creative hobby (e.g. woodwork, baking, making music etc)	56	2.7	Creative hobby	56	2.7
Travel	171	8.3	Travel	171	8.3	Travel	171	8.3
Resting (s)	310	15.0	Resting	310	15.0	Resting	310	15.0
n	2,065	100.0		2,065	100.0		2,065	100.0

⁴ Reading and listening have been inconsistently classified in previous studies (Yamashita, Bardo and Liu, 2018). They were classified as mentally passive activities here on the grounds that they do not necessarily require much mental effort, in contrast to for example planning and organising, which does.

[Table 2 here]

Sport or exercise at moderate-vigorous intensity was not significantly associated with either happiness or sense of purpose when compared with mentally passive activities, such as screen time (Table 3). Sport or exercise at light intensity had a positive association with sense of purpose but volunteering or caring for someone had the largest association with sense of purpose of any of the 13 activities. Activities that had the strongest association with momentary happiness were social (e.g. visiting or entertaining friends or family, and going out to a pub, club or restaurant), or recreational (e.g. attending a theatre or other cultural attraction).

Table 3
Predictors of older adults' momentary happiness and purpose

Predictors	Happiness		Sense of Purpose	
	Beta	95% CI	Beta	95% CI
Participant characteristics				
<i>Percentage of wear time sedentary</i>	-2.802*	-5.33 to -0.266	-3.2568	-5.896 to -0.596
Activities (Base = Mentally Passive Activities)				
<i>Light sport/ex</i>	0.257	-0.233 to 0.804	0.662**	0.169 to 1.156
<i>Mod-vigorous sport/ex</i>	-0.409	-0.854 to 0.028	0.398	-0.624 to 0.858
<i>Domestic tasks</i>	0.003	-0.403 to 0.540	0.681**	0.212 to 1.150
<i>DIY/Gardening</i>	0.404	-0.172 to 1.110	0.972***	0.426 TO 1.518
<i>Visiting/entertaining friends or family</i>	0.741**	0.233 to 1.200	0.707*	0.136 to 1.278
<i>Going to pub, club, café or restaurant</i>	0.658**	0.171 to 1.129	0.398	-0.145 to 0.940
<i>Volunteering/caring for someone</i>	0.498	-0.158 to 1.1.41	1.376***	0.760 to 1.991
<i>Mentally active</i>	-0.339	-0.789 to 0.124	0.660**	0.178 to 1.1.43
<i>Concert, film, theatre, museum etc</i>	0.995**	0.302 to 1.671	0.807*	0.814 to 1.532
<i>Creative hobby</i>	0.888**	0.340 to 1.437	1.151 ***	0.602 to 1.700
<i>Resting</i>	-0.446	-0.936 to 0.019	-0.922***	-1.452 to -0.392
<i>Travelling</i>	-0.852**	-1.338 to -0.270	-0.134	-0.716 to 0.447
Context variables				
<i>Social</i>	0.452**	0.198 to 0.705		
<i>Weekend</i>	0.253**	0.033 to 0.449		
<i>Outdoors</i>	0.798***	0.428 to 0.945	0.456*	0.197 to 0.716
Observations	2,065		2,065	
Adjusted R-squared	0.196		0.179	
Model degrees of freedom	17		14	
<i>*p < 0.05, **p < 0.01, ***p < 0.001</i>				
<i>Constant suppressed for space reasons</i>				

[Table 3 here]

Given the significance of context variables for happiness and purpose (Table 3), coupled with literature showing that being with others (i.e. social) and/or outdoors improved happiness among older people (Cabrita et al., 2017; Lam and García-Román, 2019; Sharifian and Grünh, 2019), the interaction between each of the activities and dichotomous variables for whether activities were active/sedentary; social/solo; and outdoors/indoors - as reported by participants - were explored. (Table 4). The regression shows that for many activities, context is important: social activities for example were positively associated with both outcomes compared

to solo activities – with the exception of volunteering. In general, sedentary activities were negatively associated with both outcomes, unless they were social sedentary activities (e.g. visiting friends and family). Of the active recreational activities, those that were social and outdoors had the largest positive association with both outcomes. Less sedentary participants were more likely to experience higher feelings of happiness and sense of purpose during any recreational activity.

Table 4

Active/Sedentary activities interacted with social and environmental context predicting older adults' momentary happiness and sense of purpose

Predictors	Happiness		Purpose	
	Beta	95% CI	Beta	95% CI
Participant characteristics				
<i>Percentage of wear time sedentary</i>	-2.779	-5.300 to -0.258	-3.342	-5.898 to -0.787
Activities interacted with Active/Sedentary, social and environmental context: base = Mentally Passive Activities, Active, Solo, Outdoors				
Light Sport or Exercise				
<i>Active, Social, Outdoors</i>	1.025	0.122 to 1.923		
<i>Sedentary, Social, Indoors</i>	1.732	0.116 to 3.349		
<i>Sedentary, Social, Outdoors</i>	-1.022	-1.896 to - 0.148		
Moderate-Vigorous Sport or Exercise				
<i>Sedentary, Solo, Indoors</i>	-1.411	-2.773 to - .0490		
Domestic tasks/errands				
<i>Active, Social, Outdoors</i>	1.409	0.389 to 2.4289	1.542	0.344 to 2.742
<i>Sedentary, Solo, Indoors</i>			-1.698	-2.843 to -0.554
DIY/Gardening				
<i>Active, Social, Indoors</i>	1.061	0.175 to 1.947	1.232	0.118 to 2.347
<i>Active Social, Outdoors</i>	1.268	0.026 to 2.509		
<i>Sedentary, Social, Outdoors</i>	1.748	0.995 to 2.501		
Visiting/entertaining Friends/Family				
<i>Active, Social, Indoors</i>	1.138	0.319 to 1.957		
<i>Active, Social, Outdoors</i>	1.501	0.062 to 2.940		
<i>Sedentary, Social, Indoors</i>	0.787	0.050 to 1.524		
Going to pub, club or restaurant				
<i>Sedentary, Social, Outdoors</i>	1.407	0.613 to 2.202		
Volunteering, Caring for or Helping Someone				
<i>Active, Solo, Indoors</i>	2.164	1.458 to 2.870		
<i>Sedentary, Solo, Indoors</i>			2.730	0.280 to 2.647
<i>Active, Social, Outdoors</i>	1.710	0.584 to 2.837	1.464	1.447 to 4.012
Mentally Active Activities				
<i>Active, Solo, Outdoors</i>			1.464	0.388 to 2.540
Concert, film or theatre, museum or gallery				
<i>Active, Social, Indoors</i>	1.829	0.855 to 2.803	1.888	0.628 to 3.148
<i>Sedentary, Social, Indoors</i>	1.321	0.488 to 2.155		
<i>Sedentary, Social, Outdoors</i>	1.534	0.718 to 2.350		

Predictors	Happiness		Purpose	
Creative Hobby				
<i>Active, Social, Indoors</i>	0.998	0.086 to 1.911	1.241	0.105 to 0.377
<i>Active, Social, Outdoors</i>	1.491	0.423 to 2.560	1.212	0.010 to 2.415
<i>Sedentary, Social, Indoors</i>	1.320	0.477 to 2.163	1.197	0.078 to 2.316
Resting				
<i>Sedentary, Solo, Indoors</i>	-0.927	-1.755 to -0.100	-1.555	-2.667 to -0.443
<i>Sedentary, Solo, Outdoors</i>	-1.096	-1.809 to -0.384	-1.116	-2.135 to -0.097
Travelling				
<i>Active, Solo, Indoors</i>	-1.047	-2.045 to -0.049		
<i>Sedentary, Solo, Indoors</i>	-1.561	-2.655 to -0.469		
<i>Sedentary, Solo, Outdoors</i>			1.243	0.168 to 2.318
Weekend/Weekday				
<i>Weekend</i>	0.269	0.070 to 0.467		
Observations	2,065		2,065	
Adjusted R-squared	0.2335		0.2417	
Model degrees of freedom	65		65	

[Table 4 here]

Discussion

The objective of this study was to investigate how the type (sedentary, active) and context (social and environmental) of older peoples' activities relate to momentary feelings of happiness or purpose to inform the design of interventions and policies. The finding that social (i.e. with other people) light sport/exercise was positively related to happiness, but that moderate-vigorous sport/exercise was not associated with either outcome, points to the potential challenges of promoting higher intensity activities in this age group (Downward and Dawson, 2016). For both outcomes, outdoor activities were associated with higher levels of happiness and sense of purpose. The association between outdoor activities and happiness has been noted previously (Finlay et al., 2015; Cabrita et al., 2017). However, the finding that outdoor activities were associated with greater momentary sense of purpose is new. This study also demonstrates that, although closely related, older people distinguish between the concepts of happiness and sense of purpose. The small overlap in the pattern of significant coefficients between the two outcomes illustrated this. Visiting friends and family, and going to a pub, club or restaurant were strongly associated with feelings of happiness but not purpose for example. Differences such as these suggest there is additional insight provided by investigating momentary sense of purpose (Dolan, 2014). The current analyses also show that less sedentary older adults on average experienced greater feelings of happiness compared with their more sedentary counterparts, which is in line with previous research (Lathia et al., 2017). However, a new finding is that less sedentary older adults also experienced even greater feelings of purpose during their activities. Overall the results suggest that policies and practices that encourage older adults to be less sedentary and spend more time in outdoor and social activities are likely to increase happiness and sense of purpose and could be leveraged to increase physical activity. For example, volunteering, even if solo, will enhance happiness and sense of purpose and if active, will also contribute to increased physical activity levels.

The study has two main limitations: first, the sample was not representative. For example, participants were more physically active (Sport England, 2019) and more highly-educated than UK adults of this age-group (OECD, 2020), likely due to the recruitment strategies and the need to exclude older people without smartphones. Second, the study was not designed to establish causal relationships; however momentary wellbeing was reported immediately after the activity had taken place, so causality is unlikely to be reversed.

In conclusion, this research suggests that the context of leisure-time activities is important for older adults' feelings of both happiness and purpose, with social and outdoor activities being more likely to have the widest appeal. This should be considered when designing physical activity-increasing interventions and policy. There is value in future research measuring momentary sense of purpose as well as happiness in a larger and more representative sample of older people.

Declarations

Competing interests

The authors declare that they have no competing interests

Availability of data and materials

The datasets generated during the study are obtainable from the corresponding author on reasonable request

Ethics approval and consent to participate

The study received ethical approval from the Loughborough University Ethics (Human Participants) sub-committee on 24 Jan 2019

Consent for publication

Not applicable

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Authors' contributions

Karen Hancock: devised the surveys, conducted fieldwork, analysed data and drafted the manuscript as part of her PhD studies.

Prof. Paul Downward: provided technical advice on analysis and commented extensively on the manuscript.

Dr. Lauren Sherar: advised on data collection methods, processed raw accelerometer files and commented extensively on the manuscript.

All authors: conceived the idea for the study.

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