Physical Activity Buffers the Effects of Daily Stress on Daily Executive Functioning

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Background and Rationale

- Chronic and acute stress are detrimental for cognitive performance (e.g., Lupien, McEwen, Gunnar, & Heim, 2009; Wilson, Begeny, Boyle, Schneider, & Bennett, 2011) via rumination, altered hormonal patterns, or neuronal damage
- Daily stressors also related to worse daily cognitive functioning in lab settings (Sliwinski, Smyth, Hofer, & Stawski, 2006) and naturally occurring memory problems (Neupert, Almeida, Mroczek, & Spiro, 2006)
- In contrast, physical activity related to lower stress response (Salmon, 2001), fewer everyday memory problems (Whitbourne, Neupert, & Lachman, 2008), and improved cognition (e.g., executive functioning) (Colcombe & Kramer, 2003)

Current Study

Current study aims and predictions:
Are daily stressors and physical activity related to daily cognition?

1. On days in which adults experienced more daily stressors, their cognition (daily executive functioning and daily episodic memory) will be worse
2. Increased physical activity will attenuate (i.e., moderate) the negative effects of daily stressors on daily cognition

Methods

Sample and design:
- 101 participants [Mean age: 52.11 years (range 23-94), 57% female, 15.75 years of education (range 10-20; 63% of participants had a Bachelor's degree or higher education), 50% currently working]

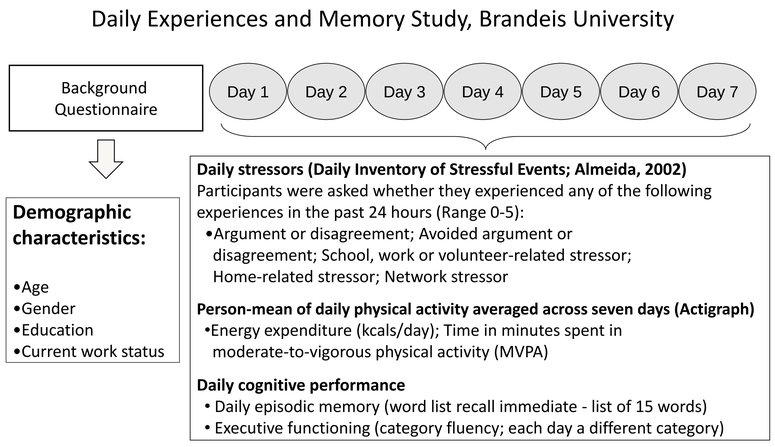
Table 1, *Descriptive information for sample (n = 101)*[a]

Variable	M or %	SD
Person-mean daily energy expenditure (kcals/day)[b]	527.59	339.93
Person-mean daily MVPA (minutes)	38.77	28.89
Person-mean number of daily stressors	1.01	0.80
Percentage of all days with a daily stressor	55	

Note. M: mean; MVPA: moderate-to-vigorous activity; SD: standard-deviation. [a]Person-means were calculated by averaging the daily diary data across up to seven days. [b]Daily energy expenditure (EE) and MVPA calculated using previously reported methods (EE: Sasaki, John, Freedson, 2011; MVPA: Troiano Adult 2008).

Design and Measures:

Figure 1, *Study Design*



Data analyses:

- Multilevel model with SAS PROC MIXED
- Covariates: Demographic characteristics and person-mean of daily stressors
- **WP Daily stress**: Within-person effect of daily stressors

$$\text{DAILY COGNITION}_{ij} = \gamma_{00} + \gamma_{01}(\text{COVARIATES}_j) + \gamma_{02}(\textbf{PHYSICAL ACTIVITY}) + \gamma_{03}(\textbf{WP DAILY STRESS}_{ij}) + \gamma_{04}(\text{COVARIATES}_j * \textbf{WP DAILY STRESS}_{ij}) + \gamma_{05}(\textbf{PHYSICAL ACTIVITY}_j * \textbf{WP DAILY STRESS}_{ij}) + u_{0j} + u_1 j + r_{ij}$$

Results

Descriptive information
- Greater physical activity related to younger age, male gender, better person-mean daily cognition

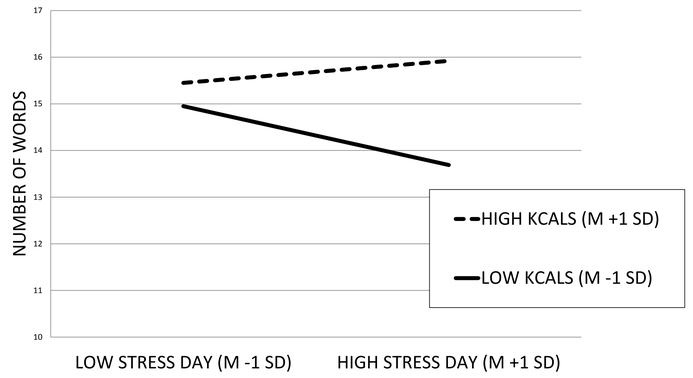
Model 1: Daily executive functioning
- Time spent in MVPA and energy expenditure not related to daily executive functioning as a main effect
- On days when participants reported more stressors, they have worse executive functioning (**WP daily stress**; **Table 2**)
- Daily stressor-EF relationship buffered by greater levels of energy expenditure (**WP daily stress * person-mean energy expenditure**; **Table 2 and Figure 1**), but not by time spent in MVPA

Table 2, *Fixed effects of the moderating role of energy expenditure in the relationship between daily stressors and daily executive functioning*

	Est.	*SE*	*p*
Intercept	4.281	2.889	.141
PM energy expenditure	0.003	0.001	.170
WP daily stress	-5.221	2.236	.020
PM daily stress	0.530	0.414	.203
WP daily stress * PM energy expenditure	0.002	0.001	.034

Note. Demographic characteristics were included in the model as covariates but are not shown here. PM: person-mean, SE: standard error, WP: within-person.

Figure 2, *Moderating effect of physical activity in the relationship between daily stress and daily executive functioning*



Note. For illustrative purposes, one standard deviation above and below the mean for daily stressors and kcals was calculated. Continuous variables were used in analyses.

- Participants with lower energy expenditure performed worse on daily EF task on high stressors days compared to low stressor days
- Participants with higher energy expenditure were more stable across low and high stressor days

Model 2: Daily episodic memory
- In unadjusted correlations, greater physical activity related to better daily EM, but not after adding demographic characteristics
- Daily stressors were not directly associated with EM, and no moderating effects of physical activity

Discussion

- Daily cognition, in particular executive functioning, is less influenced by stressors for people who exercise
- Especially on high stressors days, physical activity helps to manage daily stress with benefits for daily executive functioning
- Results suggest that the amount of energy expended is more relevant than the number of minutes spent above a threshold (MVPA) for stress-cognition relationship
- The timing of daily stressors and physical activity in relation to cognitive tasks was not included in the current study thus examination of directionality is limited
- The findings have implications for physical activity interventions aimed to reduce the negative effects of stress in everyday life
- Following previous work showing immediate effects of physical activity for cognition (Hogan, Mata, & Carstensen, 2013) future research should examine the role of timing of physical activity for the relationship between stress and cognition

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