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Effects of Variety Support on Exercise-Related Well-Being

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Background: The purpose of this study was to experimentally examine the extent to which variety support in a resistance exercise program influences exercise-related well-being among inactive adults. **Methods:** A sample of 121 inactive university students were randomly assigned and participated in either a high or low variety support 6-week exercise program. Measures of exercise-related perceived variety, positive affect, negative affect, and subjective vitality were completed at baseline, after 3 weeks, and after 6 weeks (i.e. post-test). **Results:** Through use of structural equation modelling, the results showed that for those who completed measures at post-test (i.e. $n = 55$), and for all participants who received variety support (i.e. a modified intention-to-treat analysis; $N = 121$), exercise-related variety support indirectly explained higher levels of exercise-related positive affect, and subjective vitality, and lower levels of negative affect, through the mediating role of perceived variety. **Conclusions:** The provision of variety support in a resistance exercise program influences exercise-related well-being through perceptions of variety. Results are discussed in relation to the potential utility of providing variety support to promote exercise-related well-being in people who are physically inactive.

Keywords: diverse, perceived variety, physical activity, resistance training, well-being

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INTRODUCTION

In recent years, there has been increased research interest in the concept of well-being, and its impact on health (i.e. Diener & Chan, 2011; Kobau et al., 2011; Lyubomirsky, King, & Diener, 2005). Scientific study has recognised the utility of considering both hedonic and eudaimonic components of well-being (e.g. Gallagher, Lopez, & Preacher, 2009). Hedonic well-being is characterised as the experience of positive feelings and a lack of negative feelings, while eudaimonic well-being corresponds to the notion of self-realisation, and feeling vital and fully alive (cf. Kahneman, Diener, & Schwarz, 1999; Ryan & Deci, 2001). Researchers have sought to understand the antecedents and psychological factors that are necessary to increase components of well-being (e.g. Sin & Lyubomirsky, 2009), with a promising line of research pertaining to the context of exercise (Biddle, Mutrie, & Gorely, 2015). To make robust inferences regarding possible antecedents and psychological mechanisms through which well-being may be enhanced in exercise contexts, experimental research is needed.

One psychological factor that may have a substantive effect on well-being in exercise is *variety*. Variety has been operationalised as both variety support, which refers to the provision of diverse endeavours, opportunities, and tasks within a given context (cf. Lyubomirsky & Layous, 2013), and also as an experience in which someone feels (or felt) as though they take part in diverse activities in a given context (cf. Sylvester et al., 2014). For example, within exercise contexts, variety *support* might involve the extent to which a personal trainer prescribes a diverse range of exercises, while the degree to which a person perceives that they actually engage in diverse exercises would constitute his/her *experience* of variety. In the present study, we focus on both variety support and the experience of variety, along with indices of well-being, in the context of exercise.

Sheldon, Boehm, and Lyubomirsky (2012, Study 2) presented some of the only experimental data examining the influence of variety support on indices of well-being. Specifically, they conducted a kindness intervention in which participants were randomly assigned to either vary or repeat kind acts and behaviours each week. Results showed that people who vary their acts of kindness continue to experience well-being in that activity, while those who repeat the same acts of kindness adjust to the positive effect and derive less well-being from the activity over time. Although the results of Sheldon et al.'s (2012) study provide insight into the role of variety support in the context of a kindness intervention, the results also point to the importance of the provision of variety support in facilitating greater well-being in a given context.

Researchers have yet to examine variety support in relation to well-being in the context of exercise. However, research findings suggest that examining variety is a worthwhile line of enquiry (e.g. Sylvester et al., 2014). Specifically, in a

prospective observational study, Sylvester et al. (2014) found that *perceptions* of variety in exercise positively predicted variance in exercise-related positive affect, and subjective vitality, but not exercise-related negative affect, over time. As such, the psychological experience of variety may be implicated in the promotion of well-being, although the non-experimental nature of Sylvester et al.'s (2014) study design limits inferences of causality. Another notable limitation of Sylvester et al.'s (2014) study pertains to the exclusion of exercise-related variety *support* as a potential antecedent of perceptions of variety and subsequent well-being in exercise contexts. In a recent experimental study, Sylvester et al. (2016) found that the provision of high variety support in the context of a six-week exercise program resulted in higher levels of perceived variety when compared to participants in a low variety support program, and this was subsequently related to higher levels of exercise adherence. Thus, drawing from observational findings linking perceptions of variety to exercise-related well-being (Sylvester et al., 2014), and experimental findings linking variety support to perceptions of exercise variety (Sylvester et al., 2016), it would seem plausible to suggest that variety support would (causally) lead to improved perceptions of well-being in exercise and that perceptions of variety would mediate those effects.

One population that is an important target for exercise-related well-being intervention is adults who are physically inactive (Centers for Disease Control and Prevention, 2014). Physical inactivity has been described as a global health pandemic (Hallal et al., 2012) and is associated with numerous health consequences (World Health Organization, 2007). Researchers have found that affective responses to physical activity are proximal determinants of behaviour (Kiviniemi, Voss-Humke, & Seifert, 2007) and suggest that understanding how to manipulate the causal antecedents of affective responses to exercise could support improved efforts to promote exercise participation among this population (Ekkekakis, Hargreaves, & Parfitt, 2013). While affect is not fully representative of well-being itself, affect is an index of hedonic well-being which, along with eudaimonic well-being, represents two broad components of well-being that researchers can assess to determine the extent to which people experience well-being in exercise contexts (cf. Ryan, Huta, & Deci, 2013).

The purpose of the present study was to examine the extent to which variety support in a resistance exercise program influences indices of exercise-related well-being, namely, positive affect, negative affect, and subjective vitality, in a sample of physically inactive adults. We also examined the extent to which the potential relationships between variety support and exercise-related well-being are mediated by perceptions of variety in exercise. In this study, our hypotheses drew from previous research which has shown that (a) variety support increases both context-specific well-being (i.e. Sheldon et al., 2012) and perceptions of variety in exercise (Sylvester et al., 2016), and (b) perceptions of variety in exercise have been found to explain variance in exercise-related positive affect and subjective vitality, but not exercise-related negative affect (i.e. Sylvester et al.,

2014). Specifically, we hypothesised that the provision of exercise-related variety support would lead to higher scores of exercise-related positive affect and subjective vitality, when compared to a low variety support exercise program, and that these relationships would be mediated by perceptions of variety in exercise. Finally, in a test of discriminant validity, we sought to experimentally examine the relationship between variety support, perceived variety in exercise, and exercise-related negative affect. Based on findings by Sylvester et al. (2014), we hypothesised that exercise-related variety support, and perceived variety in exercise, would have no effect on scores of exercise-related negative affect.

METHODS

Participants

One hundred and forty-four university students (i.e. n = 104 females, n = 40 males; M_{age} = 21.39 years, SD_{age} = 3.67 years) enrolled in the study and completed questionnaires at pre-test (N = 144), mid-test (i.e. after three-weeks; Time 2; n = 88) and at post-test of a six-week (i.e. Time 3; n = 55) resistance training exercise study.[1] Eligibility criteria included: Being currently enrolled as a university student, being fluent in English, reporting no health risks that would impede engaging in moderate-intensity exercise (i.e. based on responses to the Physical Activity Readiness Questionnaire for Everyone; PARQ+; Warburton, Jamnik, Bredin, & Gledhill, 2011), and reporting two or fewer bouts, lasting at least 20 minutes, of moderate-vigorous exercise per week (i.e. categorised as physically inactive; cf. Wilcox, King, Brassington, & Ahn, 1999). Of the 144 people who completed baseline measures, 121 participants received the exercise-related variety support manipulation (i.e. $n_{high\ variety\ support}$ = 58; $n_{low\ variety\ support}$ = 63) by attending at least one exercise session, and were subsequently included in the main analyses.

Procedure

After obtaining ethical approval from the research ethics board of the lead author's institution, participants attended a baseline orientation session, provided

[1] The present study was part of a larger program of research designed to examine the effects of variety support and the experience of variety in the context of exercise. Research on the effects of variety support in exercise in relation to perceived variety, physical activity behaviour (i.e. adherence to the program), and the psychological needs for competence, relatedness, and autonomy were reported in Sylvester et al. (2016). In this study, our research question focused on the effects of variety support in relation to various indices of exercise-related well-being. None of the well-being data were reported in the Sylvester et al. (2016) study.

written informed consent, completed baseline measures, and were randomised (using a computer random number generator) to either the high variety support (HVS) or low variety support (LVS) exercise condition. Participants were blinded to the experimental condition/exercise program (which took place at a university fitness centre in British Columbia, Canada) and were asked to refrain from engaging in other resistance exercise training programs over the course of the six-week study to avoid compromising internal validity. All participants were given the same exercise protocol instructions, which consisted of three one-hour training sessions per week (i.e. 18 sessions total), and could drop in to complete their exercise program at their convenience. The exercise program was structured (e.g. frequency and duration of exercise bouts, number of sets and repetitions) to match a resistance-based exercise program conducted by Sparkes and Behm (2010) that was designed for previously inactive adults within a university setting. In line with Sparkes and Behm (2010), we experimentally controlled for volume and intensity by instructing participants (after a brief warm-up consisting of aerobic exercise and dynamic stretching) to perform 10 repetitions for each set of each prescribed exercise (16 sets total; Sparkes and Behm prescribed two sets of eight different exercises). For each exercise, participants were instructed to select a weight at which they would be able to complete no more than 10 repetitions without conceding proper form. This way, participants would experience the same relative intensity even though the amount of weight for each given exercise was personalised. Each participant received an exercise booklet (copies of the HVS and LVS exercise booklets are available from the first author upon request) that remained at the exercise facility throughout the study, and included their exercise program as well as space for them to record their adherence to the protocol. Participants were invited to complete all study measures after three weeks into their respective programs (Time 2), as well as at the end of their six-week programs (Time 3).

Intervention

Consistent with our conceptual understanding of variety, to foster (or thwart) the experience of variety in exercise, we manipulated (a) the quantity of exercises to complete within each session (i.e. two sets of eight exercises for the HVS condition, compared to four sets of four exercises for the LVS condition; cf. Juvancic-Heltzel, Glickman, & Barkley, 2013; Sparkes & Behm, 2010), (b) whether exercises changed between consecutive bouts (cf. Glaros & Janelle, 2001), and (c) whether there was variation in the movement patterns of individual exercises (e.g. changing the hand grip on a pull-up to a chin-up; cf. Dimmock, Jackson, Podlog, & Magaraggia, 2013). To consistently support the experience of variety, participants in the HVS condition performed different combinations of (novel and/or familiar) exercises each session, and those in the LVS condition repeated the same exercises each session.

Measures

Perceived Variety in Exercise. The Perceived Variety in Exercise (PVE) questionnaire (Sylvester et al., 2014) was administered to measure the extent to which participants felt that they experienced variety in exercise. Each of the five items comprising the PVE questionnaire is rated on a 6-point Likert-type rating scale ranging from 1 "*false*" to 6 "*true*", with higher scores reflecting greater levels of perceived variety in exercise. An example item includes "I feel like I try a range of exercises." In the current study, PVE scores were found to have an ordinal composite reliability (Zumbo, Gadermann, & Zeisser, 2007) estimate ≥ .93 (see Tables 2 and 4).

Exercise-Related Well-Being. Indices of exercise-related well-being were measured using the Scale of Positive and Negative Experience (SPANE; Diener et al., 2010) as well as the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997). The word "exercise" was added to the instructions of both the SPANE and the SVS to denote that we were interested in participants' positive and negative affect and subjective vitality in the context of exercise. Specifically, in the SPANE instructions, we asked participants, "Please think about what exercise you have been doing and experiencing during the past 4 weeks. Then report how much you experienced each of the following feelings, using the scale below." The SPANE was used to assess positive and negative experiences (e.g. pleasant, unpleasant) and comprises six adjectives that are rated on a 5-point ordinal scale ranging from 1 "*very rarely or never*" to 5 "*very often or always*" for each of the (positive and negative) subscales. Ordinal composite reliability in the current study was ≥ .87 for scores of positive affect and ≥ .85 for scores of negative affect (see Tables 2 and 4).

To examine the extent to which participants experienced feelings of vitality in exercise the SVS was administered (Ryan & Frederick, 1997). To direct participants to the context of exercise the instructions for the SVS read "Please respond to each of the following statements by indicating the degree to which the statement is true for you when you engage in exercise." The SVS comprises six items (cf. Bostic, Rubio, & Hood, 2000), which participants rated on a 7-point Likert-type scale ranging from 1 "*not at all true*" to 7 "*very true*". An example item includes "I nearly always feel alert and awake." Ordinal composite reliability indicators for SVS scores in the current study were ≥ .87 (see Tables 2 and 4).

Data Analysis

Potential patterns of missing data were examined using Little's chi-square test (Little, 1988). Subsequently, Mplus 6.11 software was used to construct a series of structural equation models (described below). Since scores derived from the PVE, SPANE, and SVS questionnaires reflect ordinal data and have less than (or

equal to) seven response options, a weighted least squares means and variance-adjusted (WLSMV) method of estimation was used (Beauducel & Herzberg, 2006; Finney & DiStefano, 2006). The WLSMV algorithm within Mplus was used to estimate missing data using all information available. Goodness of fit for the model was assessed using the χ^2 goodness of fit index, the comparative fit index (CFI), Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA; Brown, 2006; Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). Thresholds for categorising model-data fit as good or excellent were designated as CFI and TLI values > .90, and RMSEA values < .08, or CFI and TLI values > .95, and RMSEA values < .06, respectively (cf. Hu & Bentler, 1998, 1999). To estimate score reliability we examined ordinal composite reliability based on the polychoric correlation matrix (Bollen, 1989; Fornell & Larcker, 1981; Zumbo et al., 2007).

A preliminary analysis was conducted to determine whether participants who completed measures at Time 3 were systematically different from those who did not. We conducted a latent variable multivariate analysis of variance (LVMANOVA) to examine potential differences with regard to Time 1 age, gender, year of university, positive affect, negative affect, subjective vitality, and intervention condition, between participants who completed measures at Time 3 and those who did not. A LVMANOVA is a specific type of Structural Equation Model that is used for difference testing with unobserved (latent) variables. Scores from each item have a unique weighting in the construction of latent variables (which reduces measurement error) while simultaneously modelling both the measurement and structural relations (which reduces the risk of Type I error).

Subsequently, we examined the extent to which receiving exercise-related variety support explains variance in exercise-related positive affect, negative affect, and subjective vitality in those who completed measures at all three time points (i.e. completers analysis) through the mediating role of perceived variety in exercise measured at Time 2, after statistically controlling for gender and baseline scores of exercise-related perceived variety, positive affect, negative affect, and subjective vitality. Throughout the analyses we used the term "statistical control" to refer to partialling out variance in the criterion variables (i.e. exercise-related positive affect, negative affect, and subjective vitality) that was attributable to covariates (e.g. gender).

Due to the fact that only 55 people completed post-test measures of well-being, and potential selection bias from estimating effects exclusively based on those who completed measures at Time 3, we subsequently conducted a more pragmatic secondary analysis to examine this sequential pathway for all participants who were randomised to a condition and received variety support (i.e. an intention-to-treat [ITT] analysis; Altman et al., 2001; Ruiz-Canela, Martinez-Gonzalez, & De Irala-Estevez, 2000). ITT analyses are considered the "gold standard" for pragmatically evaluating the results of interventions in which

researchers use randomisation to condition (Altman et al., 2001). ITT analyses include all participants who are randomised to a condition (see Altman et al., 2001); however, based on recommendations by Fergusson, Aaron, Guyatt, and Hebert (2002), if the participant did not receive any part of the intervention after randomisation, it may be sensible for researchers to exclude those randomised participants from the ITT analysis. Since our aim in conducting an ITT analysis was to pragmatically evaluate the effects of *receiving* variety support, consistent with Fergusson et al. (2002) it was not appropriate to include participants who did not receive any of the intervention (i.e. did not attend at least one exercise session; n_{HVS} = 12; n_{LVS} = 11). Therefore, we conducted a modified ITT analysis, based on recommendations by Fergusson et al. (2002), by including all participants who received variety support (n = 121) in the analysis. By considering all participants who received variety support as they were randomised, we were able to preserve some of the quality control benefits of randomisation (e.g. the likelihood that changes in indices of exercise-related well-being are attributable to differences in the variety support received, rather than extraneous factors). The ITT model was used to examine the extent to which receiving exercise-related variety support explains variance in exercise-related positive affect, negative affect, and subjective vitality through the mediating role of perceived variety in exercise measured at Time 2, after statistically controlling for gender. Baseline measures of the study variables were not included as covariates in the ITT analyses, as we used the last value obtained from participants as a conservative estimate of the participant's true outcome (cf. Gadbury, Coffey, & Allison, 2003; Unnebrink & Windeler, 2001).

In accordance with contemporary assessments of mediation (i.e. Rucker, Preacher, Tormala, & Petty, 2011), in both analyses the primary outcome of interest was the magnitude and significance of the indirect effect of exercise-related variety support on positive affect, negative affect, and subjective vitality through perceptions of variety. Preacher and Hayes' (2008) bootstrapping procedure (k = 5,000 samples) was used to estimate the indirect effects and confidence intervals. In addition to evaluating p-values, bias-corrected 95% confidence intervals were assessed to determine statistical significance (i.e. whether the confidence intervals span zero).

RESULTS

A total of 55 participants completed measures of exercise-related positive affect, negative affect, and subjective vitality at post-test (i.e. n = 39 females, M_{age} = 20.95 years; SD_{age} = 3.49 years; n = 16 males, M_{age} = 21.81 years; SD_{age} = 4.37 years). Most participants self-identified as Chinese (n = 22; 40%), White (n = 16; 29%), or multi-racial/other (n = 10; 18%), and most reported being in their second (n = 17; 31%), third (n = 15; 27%), or first (n = 12; 22%) year of university.

TABLE 1
Differential Effects between Participants Who Completed Post-Test Measures, and Participants Who Did Not

Variables	*Standardised Estimates*	*Unstandardised Estimates*	*Bootstrapped 95% Confidence Interval*
Age	−.04	−.31	[−1.62, .81]
Gender	−.02	−.02	[−.21, .10]
Year in University	−.05	−.14	[−.58, .26]
Positive Affect	.09	.15	[−.19, .47]
Negative Affect	.02	.04	[−.34, .28]
Subjective Vitality	.12	.21	[−.06, .56]
Intervention Condition	.04	.04	[−.14, .20]

Note: All variables were measured at Time 1.

Evaluation of Little's chi-square test revealed that data were missing completely at random (MCAR): χ^2 (220) = 216.32, p = .567. Subsequently, we examined any potential differences at baseline between participants who completed measures at post-test (n = 55) and participants who did not (n = 89). The fit indices of the LVMANOVA model were χ^2 (355) = 637.30, $p < .01$, CFI = .905, TLI = .891, RMSEA = .074. There were no statistically significant differences between participants who completed measures at post-test and those who did not (see Table 1).

Next, for those who completed Time 3 questionnaires (i.e. "completers") we examined the extent to which exercise-related variety support explained variance in exercise-related positive affect, negative affect, and subjective vitality, through the mediating role of perceived variety in exercise (at Time 2; after statistically controlling for gender and baseline scores of exercise-related perceived variety,

TABLE 2
Bivariate Correlations and Composite Reliability for Participants Who Completed Post-Test Questionnaires

Variable	*CR*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. Variety Support		–								
2. Perceived Variety-T1	.93	−.06	–							
3. Positive Affect-T1	.89	.11*	.07	–						
4. Negative Affect-T1	.85	.21*	.17	−.67*	–					
5. Subjective Vitality-T1	.87	−.12*	.44*	.52*	−.32*	–				
6. Perceived Variety-T2	.95	.40*	.37*	.03	.07	.17	–			
7. Positive Affect-T3	.90	.22*	.13	.58*	−.37*	.34*	.25*	–		
8. Negative Affect-T3	.95	.07*	.05	−.43*	.61*	−.25*	−.19	−.51*	–	
9. Subjective Vitality-T3	.90	−.03	.34*	.24*	−.12	.51*	.37*	.81*	−.33*	–

Note: CR = composite reliability; T1= Time 1, T2 = Time 2, T3 = Time 3; n = 55. * $p < .05$.

TABLE 3
Direct and Indirect Effects of Exercise-Related Variety Support for Participants Who Completed Measures at Post-Test

Variables	*Standardised Estimates*	*Unstandardised Estimates*	*Bootstrapped 95% Confidence Interval*
Direct Effects of Exercise-Related Variety Support on:			
Perceived Variety	.49	.99	**[.74, 1.09]**
Positive Affect	−.04	.07	[−.04, .58]
Negative Affect	.06	.10	[−.16, .17]
Subjective Vitality	−.16	−.27	**[−.50,−.03]**
Indirect Effects of Exercise-Related Variety Support on Positive Affect, Negative Affect, and Subjective Vitality via Perceived Variety			
Positive Affect	.12	.20	**[.16, .35]**
Negative Affect	−.14	−.24	**[−.48,−.15]**
Subjective Vitality	.19	.32	**[.27, .44]**

Note: Bold confidence intervals do not contain 0. $n = 55$.

positive affect, negative affect, and subjective vitality). One of the positive affect items from the SPANE (Diener et al., 2010) measure at Time 1 created problems with respect to model convergence and so was removed from the analysis. The problem stemmed from the scores of the "Good" item in relation to positive affect at Time 1 (but not Time 3). When we included the item "Good" (at Time 1) in the analysis, a warning in the output indicated that the latent variable covariance matrix was not positive definite, and this was due to a negative residual variance from one of the items (i.e. "Good" from the positive affect scores at Time 1). However, the results do not provide an indication why the scores for "Good" had negative residual variance in the analysis. Since variances cannot be negative by definition, and the item was one of six items representing positive affect at Time 1 (i.e. a covariate in the model), we deleted that item from the analysis. We proceeded with the analysis using the remaining five items to create the latent variable of "positive affect" (that was operationalised as a covariate in the "completers" model; i.e. those who completed measures at Time 3). All items in our outcome variable "positive affect" (i.e. Time 3 scores) were included in the analysis. The model then converged normally, and overall had good fit (χ^2 (1012) = 1157.70, $p < .01$, CFI = .932, TLI = .928, RMSEA = .051). Bivariate correlations and composite reliability values are reported in Table 2.

With regard to the structural relations in the completers model (see values in Table 3), exercise-related variety support explained significant variance in perceived variety in exercise at Time 2 ($\beta = .49$, $p < .01$), which subsequently explained variance in exercise-related positive affect ($\beta = .24$, $p < .01$), negative affect ($\beta = -.28$, $p < .01$), and subjective vitality ($\beta = .38$, $p < .01$) at the end of the six-week exercise program (see path diagram in Figure 1). Gender positively explained positive affect ($\beta = .14$, $p < .01$), and negatively explained negative

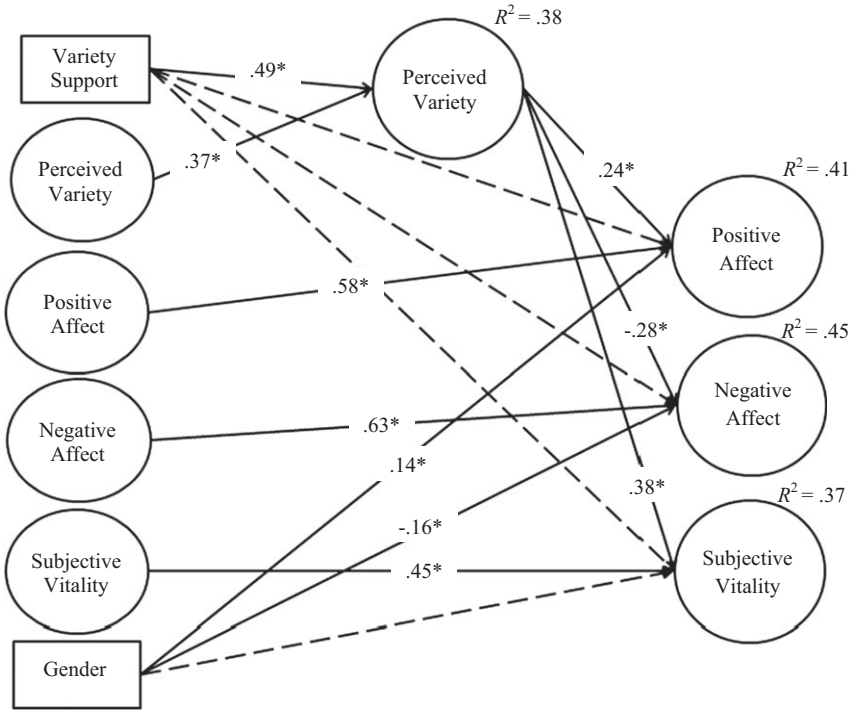

FIGURE 1. Full information path diagram of the relationships between variety support (i.e. condition) and exercise-related positive affect, negative affect, and subjective vitality (all measured at Time 3; T3) via perceived variety in exercise at Time 2 (T2) after statistically controlling for gender and baseline scores of positive affect, negative affect, and subjective vitality at Time 1 (T1) as covariates. Solid lines represent standardised significant path coefficients and dashed lines represent non-significant path coefficients. * $p < .01$.

affect ($\beta = -.16$, $p < .01$), with females experiencing higher levels of positive affect and less negative affect toward exercise than males. Indirect effects were found to be significant for the relationships between exercise-related variety support and positive affect ($\beta = .12$, $p < .01$), and subjective vitality ($\beta = .19$, $p < .01$), through perceived variety in exercise. The indirect effect for variety support in relation to negative affect, via perceptions of variety, approached statistical significance ($\beta = -.14$, $p = .06$). However, examination of the confidence intervals for this indirect effect revealed that the upper and lower points of the point estimate did not span zero (95% CI [−.479, −.147]), which suggests the existence of a significant indirect effect. After statistically accounting for the effects of perceived variety in exercise (Time 2; i.e. the mediator) and baseline values of positive affect, negative affect, and subjective vitality, the direct

TABLE 4
Bivariate Correlations and Composite Reliability for Variables in the Intention-to-Treat Analysis

Variable	*CR*	*1*	*2*	*3*	*4*	*5*
1. Variety Support		–				
2. Perceived Variety	.93	.42*	–			
3. Positive Affect	.87	.14	.40*	–		
4. Negative Affect	.86	−.22*	−.38*	−.63*	–	
5. Subjective Vitality	.93	.10	.48*	.72*	−.49*	–

Note: CR = composite reliability. $N = 121$. * $p < .05$.

TABLE 5
Direct and Indirect Effects of Exercise-Related Variety Support in the Intention-To-Treat Analysis

Variables	*Standardised Estimates*	*Unstandardised Estimates*	*Bootstrapped 95% Confidence Interval*
Direct Effects of Exercise-Related Variety Support on:			
Perceived Variety	.43	.82	**[.47 – 1.16]**
Positive Affect	−.03	−.05	[−.40, .36]
Negative Affect	−.11	−.18	[−.50, .14]
Subjective Vitality	−.12	−.23	[−.60, .07]
Indirect Effects of Exercise-Related Variety Support on Positive Affect, Negative Affect, and Subjective Vitality via Perceived Variety			
Positive Affect	.18	.31	**[.14, .50]**
Negative Affect	−.15	−.25	**[−.44,−.08]**
Subjective Vitality	.23	.41	**[.19, .66]**

Note: Bold confidence intervals do not contain 0. $N = 121$.

effects of variety support in relation to exercise-related positive affect (i.e. $\beta = .04$, $p = .85$), negative affect (i.e. $\beta = .06$, $p = .42$), and subjective vitality (i.e. $\beta = -.16$, $p = .16$) were non-significant. With regard to this latter direct effect of variety support on subjective vitality, examination of the confidence intervals revealed that caution should be exercised with interpreting the non-significant p-value (i.e. $p = .16$) given that the 95% CI [−.500, −.034]) did not span zero.

Subsequently, we examined the extent to which exercise-related variety support explains variance in exercise-related positive affect, negative affect, and subjective vitality, through the mediating role of perceived variety in exercise in an ITT analysis. No problem with the positive affect item "good" emerged, and thus, all items were included to fully represent the construct "positive affect" as our outcome variable. The overall model fit was χ^2 (263) = 420.73, $p < .01$, CFI = .961, TLI = .956, RMSEA = .070. Bivariate correlations and composite reliability values are presented in Table 4. Exercise-related variety support

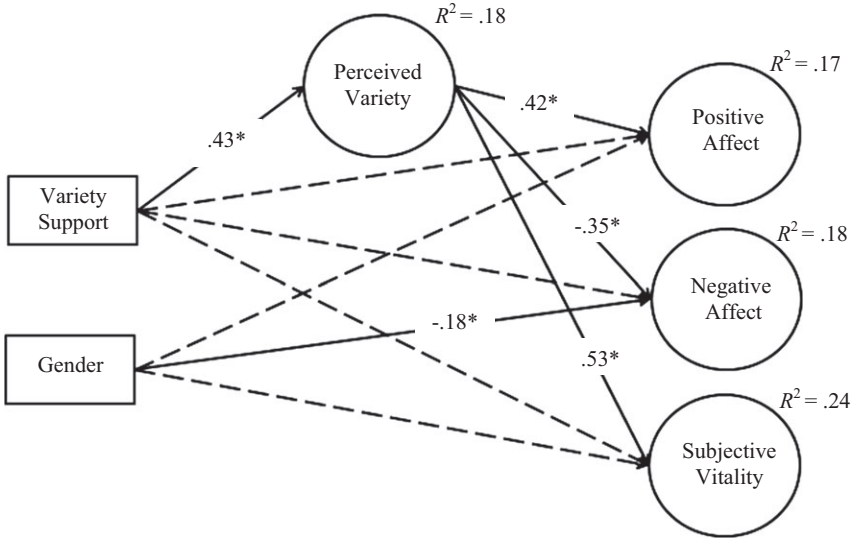

FIGURE 2. Full information path diagram of the relationships found in the intention-to-treat analysis between variety support (i.e. condition) and exercise-related positive affect, negative affect, and subjective vitality via perceived variety in exercise, after statistically controlling for gender as a covariate. Solid lines represent standardised significant path coefficients and dashed lines represent non-significant path coefficients. * $p < .01$.

explained significant variance in perceived variety in exercise ($\beta = .43$, $p < .01$), which subsequently explained variance in exercise-related positive affect ($\beta = .42$, $p < .01$), negative affect ($\beta = -.35$, $p < .01$), and subjective vitality ($\beta = .53$, $p < .01$; see Table 5 and Figure 2). Gender was negatively related to negative affect ($\beta = -.18$, $p < .01$), with females reporting lower levels of negative affect than males. Indirect effects were found to be significant for the relationships between exercise-related variety support and positive affect ($\beta = .18$, $p < .01$), negative affect ($\beta = -.15$, $p < .01$), and subjective vitality ($\beta = .23$, $p < .01$) through perceived variety in exercise. After statistically accounting for the effects of perceived variety (i.e. the mediator), the direct effects of variety support in relation to positive affect ($p = .78$), negative affect ($p = .30$), and subjective vitality ($p = .18$) were not significant, thus supporting mediation.

DISCUSSION

It is widely recognised that the development of efficacious intervention strategies is warranted to enhance the experience of exercise for physically inactive

adults. With this aim in mind, the purpose of this study was to examine the extent to which variety support in a resistance exercise program influences exercise-related well-being in a sample of inactive adults. We also examined the extent to which those relationships are mediated by perceived variety in exercise. Overall, the results provide evidence that inactive people tend to experience improved well-being in exercise contexts when they receive variety support. Furthermore, the experience of variety in exercise was found to be a psychological mechanism that explained *how* variety support influences well-being in this setting.

Across both sets of analyses (i.e. based on the completers model and ITT analyses), an indirect causal effect was found between variety support and the three indices of exercise-related well-being operationalised in this study (positive affect, negative affect, subjective vitality) six weeks later. In each case, these relationships were mediated through the psychological mechanism of perceived variety in exercise. Previous research has found that the provision of variety support influences well-being within the context of a kindness intervention (cf. Sheldon et al., 2012, Study 2); our study suggests that the provision of variety support might affect indices of well-being within exercise settings as well. In an observational (non-experimental) study, Sylvester et al. (2014) found that perceptions of variety in exercise settings were prospectively related to exercise-related positive affect and subjective vitality. The findings of the current study provide experimental evidence that the provision of variety support results in improvements in positive affect (as a measure of hedonic well-being) and subjective vitality (as a measure of eudaimonic well-being).

Interestingly, the results of this study also suggest that in addition to influencing these different indices of positive well-being, the variety support intervention also resulted in reductions in negative feelings. Specifically, the provision of variety support resulted in lower levels of negative affect, and this effect was mediated by perceptions of variety. In previous non-experimental work (Sylvester et al., 2014), perceptions of variety were unrelated to measures of negative affect, with the authors suggesting that the experience of variety might be more strongly implicated in supporting positive well-being than in alleviating negative affect. The results of the current experimental study challenge those earlier observations, and suggest that the provision of variety support in exercise might be able to offset negative affect as well as improve positive well-being in exercise (i.e. promote positive affect and subjective vitality, as well as reduce negative affect).

When considered in concert, the results of this study suggest that the provision of a varied exercise program may be an efficacious intervention strategy that can influence indices of both positive and negative exercise-related well-being. In line with existing research, in this study we provided variety support by varying the exercise activities from one session to the next (Glaros & Janelle, 2001), by increasing the quantity of diverse exercise activities (Juvan-

cic-Heltzel et al., 2013), and by supporting variety within individual movements (Dimmock et al., 2013). While these three methods of providing variety support in exercise were effective at influencing perceptions of variety and subsequent indices of exercise-related well-being, additional variations in exercise may further increase perceptions of variety and improve exercise-related well-being. For example, participants in the current study engaged in one type of exercise (i.e. resistance training); however, engaging in multiple types of exercise (e.g. aerobic exercise, high intensity interval training, resistance training, different sports) may expand the effects of variety and have subsequent effects on indices of well-being. In future work, it would be an interesting line of enquiry for researchers to explore additional methods of fostering the experience of variety in relation to subsequent exercise-related well-being.

Similarly, in the current study, prescribing two sets of eight repetitions (for participants in the HVS condition) and four sets of four repetitions (for participants in the LVS condition) was effective at influencing indices of exercise-related well-being. However, the provision of variety support in exercise is certainly not limited to the structure of exercise sets and repetitions we implemented. In future work, researchers should test additional ways of structuring the sets and repetitions of exercises to determine any systematic effects on indices of exercise-related well-being.

Balanced against the strengths of the study, limitations should also be acknowledged. First, within the context of a pretest-midtest-posttest control group design, the results provide preliminary evidence for the efficacy of a variety support intervention to engender improvements in well-being. However, by virtue of the very design employed, whereby participants were randomised to the two conditions, the results do not provide any indication of the extent to which people experience well-being when they choose to enroll in high (or low) variety support exercise programs in real world settings. Indeed, it is entirely conceivable that some people will have a high need for variety, and others will have a lower need for variety, and these preferences might shape the types of exercise programs in which they would naturally choose to participate. In light of the current findings, future research is encouraged that uses a hybrid preference/randomised control trial design (Bradley, 1993) that includes standard "randomisation" (high internal validity) and "choice" (high ecological validity) arms. That way, researchers will be able to ascertain the effectiveness of a variety support intervention within real world settings (high ecological validity), whereby participants are able to choose to enroll in high variety or low variety programs, and compare the adherence rates to those of participants who are randomised to high and low variety support conditions. A second limitation of the study is that the sample included inactive university students, and therefore one cannot generalise the findings to other populations such as active adults or those outside of university settings. Future work is needed to examine

the effectiveness of variety support exercise interventions with other age groups and populations.

Conclusion

In summary, providing greater exercise-related variety support in a resistance exercise program led to higher ratings on indices of exercise-related well-being among a sample of university students who were physically inactive, when compared to those who received low variety support. The psychological mechanism that explained this effect was the extent to which participants felt that they experienced variety. Variety support may be an efficacious strategy for fostering exercise-related well-being, and it appears prudent for researchers to examine the effectiveness of this intervention strategy in different applied settings and with other populations.

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