

The psychological benefits of recreational running: A field study

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Running yields positive changes in affect, but the external validity of controlled studies has received little attention in the literature. In this inquiry, 50 recreational runners completed the Exercise-Induced Feeling Inventory (Gauvin & Rejeski, 1993) before and after a bout of self-planned running on an urban running path. Positive changes were seen in all four measures of affect ($p < .001$). Multivariate regressions were performed to examine the contribution of four exercise characteristics (i.e., duration of the current run, weekly running time, weekly running distance, and running experience) to the observed changes in affect. The results have revealed that exercise characteristics accounted for only 14–30% of the variance in the recreational runners' affect, in both directions. It is concluded that psychological benefits of recreational running may be linked to placebo (conditioning and/or expectancy) effects.

Keywords: exercise; expectation; mood; physical activity; placebo

Epidemiological research reveals that a physically active lifestyle yields numerous health benefits (Bellocco, Jia, Ye, & Lagerros, 2010; Blair, Kohl, & Barlow, 1993; Lee et al., 2011; Powell & Blair, 1994). There is also evidence showing that physical activity is associated with positive mental well-being (Biddle, 1995; Biddle, Fox, & Boutcher, 2000; Biddle & Mutrie, 2001; Brown, Mishra, Lee, & Bauman, 2000) and lower reactivity to mental stress (Norris, Carroll, & Cochrane, 1990, 1992; Rosenfeldt et al., 2011; Stein & Boutcher, 1992). The psychological benefits of regular exercise are consistently demonstrated (Anderson & Brice, 2011; Berger & Motl, 2000; Biddle & Mutrie, 2001; Dasilva et al., 2011; Fontaine, 2000; Hoffman & Hoffman, 2008; O'Connor, Raglin, & Martinsen, 2000; Paluska & Schwenk, 2000; Raglin, 1990). Since a bout of exercise yields immediate benefits, many scholars see exercise as a non-pharmaceutical antidote to stress and various mood disorders.

There are several plausible theories which emphasize that exercise benefits psychological well-being. The affect-regulation hypothesis posits that exercise has dual effects: (1) It increases positive affect, and (2) it reduces negative affect (Hamer & Karageorghis, 2007). A thermogenic hypothesis postulates that exercise-induced increase in body temperature triggers a relaxation effect with a concomitant

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reduction in anxiety (De Vries, 1981; Morgan & O'Connor, 1988). The catecholamine hypothesis presumes that exercise increases catecholamine levels in the body (Cousineau et al., 1977). There is also evidence showing that exercise stimulates dopamine, serotonin, and noradrenergic activity in the central nervous system (Meeusen & De, 1995). Limited evidence supports the long debated β -endorphin hypothesis. For example, Biddle and Mutrie (1991) reported that aerobic exercise could cause β -endorphin levels to increase fivefold in contrast to baseline levels. New models suggest that exercise may play role in hippocampal-neurogenesis such as β -endorphins, vascular endothelial growth factor, neurotrophic factor, and serotonin (Ernst, Olson, Pinel, Lam, & Christie, 2006). Another plausible mechanism, the placebo effect for which there is strong neurobiological evidence (Benedetti, Carlino, & Pollo, 2011), has been overlooked in the literature in spite of results showing that personal attitudes and expectations are linked to greater changes in mood after exercise (e.g., Pistacchio, Weinberg & Jackson, 1989).

Research shows that different forms of exercise trigger identical psychological benefits: Walking (Dasilva et al., 2011), cycling (Petruzzello, Snook, Gliottoni, & Motl, 2009), swimming (Valentine & Evans, 2001), yoga (Lavey et al., 2005), dance aerobics (Rokka, Mavridis, & Kouli, 2010), shadowboxing (Li & Yin, 2008), treadmill running (Hoffman & Hoffman, 2008), etc. Running is one of the most popular leisure exercises, because it is inexpensive and can be performed anywhere and at any time. However, *in situ* investigation of the psychological effects of planned or self-scheduled running in conjunction with exercise characteristics has not been investigated to date, which sheds doubts on the external validity of experimenter-planned studies.

Another issue in this area of research is whether the effects of acute running are dose-dependent, in which case harder or longer exercise could buffer more stress or generate greater immediate psychological benefits. This issue was addressed by several authors. Ekkekakis and Petruzzello (1999) have reviewed over 200 reports and concluded that harder exercise may not benefit affect and, at any given (constant) workload, the duration of exercise also does not matter. Later, Szabo (2003) reported that the intensity of exercise did not mediate the acute psychological effects as based on planned but self-paced studies on running. His findings were corroborated by other inquiries including some recent investigations (Minjung, Sungwoon, Jingu, Petruzzello, & Hatfield, 2010; Rokka et al., 2010). In another literature review, Ekkekakis (2009) has examined over 100 publications and concluded that exercise performed at self-selected intensity may be the most appropriate from a public health perspective. Therefore, the acute psychological benefits of exercise appear to be dose-independent, and runners running slower or faster and shorter or longer distances, as part of their running habit, may be expected to report comparable changes in affect.

In daily life, recreational runners usually self-select both the duration and intensity of their running. These two characteristics of exercise could be influenced by various factors and, therefore, *in situ* studies examining the psychological benefits of exercise have greater external validity than studies conducted in a controlled, but artificial, laboratory setting or experimenter-planned field studies in which both the duration and intensity of exercise are prescribed for the participants (Ekkekakis, 2009).

This *in situ* study was designed to investigate the changes in affect in recreational runners following their planned bout of running, during which they had control over

running pace and the duration of the run. Another purpose of the work was to explore the relationship between changes in exercise-induced affect (if any) and four exercise characteristics (duration of run, past running experience, average weekly running times, and distances). Based on the current information from the literature, it was hypothesized that regardless of the differences in running pace and duration, all runners – *in situ* – would report improved affect after running. Further, it was posited that there would be little or no relationship between the changes in affect and the duration of run.

Method

Participants

Participants were recruited through systematic random sampling. Accordingly, every third runner preparing to start his/her run on a specially designated 5-km long public running path was approached by one of the experimenters and asked to take part in the inquiry. Three of the approached eligible runners have rejected the invitation to participate in this study. The conditions of participation were that the volunteering runners be at least 18 years old, consent in writing to their participation, run for at least 12 months prior to the research, and have planned to complete the path at least once (run at least 5 km). A total of 50 runners (37 males and 13 females), who met the above selection criteria, were recruited in this study. Nine runners were refused participation because they did not meet the selection criteria. Participants' mean age was 29.02 ($s = 6.55$) years, ranging from 19 to 45 years, and mean running experience was 69.64 ($s = 48.07$) months, ranging from 12 to 240 months. The volunteers reported running an average of 33.80 ($s = 11.19$) km/week, ranging from 15 to 65 km, for an average duration of 171.30 ($s = 49.57$) min/week, ranging from 90 to 280 min. In addition to the ethical requirements of the local Research Ethics Board, the Code of Human Research Ethics (The British Psychological Society, 2010) was also followed and written informed consent was obtained from the runners.

Materials

In conjunction with a demographic questionnaire assessing age, gender, time and distance of weekly runs, and running experience, the Exercise-Induced Feeling Inventory (EFI – Gauvin & Rejeski, 1993) was employed because of its reliability, proven specificity and sensibility, as well as quick and easy administration. The EFI was used to measure the changes in affect from pre- to post-run. This instrument is a 12-item Likert scale, rated from 0 to 4, and taps four distinct states of affect: (1) Positively engaged (*enthusiastic, upbeat, happy*), (2) revitalized (*energetic, refreshed, revived*), (3) tranquil (*calm, peaceful, relaxed*), and (4) physically exhausted (*fatigued, tired, worn out*). To avoid working with zeros (0), in this study a constant (+1) was added to the rating scale, making it range from 1 to 5.

The four affective states are conceptually (and psychometrically) distinct. For example, positive engagement gauges the degree of *enjoyment* of the exercise, revitalization measures how *refreshed* the person feels after exercising, tranquility reflects the state of post-exercise *calmness* associated with a bout of exercise, and finally physical exhaustion measures the mental appraisal of *fatigue* resulting from the running (Gauvin & Rejeski, 1993). The EFI is acceptable to good psychometric

properties (Bozoian, Rejeski, & McAuley, 1994). The internal consistencies of the four subscales range from .72 to .91 (Gauvin & Rejeski, 1993). Nevertheless, the EFI has been criticized in the past (Ekkekakis & Petruzzello, 2000, 2001), but the developers have defended the instrument with convincing arguments (Gauvin & Rejeski, 2001).

Method

After consenting to participation, eligible volunteers completed the questionnaires. This task lasted less than 3 min in all instances. Subsequently, the runner set his/her or experimenter-provided chronograph, while the experimenter recorded the time on the file of the participant. The runner was instructed to run as he/she would do it normally, self-determining the pace of the run, and to stop where the experimenter stood, which corresponded to the start and finish line of the circular 5-km running path. Upon the completion of the run, the elapsed time was recorded again by the experimenter and cross-checked for accuracy with the time measured by the runner. The running times ranged from 23 to 74 min (mean = 39.26, $s = 11.88$). Within 5 min after the run, the participant had rated the EFI again, which marked the end of the testing. All testing took place in daylight, between 10.00 h and 16.00 h, in dry and sunny weather with outside temperature ranging between -1°C and $+4^{\circ}\text{C}$.

Data analyses

Multivariate analysis of variance (MANOVA) was used to examine whether there was a statistically significant difference in the exercise habits of men and women. Changes in affect from pre- to post-exercise were tested with repeated measures multivariate analysis of variance (RM-MANOVA). Multivariate regression analyses were used to investigate the relationship between exercise characteristics and changes in affect resulting from running. Finally, Pearson correlations were performed between baseline (pre-run) scores of affect and the running habits. All the statistical calculations were carried out with the Statistical Package for Social Sciences (SPSS) software, version 17.

Results

Gender differences in exercise characteristics

The 2 (gender) by 4 (time of current run, running experience (months), weekly running distance (km), and weekly running time (min)) MANOVA yielded statistically no significant results (Wilks' $\Lambda = .917$, $F(4,45) = 1.02$, $p = .41$). Therefore, in the subsequent analyses, the four exercise characteristics were studied together for men and women.

Changes in affect from pre- to post-run

The 2 (gender) by 2 (pre- to post-run) by 4 (indices of affect; positive engagement, revitalization, tranquility, and exhaustion) RM-MANOVA yielded a statistically significant main effect for time (Wilks' $\Lambda = .234$, $F(4,45) = 36.9$, $p < .001$), as well as a time by gender interaction (Wilks' $\Lambda = .705$, $F(4,45) = 4.71$, $p = .003$). Therefore, the interaction was followed up first with the univariate tests (automatically

calculated in the SPSS). These tests revealed that the multivariate effect was due to a time by gender interaction only in exhaustion because women reported greater exhaustion before the run than men ($t(48) = 2.1, p = .04$). No statistically significant interaction effect was observed for the other three measures of affect. Therefore, the multivariate main effects were also examined. They revealed that pre- to post-changes in affect emerged in all four dependent measures: Revitalization ($F(1,48) = 145.93, p < .001$, partial $\eta^2 = .75$), positive engagement ($F(1,48) = 97.11, p < .001$, partial $\eta^2 = .67$), tranquility ($F(1,48) = 85.02, p < .001$, partial $\eta^2 = .64$), and exhaustion ($F(1,48) = 32.25, p < .001$, partial $\eta^2 = .40$). Means and standard deviations for these results are presented in Table 1.

The connection between exercise characteristics and changes in affect

Since all four psychological measures demonstrated statistically significantly pre- to post-run changes, difference (Δ) scores were calculated for these measures. These Δ scores formed the dependent measures of the multivariate regressions performed using four exercise characteristics (duration of the current run, time (min) and distance (km) of the weekly runs, and running experience (months)) as the independent variables. The regression analyses yielded significant regression models for three out of the four dependent measures, the sole exception being exhaustion. Current running time was the only predictor in the model to explain a statistically significant proportion of variance in changes in tranquility ($R^2 = .14, F(1,48) = 8.04, p < .007$, Table 2). The regression model including the duration of the current run and weekly running distance (dulling the effects) has accounted for a statistically significant proportion of the variance in the changes observed in positive engagement ($R^2 = .21, F(2,47) = 6.36, p < .004$, see Table 2). Lastly, running experience (dulling the effect) and the duration of the current run have comprised a model that explained 30% of the variance in changes in revitalization ($R^2 = .30, F(2,47) = 10.17, p < .001$, refer to Table 2).

Finally, still in context of the relationship between exercise characteristics and changes in affect, the running speed was calculated from the time and distance. This measure of exertion was correlated with the pre- to post-run change scores in affect. Statistically no significant correlation emerged between running speed and change scores in affect (revitalization, $r = .08$; tranquility, $r = -.06$; positive engagement, $r = .08$; exhaustion, $r = -.08$; p (in all instances) $> .05$).

Table 1. Means and standard deviations (s) in four measures of affect before and after running. The percent changes are all statistically significant ($p < .001$).

Measure of affect	Pre-run	Post-run	Change (%)	Effect size (d)*
Revitalization	8.72 (2.33)	12.70 (1.58)	31%	2.0
Positive engagement	9.62 (2.47)	12.88 (1.59)	25%	1.6
Tranquility	9.50 (2.03)	12.20 (1.55)	22%	1.5
Exhaustion	6.92 (2.55)	4.86 (1.63)	-30%	1.0

Notes: *The partial η^2 is presented in the text. The effect size (d) given in this table is calculated on the basis of Cohen's d (Cohen, 1992), according to which $d = .20$ is a small, $d = .50$ is moderate, and $d = .80$ (or larger) represents large and meaningful differences.

Table 2. Summary results of the multivariate regression analyses for exercise-induced changes in tranquility, positive engagement, and revitalization.

Dependent measure	Components in model	<i>B</i> (unstandardized coefficients)	Standard error	β (standardized coefficients)	<i>t</i>	<i>p</i>
Tranquility ($R^2 = .14$)	Duration of current run	.06	.02	.38	2.84	.007
	Duration of current run	.11	.03	.58	3.50	.001
Positive engagement ($R^2 = .21$)	Weekly running distance	-.09	.03	-.45	-2.72	.009
	Running experience	-.03	.01	-.54	-4.04	.001
Revitalization ($R^2 = .30$)	Duration of current run	.09	.03	.47	3.48	.001

Correlations between baseline (pre-run) scores of affect and running characteristics

Correlations between baseline values (pre-run) of affect and running characteristics revealed statistically significant, but relatively weak, correlations between revitalization before running and three running characteristics (Table 3). The largest proportion of common variance was 18% between running experience and pre-run revitalization ($r^2 = .185$). Another statistically significant correlation emerged between positive engagement at baseline and running experience, with a shared variance of 11% ($r^2 = .109$). Pre-run level of exhaustion was inversely related to the running experience, with a common variance of 10% ($r^2 = .102$).

Discussion

The findings from this *in situ* study are consistent with previous laboratory and field research showing that an acute bout of exercise has positive impact on affect (Anderson & Brice, 2011; Berger & Motl, 2000; Biddle & Mutrie, 2001; Dasilva et al., 2011; Fontaine, 2000; Hoffman & Hoffman, 2008; O'Connor et al., 2000; Paluska & Schwenk, 2000; Raglin, 1990; Szabo, 2003). Further, the current results, showing a lack of connection between speed of running and changes in four measures of affect, add to the mounting evidence that pace or workload is unimportant in disclosing positive changes in affect after exercise (Alfermann & Stoll, 1996; Ekkekakis, 2009; Minjung et al., 2010; Parfitt, Rose, & Markland, 2000; Rokka et al., 2010; Szabo, 2003). This finding may not be surprising knowing for a long time that physically effortless activities also trigger affective benefits similar to exercise (Alfermann & Stoll, 1996; Parente, 2000; Szabo, 2003). The gist of these findings lends support to Stoll's (1997) contention that physiological models alone may be insufficient to account for positive changes in affect following exercise.

The exploration of the relationship between changes in four psychological measures and running characteristics showed that the largest proportion of variance accounting for changes in revitalization was only 30% as predicted by running experience and duration of the current run. However, running experience was inversely present in the model, indicating that runners may possess more positive overall affect with time resulting in "lesser room for improvement," or become habituated to the invigorating effects of running and report lesser revitalization over time. Two exercise characteristics have predicted 21% of the variance in positive engagement: Duration of the current run and weekly running distance. The latter was inversely contributing to the model, indicating that habitually longer running bouts may be associated with lesser positive affect. This conjecture may be supported

Table 3. Summary table of the correlations (r) between baseline (pre-run) values of affect and four running characteristics.

	Revitalization	Tranquility	Positive engagement	Exhaustion
Running experience (months)	.43*	.23	.33*	-.32*
Weekly running distance (km)	.31*	.17	.25	-.19
Weekly total running time (min)	.32*	.20	.26	-.15
Duration of the current run (min)	.09	-.01	.01	-.03

Note: * $p < .05$.

at least in part by the results of the correlations between running experience and positive engagement, revitalization, and exhaustion at baseline (pre-run). Indeed, if highly experienced runners start their run with more positive affect overall, a “ceiling” effect may limit the spectrum of change in affect. It has been known for a long time that the level of running is positively associated with measures of mood at any time (Wilson, Morley, & Bird, 1980). Finally, only 14% of the variance in changes in tranquility was accounted by the duration of the current run, while exhaustion could not be connected to the running characteristics at all.

An emerging question is then, what other factors account for more of the variance in the improved affect following running than the studied exercise characteristics? A recent experiment showing that habitual exercisers responded to acute running with positive changes in affect while no changes were seen in nonexercisers (Hoffman & Hoffman, 2008) could suggest that runners “expect” to experience positive changes after the exercise has been fulfilled. They may feel that they *deserve* those feelings after working out. This presumption may be even more applicable *in situ* than in the laboratory work reported by the Hoffmans, because in the former the runner plans his/her run whereas in the latter the run is planned for him/her.

Indeed, the acute affective benefits of exercise (and some other passive treatments) may be linked to the mental interpretation (Lazarus, 1988) of the activity that the person is engaged in. In light of this model, desire to engage in an activity should yield positive effects. Consequently, all life-experiences interpreted as pleasant are likely to trigger positive changes theoretically and experimentally (Sandlund & Norlander, 2000). Therefore, enjoyment level of the activity may be a variable of interest, because past enjoyment generates future expectancy. Such an expectation-based effect is a form of self-fulfilled prophecy that matches the expectation model forwarded for the placebo effect (Stewart-Williams & Podd, 2004). This conjecture is supported by the work of Pistacchio et al. (1989) in which people with positive attitude toward exercise experienced greater decreases in state anxiety and depression following exercise than people who had a neutral attitude. In a recent investigation, a 10-min bout of jogging improved the mood of the participants, and the results were augmented by biased recall of pre-jogging mood (Anderson & Brice, 2011). Based on their findings, the authors deduced that people’s expectations regarding the psychological benefits of exercise are influential in the emerging results.

In summary, the current findings from *in situ* research agree with the literature about the acute effects of exercise on affect in several aspects. The results suggest that the studied running variables may account little for the observed changes in affect. The psychological benefits may be due, at least in part, to expectations or conditioning through pleasant past experiences, both of which are the bases of the placebo response. Therefore, at least one hypothesis may be generated for future research presuming that recreational running – and other leisure exercises – may act as behavioral *placebos* in enhancing one’s psychological well-being. Future studies need to address this conjecture directly and examine the role of the placebo response in the acute psychological benefits of exercise. The impact of running characteristics also ought to be addressed in a wider spectrum than in the current work. However, until then, the current results should be interpreted as a robust signal for the lesser-than-presumed contribution of exercise characteristics to the acute psychological benefits of running, at least in the naturalistic running environment.

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