



Is it better to cultivate positive affect or optimism? Predicting improvements in medical adherence following a positive psychology intervention in patients with acute coronary syndrome[☆]

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ABSTRACT

Objective: Adherence to health behaviors following an acute coronary syndrome (ACS) is strongly associated with superior prognosis. Both optimism and positive affect may play important roles in such adherence. However, the relationship between changes in these constructs in the context of positive psychology interventions (PPIs) and adherence to health behaviors is not fully understood. Accordingly, we aimed to examine these relationships among a cohort of post-ACS patients receiving a PPI.

Method: Post-ACS participants who received a PPI during a factorial trial ($N = 128$) completed self-report measures of positive affect and optimism, along with the Medical Outcomes Study Specific Adherence Scale items for diet, physical activity, and medication adherence, over 16 weeks. The baseline and longitudinal effects of positive affect and optimism—representing changes in those constructs—on adherence were analyzed using mixed effects regression models.

Results: Positive affect, but not optimism, was longitudinally associated with greater overall adherence to health behaviors (positive affect: $\beta = 0.057, p = .006$; optimism: $\beta = 0.032, p = .36$), with the effect driven by physical activity adherence (positive affect: $\beta = 0.040, p = .004$; optimism: $\beta = 0.005, p = .83$).

Conclusion: Changes in positive affect may be more strongly associated with post-ACS adherence than optimism; this could have important implications for the development of PPIs to promote adherence.

1. Introduction

An acute coronary syndrome (ACS; myocardial infarction or unstable angina) is a highly prevalent condition experienced by 1.3 million Americans annually, with significant rates of rehospitalizations and mortality within the first year [1]. Following ACS, a critical aspect of treatment involves adherence to recommendations related to physical activity, a heart-healthy diet, and medications [2]. Adherence to these behaviors is associated with superior health outcomes [3], including reductions in cardiac symptoms, rehospitalizations, and mortality [4,5]. However, most patients struggle to follow these recommendations, to their detriment [4,5].

Positive psychological constructs, notably optimism and positive affect, are associated with superior cardiovascular outcomes [6–9]. Optimism, defined as having a generalized expectation that favorable

things will happen in the future [10], has been linked to a reduced incidence of heart disease and lower risk of cardiovascular and all-cause mortality among patients without pre-existing heart disease [11–14], and, in patients who have experienced an ACS, optimism is associated with a reduced risk of subsequent cardiac rehospitalizations [6,15,16]. Positive affect, which broadly describes the extent to which an individual experiences positive emotional states (e.g., happiness, interest) [17], also has been linked to lower all-cause mortality [18–20], reduced incidence of coronary heart disease [21,22], and reduced hospital readmissions following a cardiovascular event [23], though data is mixed [19,24–26].

The links between psychological constructs and cardiovascular health may be explained in part by adherence to health behaviors, such as physical activity or a heart-healthy diet. Both optimism and positive affect have been linked to better medical compliance and favorable

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health-related behaviors including absence of cigarette smoking, increased physical activity, and increased consumption of fruits or vegetables [27–31]. These constructs may promote the initiation of health behaviors by increasing one's self-efficacy, intention, and willingness to perform behaviors and may also facilitate the *enjoyment* of health behaviors (e.g., during exercise) [32–34]. Thus, these constructs may make individuals more likely to both start and continue to engage in healthy behaviors.

Positive psychology interventions (PPIs), which are designed to enhance positive psychological experiences through the deliberate and systematic completion of specific activities [35,36], are increasingly being incorporated into interventions aiming to enhance health behavior adherence. While some research indicates that PPIs may be effective at increasing engagement in health behaviors, findings are mixed, and not all participants appear to increase adherence following completion of a PPI [37–39]. In fact, it is currently unknown whether individuals who experience improvements in positive psychological constructs over the course of a PPI experience greater improvements in adherence to health behaviors than those who experience smaller or no gains in these qualities.

Accordingly, in an analysis of data from a randomized, factorial trial of an 8-week, phone-delivered PPI for post-ACS patients, we aimed to explore the baseline and longitudinal relationships between positive affect and optimism and adherence to diet, physical activity, and medications. Given the known links between optimism, positive affect, and health behavior adherence [6,7,37,40,41], we hypothesized that changes in positive affect and optimism would be associated with changes in health behavior adherence.

2. Methods

Data for this analysis were drawn from the PEACE (Positive Emotions after Acute Cardiac Events)-III factorial trial [42,43]. Participants were recruited between November 2014 and November 2016 from inpatient cardiac units at two urban academic medical centers. Institutional Review Board approval was obtained at both sites, and the trial was registered prospectively on ClinicalTrials.gov (removed for blinding).

The goal of the primary project was to identify optimal components of a phone-based PPI to promote physical activity in post-ACS patients; all 128 participants received a version of the phone-based PPI. The protocol and main results have been published elsewhere [42,43]. The primary outcome of the trial was moderate to vigorous physical activity, given its importance in cardiac health and prior links between positive psychological constructs and activity. In brief, across all conditions, the PPI was associated with pre-post improvements in positive affect, optimism, and health behavior adherence over the 16-week study period.

2.1. Participants

Participants were patients hospitalized on an inpatient cardiology unit and were (a) diagnosed with an ACS (myocardial infarction or unstable angina), confirmed using consensus criteria [44], and (b) had suboptimal health behavior adherence measured using Medical Outcomes Study Specific Adherence Scale (MOS-SAS) items for diet, medications and physical activity [45]. Patients were excluded if they: (a) had cognitive deficits, (b) had a medical condition that would likely lead to death within 6 months, (c) were unable to increase physical activity, or (d) were unable to communicate in English.

2.2. Procedures

Prospective participants were screened for eligibility, and eligible patients provided written informed consent. During hospitalization, participants completed baseline outcome measures and then were

randomized to receive one of eight versions of the PPI. All participants completed a core 8-week telephone-based PPI delivered by a mental healthcare professional. This intervention focused on enhancing gratitude (e.g., participants wrote a letter of gratitude to someone), using strengths (e.g., participants chose one of their strengths and used it in a new way), and cultivating meaning (e.g., participants scheduled and performed enjoyable and meaningful activities alone and with others) in their lives. To identify optimal intervention components, the intervention varied in three dimensions: 1) the presence/absence of booster sessions, 2) the presence/absence of motivational interviewing, and 3) daily versus weekly completion of PP exercises.

2.3. Data collection

Sociodemographic and medical variables were obtained through participant interview and chart review. Baseline self-reported assessments were completed with the help of study staff during the hospitalization. Follow-up measures were collected at 8 weeks and 16 weeks.

2.4. Measures

2.4.1. Positive affect

Positive affect was measured using the 10-item positive affect items of the Positive and Negative Affect Schedule [46]. The PANAS is widely used with good psychometric properties [47], and has been validated for use in medical settings [48]. In our sample, internal consistency was high ($\alpha = 0.87$).

2.4.2. Optimism

Optimism was measured using the Life Orientation Test – Revised (LOT-R) [49], a valid and reliable 6-item questionnaire, which has been used in studies with patients after an ACS [6,16]. This measure had high internal consistency ($\alpha = 0.82$) in our sample.

2.4.3. Health behavior adherence

Overall health behavior adherence was measured by the Medical Outcomes Study Specific Adherence Scale (MOS-SAS; [45]) items for diet, physical activity and medication (score range = 3–18). This scale has been used previously in cardiac populations [41,50,51], and low scores on this scale have been prospectively associated with readmissions in this patient population [52].

2.5. Statistical analyses

Baseline characteristics were summarized using descriptive statistics (means, proportions, and standard deviation [SD]). To determine whether changes in optimism and positive affect were associated with changes in adherence, we performed mixed effects linear regression models that included both the baseline and change from baseline for each psychological construct in the same model [53]. This allowed us to include all 128 participants in these analyses. We were interested primarily in the association between the change from baseline and adherence, as this estimated the association between changes in those constructs and changes in health behavior adherence. Age, gender, and intervention time point were also included as covariates. All analyses were performed using Stata (version 15, StataCorp LLC, College Station, TX); we denoted $p < .008$ as significant, using a Bonferroni correction for six sets of comparisons, and all statistical tests were two-tailed.

3. Results

Baseline sociodemographic and medical characteristics of the 128 participants, along with psychological characteristics at 3 time points, are outlined in [Table 1](#). Participants were 63.1 years of age on average, and most were female (59%) and White (73%).

In the mixed effects regression analyses, the change from baseline

Table 1
Baseline characteristics of participants and self-report outcome measures at 3 time points (baseline, week 8, week 16).

Variable	Total (N = 128)		
Sociodemographic characteristics			
Age; mean (SD)	63.1 (12.0)		
Female sex	76 (59)		
White race	94 (73)		
Living alone	36 (29)		
Medical characteristics			
Admission diagnosis of MI	75 (59)		
Length of hospitalization (days); mean (SD)	3.2 (2.7)		
BMI (kg/m ²)	30 (6.2)		
Type 2 diabetes	35 (27)		
Current smoker	18 (14)		
Hypertension	112 (88)		
Hyperlipidemia	103 (80)		
Prior ACS	42 (33)		
LVEF (%); mean (SD)	57 (12)		
Peak troponin T (ng/ml); mean (SD)	1.3 (2.8)		
Antidepressant treatment at discharge	27 (21)		
Anxiolytic treatment at discharge	19 (15)		
Self-report outcome measures (measure; range); all listed as mean (SD)			
Optimism (LOT-R; 0–24)	16.9 (5.8)	18.2 (6.0)	19.2 (5.6)
Positive affect (PANAS; 10–50)	36.4 (7.5)	38.3 (7.6)	40.2 (6.8)
Adherence (MOS-SAS; 3–18)	11.3 (2.5)	14.4 (2.5)	14.4 (2.5)
Physical activity adherence (1–6)	2.5 (1.5)	3.9 (1.6)	4.0 (1.6)
Dietary adherence (1–6)	3.2 (1.7)	4.6 (1.4)	4.6 (1.4)
Medication adherence (1–6)	5.6 (1.0)	5.9 (0.3)	5.9 (0.3)

ACS = acute coronary syndrome; BMI = body mass index; LOT-R = Life Orientation Test-Revised; LVEF = left ventricular ejection fraction; MI = motivational interviewing; MOS-SAS = Medical Outcomes Study Specific Adherence Scale; PANAS = Positive And Negative Affect Schedule; PP = positive psychology; SD = standard deviation. All variables are presented as n (%) unless specified.

for positive affect was associated with improvements in health behavior adherence ($\beta = 0.057$, 95% CI [0.016, 0.097], $p = .006$; see Table 2); this relationship was driven primarily by physical activity ($\beta = 0.040$, 95% CI [0.013, 0.067], $p = .004$). The baseline measurement of positive affect was similarly associated with health behavior adherence, but this relationship was not statistically significant ($\beta = 0.034$, 95% CI [−0.016, 0.085], $p = .18$). Neither baseline positive affect nor change from baseline in positive affect was associated with adherence to diet or medications (Table 2). In all of the analyses, the estimated associations with baseline positive affect and change from baseline positive affect were not significantly different.

In contrast to positive affect, change in optimism was not significantly associated with health behavior adherence ($\beta = 0.032$, 95% CI [−0.037, 0.100], $p = .36$) or with adherence specifically to physical

Table 2
Relationships between positive psychological constructs and adherence, using mixed effects regression analyses.^a

		Overall adherence			Physical activity			Diet			Medications		
		β	95% CI	p-Value	β	95% CI	p-Value	β	95% CI	p-Value	β	95% CI	p-Value
Positive affect	Baseline	0.034	−0.016, 0.085	0.18	0.029	−0.001, 0.059	0.059	0.021	−0.012, 0.053	0.21	−0.013	−0.026, −0.001	0.040
	Change from baseline	0.057	0.016, 0.097	0.006	0.040	0.013, 0.067	0.004	0.024	−0.002, 0.051	0.075	−0.001	−0.015, 0.011	0.80
Optimism	Baseline	0.096	0.032, 0.160	0.004	0.032	−0.007, 0.071	0.11	0.063	0.024, 0.103	0.002	0.000	−0.017, 0.017	0.97
	Change from baseline	0.032	−0.037, 0.100	0.36	0.005	−0.041, 0.051	0.83	0.029	−0.015, 0.074	0.19	0.000	−0.022, 0.022	> 0.99

^a N = 128 for these analyses.

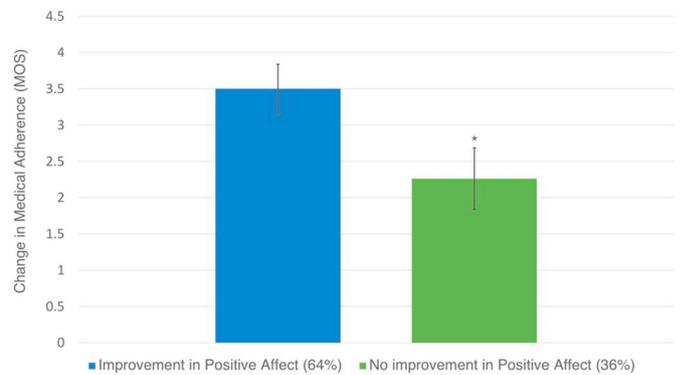


Fig. 1. Change in overall adherence as a function of improved positive affect. Note: Error bars indicate the standard error. * $p < .05$. Participants who experienced improvements in positive affect from baseline to follow-up (64%, $n = 54$) simultaneously experienced significantly larger improvements in medical adherence, relative to participants who did not experience improved positive affect (36%, $n = 28$), $t(80) = 2.22$, $p = .03$.

activity, diet, or medications ($p > .18$ for each comparison). The baseline optimism score was significantly associated with overall adherence ($\beta = 0.096$, 95% CI [0.032, 0.160], $p = .004$) and diet ($\beta = 0.063$, 95% CI [0.024, 0.103], $p = .002$) but not with physical activity or medication adherence. In all of the analyses, the estimated associations with baseline optimism and change from baseline optimism were not significantly different.

To illustrate the relationship between change in positive affect and adherence, we created two groups of positive affect change from baseline to follow-up (participants whose positive affect improved vs. those who experienced no improvements in positive affect). As shown in Fig. 1, those participants whose positive affect improved over the course of the intervention (64%; $n = 54$) simultaneously reported significantly greater improvement in overall adherence over the course of the intervention. In contrast, those whose positive affect did not improve (36%; $n = 28$) reported less improvement in overall adherence (mean difference = 1.24, 95% CI = [0.13, 2.35], $p = .03$).

4. Discussion

In sum, the present analysis found that changes from baseline in positive affect were associated with improvements in physical activity, while changes from baseline in optimism were not. These findings suggest that increases in positive affect associated with an intervention specifically designed to promote well-being are associated with improved physical activity, in a large sample of patients recovering from an acute cardiac event. In contrast, improvements in optimism did not appear to impact physical activity or other forms of health behavior adherence.

The findings regarding positive affect are consistent with recent

observational work, which has indicated that increases in positive affect tend to co-occur with improved health behaviors—and particularly physical activity—over time in patients with stable coronary heart disease [20,54]. Moreover, higher levels of positive affect have been linked to decreased mortality in stable coronary heart disease in several studies [19,20], with exercise a potential mediator of this relationship [20]. Physical activity independently improves survival and reduces morbidity after an ACS [1,55,56], by increasing cardioprotective mechanisms such as improvement in key inflammatory markers and improved autonomic function [57,58]. Here, we extend this finding to interventional research and ACS patients, finding that when an individual's positive affect increases in the setting of a PPI, that individual is more likely to report greater improvements in physical activity. Though further study (and formal mediation analysis) is needed, this suggests that positive affect may be one 'active ingredient' of PPIs that can facilitate health.

Work by Fredrickson and colleagues shows that positive emotionality, especially experienced at the time of participation in a health behavior such as exercise or healthy eating, is a powerful resource that may reinforce lasting health behavior change [32]. In brief, those who experience positive emotions while participating in health behaviors experience both non-conscious and conscious biological and psychosocial rewards that reinforce the behavior, making it more pleasurable and more desirable to engage with in the future, leading to an upwards spiral of positive health [59]. Future work, for instance using ecological momentary assessment, could explore transient changes in emotions and adherence over the course of a positive psychology intervention, to investigate the contribution of positive affect *during* health behaviors (e.g., exercise).

Our finding that the baseline level of optimism predicted improvements in medical adherence is consistent with a large body of evidence that has linked optimism to improved medical adherence and its downstream health benefits, such as longevity and reduced morbidity [60–62]. However, while baseline optimism itself is linked to adherence and healthy lifestyle choices, our findings show that *increasing* optimism may not necessarily relate to improved lifestyle choices, suggesting that increasing patient experiences of positive emotions (such as happiness, curiosity and joy) may be a more promising pathway to facilitate improvements in medical adherence, at least in patients recovering from an acute cardiac event.

This study has several important limitations. This was a predominantly White sample, and our study was conducted in two urban academic hospitals, which limit generalizability. Moreover, both psychological and health behavior measures were self-reported and retrospective; future work could include an objective measurement of self-adherence behaviors or in-the-moment measures of psychological health (e.g., ecological momentary assessment). Third, given that there was no formal control group in the study, changes in positive affect or optimism cannot necessarily be attributed fully to the PP intervention; it is possible that other forms of treatment (e.g., cardiac rehabilitation) may have led to some improvement in psychological health as well. Finally, we collected data at just three time points: baseline, 8 weeks, and 16 weeks, and future work could explore more time-points to better understand our findings.

Despite these limitations, our study has important implications. This is the first study to prospectively assess the relationship of both positive affect and optimism with self-management outcomes associated with a PPI in post-ACS patients. These results provide evidence that targeting positive affect might be more fruitful than targeting optimism in programs designed to promote health behaviors—especially activity—in medical patients. Future work is needed to expand on these findings, to investigate temporal relationships between changes in positive affect and self-adherence behaviors in more detail, and to replicate our findings in diverse patient groups.

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