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Altruism and health outcomes in multiple sclerosis: The effect of cognitive reserve

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Objective: Altruism and cognitive reserve (CR) are associated with better health and well-being. We investigated the independent and moderator effects of altruism and CR on health and well-being in multiple sclerosis (MS). **Methods:** Secondary analysis of data ($n=859$) from the North American Research Committee on MS registry. **Outcomes:** Performance Scales; Ryff Psychological Well-Being; Diener Life Satisfaction. **Analyses:** Hierarchical series of regression models adjusted for demographic covariates and stratified by neurologic disability. **Hypotheses:** Independent and moderator effects of altruism and CR on health and well-being. **Results:** Neither altruism nor passive CR had independent effects on functional health problems. Higher active CR was associated with fewer functional health problems. Altruism and active CR, but not passive CR, had significant main effects on well-being for all levels of disability. There were no moderator effects. **Conclusions:** Whereas altruism primarily impacted well-being, active CR was an important predictor of both functional health and well-being.

Keywords: altruism; quality of life; cognitive reserve; multiple sclerosis; health outcomes

Introduction

The concept of resilience is relevant and important for studying possible intervention strategies for chronic disease. Over the past decade, researchers from diverse fields in medical research and social science have converged on patient factors related to resilience. From fields related to health psychology, there is a large evidence base that behavioral factors, such as not smoking, moderate alcohol consumption, and regular physical exercise, can impact health outcomes and well-being (Baum & Posluszny, 1999; Penedo & Dahn, 2005; Schneiderman, Antoni, Saab, & Ironson, 2001). There is growing evidence that measurable changes in one's happiness 'set-point' can be achieved by cognitive strategies (e.g. practicing gratitude), behavioral strategies (e.g. pursuing meaningful goals), and social strategies (e.g. nurturing social relationships) (Lyubomirsky, 2008; Lyubomirsky, Sheldon, & Schkade, 2005). Research on the health effects of altruism suggests that such prosocial behaviors such as acting kindly to strangers not only benefits one's subjective well-being (Otake, Shimai, Tanaka-Matsumi, Otsui, & Fredrickson, 2006), but also one's mental health (Schwartz, Meisenhelder, Ma, & Reed, 2003), physical health (Wink & Dillon, 2007), and survival (Brown, Brown, House, & Smith, 2008; Brown, Nesse, Vinokur, & Smith, 2003; Ironson et al., 2002; Thoits, Hohmann, Harvey, & Fletcher, 2000).

From basic and applied medical research, we know that premorbid differences in educational and occupational achievement are relevant covariates for almost any outcome (Pincus & Callahan, 1994; Ross & Wu, 1995; Williams, 1990), but more recent research in neurology has suggested that this achievement reflects an aspect of a richer concept, that of *cognitive reserve* (CR) (Stern, 2007). CR theory posits that there are two components of reserve: *passive and active* (Stern, 2007). Whereas passive CR reflects past and premorbid indicators of brain reserve (e.g. intelligence quotient, educational and occupational attainment, childhood enrichment activities, etc.), active CR reflects current enrichment activities that keep the brain active, such as stimulating leisure, cultural, and exercise activities. Originally motivated by the repeated observation of a poor correspondence between brain pathology and clinical presentation among people with brain injury, Alzheimer's, or multiple sclerosis (MS) (Stern, 2007), CR appears to buffer the impact of neurological disease (Arnett, 2010; Sumowski, Chiaravalloti, & DeLuca, 2009; Sumowski, Chiaravalloti, Wylie, & DeLuca, 2009; Sumowski, Wylie, DeLuca, & Chiaravalloti, 2010; Sumowski, Wylie, Gonnella, Chiaravalloti, & DeLuca, 2010; Valenzuela & Sachdev, 2006) and possibly cancer (Ahles et al., 2012). Recent work by our group on people with MS has documented consistent relationships between high CR and better

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health and well-being outcomes (Schwartz, Snook, Quaranto, Benedict, & Vollmer, 2013), as well as a tendency in high cognitive reserve individuals to utilize cognitive appraisals that emphasize the positive, focus on aspects of their life that are more controllable, and less based in fantasy (Schwartz, Snook, Quaranto, Benedict, Rapkin et al., 2013). Because active CR refers to current activities that could ostensibly be the focus of intervention, it would be of interest to investigate the role of active CR on health and well-being outcomes, after adjusting for the effect of passive or premorbid CR.

Research also suggests that the mental health benefits of altruism are due in part to having more emotional, physical, or economic resources, but the physical health benefits for women do not appear to be mediated by resources (Schwartz et al., 2012). Since CR can be thought of as the ultimate resource in promoting health and wellness in the face of challenges or stressors, we hypothesize that CR and altruism are related factors in creating resilience or a buffer in the face of chronic illness. The purpose of the present work was to investigate the independent and moderator effects of altruism and CR in patients with MS. The present work builds on a systematic series of analysis of a longitudinal data set of patients with MS addressing symptom experience measurement (Schwartz, Bode, Quaranto, & Vollmer, 2012; Schwartz, Bode, & Vollmer, 2012), CR measurement (Schwartz, Snook, Quaranto, Benedict, & Vollmer, 2013) and impact (Schwartz, Snook, Quaranto, Benedict, Rapkin et al., 2013), and their relationships (Schwartz, Quaranto, Healy, Benedict, & Vollmer, 2013). The present work tests specific hypotheses related to altruism and health, and the independent and moderator effects of CR in this relationship.

Methods

Sample and design

This project involved secondary analysis of data from 1523 people who provided baseline data in an add-on survey to the North American Research Committee on Multiple Sclerosis (NARCOMS) registry, 859 of whom provided longitudinal follow-up data for our study. Data from participants who provided data at both baseline and follow-up were included in our study. Health outcomes were measured longitudinally and well-being was measured only at the last time point. This self-report registry includes over 36,000 individuals of age 18 or over with clinician-diagnosed MS. Bi-annual survey updates using either paper or secure web-based survey forms capture data on demographics, disease characteristics, disability, treatments and access to healthcare providers. Potential candidates for the study were selected from those NARCOMS registry participants who resided in the United States and completed the latest two semi-annual update surveys online. These NARCOMS participants were sent an invitation to participate voluntarily in this web-based

add-on survey after they completed the Spring 2010 and Fall 2010 semi-annual updates. This study was approved by the New England Institutional Review Board.

Measures

Health outcome

The disease-specific *Performance Scales* (Schwartz, Vollmer, & Lee, 1999) was used to measure functional health problems. This measure comprises eight domains of neurologic disability (mobility, hand function, vision, fatigue, cognition, bladder/bowel, sensory, pain, and spasticity). Performance Scales scores range from 0 ('Normal') to 5 ('Total [subscale name] disability') on all subscales except mobility, for which the highest score is 6. The Performance Scales summary score thus represents a multidimensional index of MS functional health problems, with low scores reflecting better health.

Well-being outcome

Well-being was assessed using four subscales from the *Ryff Psychological Well-Being Measure* (Ryff, 1989) to assess purpose in life, personal growth, self-acceptance, and positive relations with others; and the *Diener Satisfaction with Life Scale* (Diener, 1984), a five-item Likert scaled measure of subjective well-being. To reduce the number of comparisons, we created a well-being composite score that included the Ryff Psychological Well-Being subscales and the Diener Satisfaction With Life Scale (Eigenvalue = 2.89, $\alpha = 0.86$). These measures have been used in previous MS research (Pakenham, 2005; Schwartz & Sendor, 1999).

Altruism was measured by the Schwartz Altruism Questionnaire-Adult Version (Schwartz, Keyl, Bode, & Marcum, 2009), a 16-item self-report measure that was adapted for use with adults from the Schwartz Teen Altruism measure (Schwartz et al., 2009) and has been used with spine surgery patients (Schwartz et al., 2012). The scale assesses three attitudinal or behavioral aspects of altruistic social interest behaviors and one downside of altruism. The altruistic social interest behaviors include: Community Connection ($\alpha = 0.89$), General Helping Behavior ($\alpha = 0.81$), and Helping Orientation ($\alpha = 0.80$). The downside scale is Community Pressure ($\alpha = 0.70$), which was considered a covariate for the altruism subscales to adjust for feeling overwhelmed or over-extended by altruistic behaviors. A confirmatory factor analysis conducted with the current data set confirmed that a four-factor model fit the data well (Comparative Fit Index = 0.967, Root Mean Square Error Approximation = 0.082). Inter-subscale correlations were small to moderate (r range 0.17–0.36). To reduce the number of comparisons, we used an altruism summary score comprised of a sum of Community Connection, General Helping Behavior, and Helping Orientation (second-order principal component factor eigenvalue = 1.68).

Community Pressure was utilized as a covariate in the regression analyses.

Cognitive reserve

Passive Cognitive Reserve (CR) was measured using the Sole-Padulles Childhood Enrichment measure of passive CR (Sole-Padulles et al., 2009), which includes respondent's education level, parents' education levels, and childhood participation in music, the arts, and social activities. The measure has documented reliability and validity in MS (Schwartz, Snook, Quaranto, Benedict, & Vollmer, 2013). *Active CR* was measured by the Stern Leisure Activities measure of active CR that assesses current hobbies, cultural and leisure activities (Scarmeas, Levy, Tang, Manly, & Stern, 2001) and has documented reliability and validity in MS (Schwartz, Snook, Quaranto, Benedict, & Vollmer, 2013).

Covariates

Demographic and medical covariates included gender, age, marital and employment status, years since diagnosis, and co-morbidities. Co-morbidities were measured by the Self-Administered Co-morbidity Questionnaire (Sangha, Stucki, Liang, Fossel, & Katz, 2003). The close-ended version of the tool assesses 12 defined medical problems. An individual can receive a maximum of three points for each medical condition: one point for the presence of the problem, another point if he/she receives treatment for it, and an additional point if the problem causes a limitation in functioning, yielding a maximum score of 36 points. We included as a covariate a summative score of co-morbidities.

Disability strata

The *Patient-Determined Disease Steps (PDDS)* (Hohol, Orav, & Weiner, 1995) is a disease-specific self-report measure of perceived disability that was modeled after and correlates highly with the Expanded Disability Status Scale (Marrie & Goldman, 2007). This measure characterizes disability level into one of nine steps (0 = normal, 1 = mild disability, 2 = moderate disability, 3 = gait disability, 4 = early cane, 5 = late cane, 6 = bilateral support, 7 = wheelchair or scooter, 8 = bedridden). For purposes of stratified modeling, we created mild-, moderate-, and severe-disability groupings of patients using score ranges of 0–2, 3–4, and 5–8, respectively, on the PDDS.

Statistical analysis

Because of the structure of the data set, the analyses focused on the cross-sectional analysis using a hierarchical series of regression models of the cross-sectional data from Fall 2010, which is when the CR data were collected. These models investigated the association between altruism and patient-reported functional health

problems and well-being outcomes, to test whether passive or active CR moderated these relationships and to test whether these relationships differed for mild, moderate, and severe levels of disability. Building on the analytic framework of (Baron & Kenny, 1986), we tested moderation hypotheses by examining the significance of altruism-by-CR reserve interaction terms. Because neither passive nor active CR could be construed as being caused by altruism, we did not test mediator hypotheses (MacKinnon, Fairchild, & Fritz, 2007).

We tested a hierarchical series of linear regression models to test the hypothesis that CR and altruism are related factors in creating resilience or a buffer in the face of chronic illness. Specifically, we expect that both altruism and CR will have significant relationships with better health and well-being and that altruists with higher CR will have even better health and well-being (i.e. an interaction effect reflecting CR as a moderator of altruism). The following hierarchical series of models was tested:

- (1) We tested univariate regression models to select demographic and medical covariates. We then tested a multivariable demographic model to identify the set of covariates to include in the final model. We forced the inclusion of PDDS to reduce the impact of an inadvertent association between disability and the General Helping Behavior subscale of the Schwartz Altruism measure. This subscale contains items that are more likely to be endorsed by people who are regularly interacting in public contexts. For example, items include 'allowed someone to go ahead of me in line' and 'given directions to a stranger' among others. Item endorsement would consequently be influenced by level of physical disability.
- (2) We built multivariable models to evaluate the main effects of the altruism summary score, Community Pressure, and (passive and active) CR. Additionally, we forced the inclusion of Community Pressure because it is a known downside of altruism (Schwartz et al., 2003). We also forced the inclusion of passive CR because it has a strong association with selected demographic factors that are sometimes used as markers of passive CR (e.g. employment status, marital status) (Hakansson et al., 2009; Peterson et al., 2001).
- (3) To test the moderation hypothesis on health and well-being outcomes, interaction terms were created by multiplying the passive or active CR score by the altruism summary score (two-way interactions) or all three terms together to test the importance of the three-way interaction, after adjusting for demographic and medical covariates. We used a Type I error rate of 0.10 for covariate selection, and an error rate of 0.05 in the multivariable models as per the purposeful model-building strategy described by Bursac, Gauss,

Williams, and Hosmer (2008). To summarize briefly here, the issue with the model building has to do with trying to find a balance between under- and over-specifying a model. On the one hand, we try to find that nice parsimonious model. Getting rid of weak variables can also improve parameter estimates and model fit, arguing for more stringent p -value. On the other hand, if we hastily delete a correlated variable from a model it will introduce bias. Starting with a relaxed p -value allows us to examine individual associations without the muddying effects related to collinearity. However, in the end, we want the most parsimonious model. While deleting variables from the multivariate model might introduce bias, it will improve precision of parameter estimates.

- (4) Final models were evaluated for collinearity by examining tolerance statistics. In the case of collinearity, final models utilized centered variables (i.e. variable raw scores subtracted from variable means) for the following variables: Altruism Summary score, Stern Active CR score, Sole-Padulles Passive CR score, PS Sum, and the Well-Being Factor Score. Centering removes the problem of collinearity for the interaction terms and allows for better estimation of standardized beta coefficients. To plot the final relationships, we estimated the full adjusted-regression models stratified by PDDS disability level (mild, moderate, severe) to illustrate differences in the relationship between altruism and active reserve for our two outcomes.

Stata Release 12 statistical software was used for all analyses (StataCorp, 2011).

Results

Sample

Table 1 shows the sample demographic characteristics. Participants in the study sample had a mean age of 54 years, and 74% of the participants were female, which is consistent with the gender distribution in MS (Matthews, 1991). Less than half of the sample was employed, with a median annual household income between \$50,000 and \$100,000 in the whole sample. Ninety-seven percent of participants reported living in a private home. In terms of health behaviors, 59% endorsed drinking alcohol monthly or less often, and 88% were nonsmokers. The median body mass index characterized the sample as overweight (body mass index of 25–29.9), with 30% in the overweight category (over 25) and 29% in the obese category (over 30).

Table 1. Sample demographic characteristics.

N	859
Gender: % female	74.27%
Mean age (sd)	54.58 (9.24)
<i>Marital</i>	
Never married	8.92%
Married	70.07%
Divorced	11.27%
Widowed	3.87%
Separated	1.41%
Cohabitation/domestic partner	4.46%
<i>Employment status</i>	
Full-time	24.88%
Part-time	14.55%
Not employed	60.56%
<i>Annual income</i>	
Less than \$15,000	6.10%
\$15,001-30,000	12.68%
\$30,001-50,000	14.08%
\$50,001-100,000	30.40%
Over \$100,000	20.07%
Do not wish to answer	16.67%
<i>Income change in past six months</i>	
Yes	20.84%
No	74.59%
Do not wish to answer	4.57%
<i>If income changed, how?</i>	
Increased	28.09%
Decreased	66.29%
Lost all income	5.62%
<i>Residence status</i>	
Private home	96.71%
Private home with home health aid	2.70%
Assisted living	0.23%
Nursing home	0.35%
<i>Alcohol use</i>	
Never	32.51%
Monthly or less	26.64%
2–4 times per month	18.31%
2–3 times per week	11.62%
4 or more times a week	10.92%
<i>Smoking</i>	
No, not at all	88.26%
Yes, some days	3.64%
Yes, every day	8.10%

Participant flow and possible nonresponse bias

The add-on survey engine required answers to each question to minimize the problem of item nonresponse. It was, however, still possible to answer ‘not applicable’. All measures were scored only if less than 25% of items were missing score-able responses. Otherwise, the relevant (subscale) score would be coded as ‘missing’.

Complete data were obtained from 99% of the analytic sample for the present study.

It is possible that the baseline and follow-up samples were different from the full NARCOMS sample and/or from each other. A comparison of our sample's demographics to the full NARCOMS sample exemplified in Marrie and colleagues' work (Marrie, Cutter, Tyry, Vollmer, & Campagnolo, 2007) suggests, however, that our sample is similar to the full NARCOMS sample in terms of gender and level of disability, but is slightly older (our mean age = 54.2 as compared with 52.5 in the Marrie sample, $p < 0.0001$) and was diagnosed at a slightly older age (our mean age at diagnosis = 39.1 as compared with 37.9 in the Marrie sample, $p < 0.0001$) (Schwartz, Bode, & Vollmer, 2012). Supplementary Table 1 shows a comparison between participants in the first wave of data collection ($n = 1523$) and those with complete data in both waves ($n = 859$), who were included in the analytic data set for the analyses reported herein. There were no significant differences between samples on the following characteristics: gender, age, marital status, employment status, annual income, income change in the past six months, residence status, reported alcohol use, and reported smoking. Thus, there appears to be minimal selection bias in the analytic sample.

Covariate selection models

Supplementary Table 2 shows the intercorrelation matrix of variables used in regression modeling, color-coded by effect size as per Cohen's criteria (Cohen, 1992). The demographic covariates predicting Performance Scales Summary score were gender, employment status, years since diagnosis, number of co-morbidities, and disability level. Higher levels of functional health problems were reported by men, people who were not working, reported a longer time since diagnosis, reported more co-morbidity, reported higher levels of disability, and those who reported more Community Pressure (Supplemental Table 3). The demographic covariates predicting the well-being composite score were

gender, employment status, marital status and number of co-morbidities. Higher levels of well-being were reported by women, people who were working, married, reported less co-morbidity, and those who reported less Community Pressure (Supplemental Table 3).

Altruism, CR and functional health problems

Although altruism had a significant main effect in predicting the Performance Scales Summary score in univariate models as well as multivariate models that included Community Pressure and passive CR, once active CR was added to the model, altruism no longer had a significant parameter estimate and neither did the altruism-by-active CR interaction. When covariates were added to the final model, only active CR remained statistically significant (Table 2). We re-ran the models without the interaction term and the standardized beta coefficients and p -values were substantially the same (data not shown). These parameter estimates suggested that people reporting lower levels of active CR had worse functional health problems, even after adjusting for demographic and medical covariates.

Figure 1 illustrates the relationships between altruism, active CR, and functional health problems stratified by disability level. Patients were dichotomized into high- or low-active CR and altruism based on a median split. In general, people with low-active CR reported worse functional health problems and lower well-being. Functional health problems varied as expected by disability stratum: mild disability patients had fewer functional health problems than moderate disability patients, who had fewer than high-disability patients. High-active reserve patients were always better off within disability stratum, and level of altruism had no effect on functional health problems.

Altruism, CR and well-being

Altruism had significant main effects in predicting the well-being composite score derived from the principal

Table 2. Final multivariable regression model predicting performance scales summary score.

Variable	Standardized beta	Unstandardized coefficient	Standard error	t	p	R^2	Adjusted R^2
Altruism summary score ^a	0.03	0.02	0.03	0.86	0.390	0.52	0.51
Community pressure score	0.15	0.99	0.17	5.77	<0.01		
Passive cognitive	-0.05	-0.17	0.09	-1.89	0.059		
Active cognitive reserve ^a	-0.16	-0.66	0.12	-5.33	<0.01		
Altruism summary score ^a * active CR (interaction term)	0.01	0.01	0.01	0.45	0.655		
PDDS level	0.53	5.02	0.27	18.68	<0.01		
Gender	0.00	-0.03	0.47	-0.07	0.941		
Current employment	-0.18	-2.94	0.45	-6.51	<0.01		
Years since diagnosis	0.00	0.00	0.02	-0.11	0.909		
Comorbidities summary	0.20	1.03	0.14	7.55	<0.01		

Notes: ^aCentered variable = variable - variable mean.

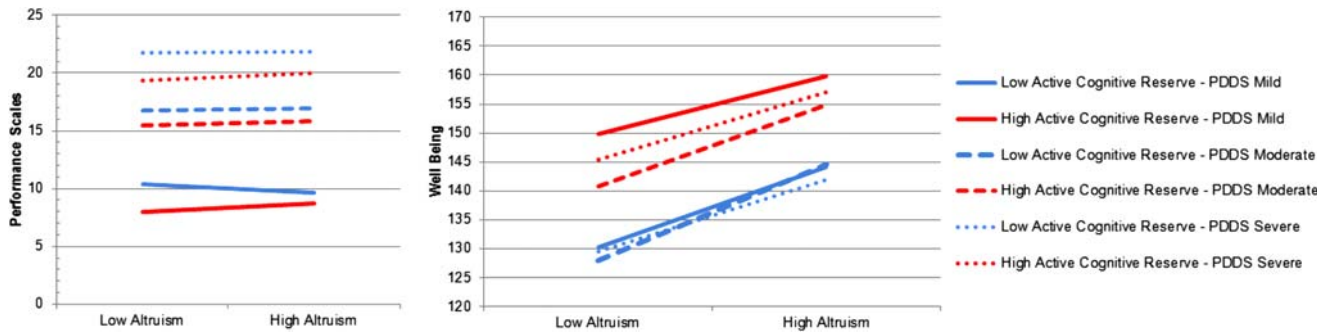


Figure 1 Effect of altruism and active CR on functional health problems and well-being. Adjusted means from the stratified regression models illustrate the relationships between altruism, active cognitive reserve, and outcomes. In general, people with high-active cognitive reserve report fewer functional health problems and better well-being. Although level of altruism had no effect on functional health problems, it was a major distinguishing factor for well-being.

Table 3. Final multivariable regression model predicting well-being composite score.

Variable	Standardized beta	Unstandardized coefficient	Standard error	<i>t</i>	<i>P</i> -value	<i>R</i> ²	Adjusted <i>R</i> ²
Altruism summary score ^b	0.32	0.95	0.10	9.17	<0.01	0.37	0.36
Community pressure score	−0.19	−3.91	0.62	−6.33	<0.01		
Passive cognitive reserve ^b	0.05	0.50	0.32	1.59	0.003		
Active cognitive reserve ^b	0.30	3.91	0.45	8.75	<0.01		
Altruism summary score ^b * active CR (interaction term)	−0.05	−0.07	0.04	−1.66	0.098		
PDDS level	0.02	0.52	0.96	0.54	0.590		
Gender	0.06	3.51	1.70	2.06	0.040		
Current employment	0.04	1.92	1.63	1.18	0.240		
Married	0.07	4.02	1.62	2.48	0.013		
Comorbidities summary	−0.17	−2.84	0.50	−5.74	<0.01		

Note: ^bCentered variable = variable – variable mean.

component factor analysis. This finding was true in both the univariate and the multivariate modeling, even after adjusting for active CR and covariates (Table 3). The final model suggested that people reporting higher levels of altruism and active CR reported higher levels of well-being (Table 3). The altruism-by-active CR showed a trend relationship ($\beta = -0.05$, $p = 0.098$). We re-ran the models without the interaction term and the standardized beta coefficients and *p*-values were substantially the same (data not shown).

Figure 1 illustrates the relationships between altruism, active CR, and well-being stratified by disability level. Both altruism and active CR were distinguishing factors. Among low-altruism/high-active CR patients, mild-disability patients reported higher levels of well-being as compared to moderate-disability patients ($t_{\text{low altruism}} = 3.36$, $p = 0.0011$), and moderate- and severe-disability low-altruism/high-active CR patients did not differ in reported well-being ($t_{\text{low altruism}} = 1.55$, $p = 0.12$). High-altruism patients also reported higher levels of well-being, with the low-active CR patients showing the biggest impact of altruism (17 point difference). Among the high-active CR patients, high-altruism patients showed about a 10–15 point difference. Among low-active CR patients, well-being did not differ by PDDS level of disability.

Discussion

Our findings suggest that altruism and active CR play different roles in health and well-being outcomes, depending on the person's level of neurologic impairment or disability. This work goes beyond previous research by testing the hypothesis that the health impact of altruism is due to a substantial extent on having more cognitive resources. We found that higher levels of active CR are associated with fewer functional health problems independent of disability level, whereas altruism did not have an independent predictive effect on functional health problems. In contrast, altruism and active CR are both important in predicting well-being at all levels of disability. Passive CR was not statistically important after adjusting for active CR. Both altruism and active CR appear to act as buffers to enhance well-being resilience. Thus, the relationship between altruism and physical functional health is largely due to having more cognitive resources, but the relationship between altruism and well-being is independent of these cognitive resources.

Our models explained a significant amount of variance ($R^2 = 52\%$ for functional health problems and 37% for well-being). We would likely boost the explained variance in both models by including factors such as depression (Lovera et al., 2006; Randolph, Arnett, Higginson, &

Voss, 2000), cognitive impairment (Barker-Collo, 2006; Hoogs, Kaur, Smerbeck, Weinstock-Guttman, & Benedict, 2011), and personality factors (Benedict et al., 2009; Ratsep, Kallasmaa, Pulver, & Gross-Paju, 2000). Although gender has been found to be an important factor in the health benefits of altruism in past research (Schwartz et al., 2009; Schwartz, Quaranto et al., 2012), the present work did not find a significant gender effect in adjusted models.

In addition to highlighting the main effects of altruism and active CR in enhancing well-being among all disability subgroups, our findings also suggest that the predictive importance of passive or premorbid CR is subsumed by active CR and possibly demographic factors that are related proxies for passive CR. Thus, although premorbid educational and occupational achievement and childhood enrichment activities are clearly associated with health and well-being outcomes (Schwartz, Snook, Quaranto, Benedict, & Vollmer, 2013) and more adaptive cognitive appraisal processes (Schwartz, Snook, Quaranto, Benedict, Rapkin et al., 2013), they do not explain unique variance as compared to current enrichment activities and demographic markers of CR (e.g. being employed (Peterson et al., 2001), being married (Hakansson et al., 2009)).

Our findings suggest that implementing interventions to increase patients' level of active CR could be effective in improving health and well-being outcomes across the disability spectrum. For example, in addition to encouraging regular physical exercise regimens, MS clinicians might also encourage stimulating cultural, continuing-educational, volunteer, and community activities. They also suggest that to fully understand the importance of passive CR, one would need to assess its role in longitudinal data and possibly measure it using items that provide a more nuanced snapshot of childhood enrichment activities capturing, for example, frequency and breadth of exposure to art, language, music, and exercise activities throughout childhood.

These findings may have implications for the connection between behavior and illness trajectory in MS. From the field of psychoneuroimmunology (Ader, 1992; Ader, Cohen, & Felten, 1995), we know that stressful life events have an impact on immune function and relapse frequency in MS (Kern & Ziemssen, 2008; Mohr, Hart, Julian, Cox, & Pelletier, 2004) as well as new brain lesions (Mohr et al., 2000). Further, the literature on altruism and health would suggest that prosocial behaviors have a protective effect on health (Post, 2007). Recent research suggests that the impact of prosocial behaviors can be seen in brain function, with functional magnetic resonance imaging studies documenting lower brain activation in the amygdala – signifying fear attenuation (Melia, Sananes, & Davis, 1991) – when one provides emotional support to others (Inagaki & Eisenberger, 2012). Future research might evaluate how altruistic and active CR behaviors

relate to clinical indices of disease activity and disease trajectories over time.

The limitations of our study should be considered as caveats. First, these analyses utilized data from one time point. On the basis of this study, causal inference is not appropriate. Longitudinal data over a long enough period of time to allow clinically important change would be needed to examine the causal impact of altruism and active CR on health and well-being outcomes. A second limitation is that more information about the motivations underlying altruism would be relevant but was not available in the current study. Recent research on the health benefits of volunteering has revealed that the health benefits on mortality are restricted to those who volunteer for other-oriented reasons (Konrath, Fuhrel-Forbis, Lou, & Brown, 2012).

In summary, our findings suggest that altruism and active CR are independent and relevant factors in MS functional health and well-being outcomes. Whereas altruism primarily impacted well-being outcomes, active CR was an important predictor of both fewer functional health problems and better well-being, even after adjusting for covariates. Future research should evaluate whether altruism and active CR have causal effects on health and well-being outcomes using longitudinal data over several years of follow-up.

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