

Author's Original Manuscript**Divergent Pathways to Influence: Cognition and Behavior Differentially Mediate the Effects of Optimism on Physical and Mental Quality of Life in Chinese University Students****Abstract**

Previous research has indicated that both cognitive and behavioral variables mediate the positive effect of optimism on quality of life (QOL), yet few attempts have been made to accommodate these constructs into a single explanatory framework. Adopting Fredrickson's broaden-and-build perspective, we examined the relationships between optimism, self-rated health, resilience, exercise, and QOL in 365 Chinese university students using path analysis. For physical QOL, a two-stage model, in which the effects of optimism were sequentially mediated by cognitive and behavioral variables, provided the best fit. A one-stage model, with full mediation by cognitive variables, provided the best fit for mental QOL. This suggests that optimism influences physical and mental QOL via different pathways.

Keywords

Optimism, resilience, exercise, self-rated health, quality of life

When faced with trying circumstances, people are often encouraged to think positively, and for good reason. Optimism—an individual difference variable reflecting the general tendency to hold positive expectancies—has been associated with a number of health-related outcomes such as subjective well-being (Carver and Gaines, 1987), depression (Wong and Lim, 2009), cardiovascular health (Boehm et al., 2011), immunological functioning (Ebrecht et al., 2004), and longevity (Giltay et al. 2004). In a recent meta-analysis, Rasmussen et al. (2009) found that optimism was related to positive physical health outcomes, while optimism has been found to be negatively related to distress across a wide range of samples and contexts (see Carver et al., 2010, for a review). Optimistic individuals, it seems, are healthier and happier, and there can be few better examples of folk psychology finding vindication in empirical research.

Given the robustness of the association between optimism and physical and mental health, attention has naturally turned to providing a mechanistic account of these relationships. In the case of mental health, some researchers suggest that optimistic thought exerts a direct effect on mental well-being (Carver and Scheier, 1998). Since the optimist's positive outcome expectancies engender positive affect in adverse or uncertain circumstances, optimism may enhance mental health simply by increasing general levels of positive affect. This is not however the whole story, and a growing body of evidence suggests that positive emotional traits such as optimism may exert their health-promoting effects via a process of resource accumulation, facilitating the acquisition of psychological, social, and physical resources that in turn lead to better health (Segerstrom, 2007). This idea of resource accumulation is the centerpiece of Fredrickson's "broaden-and-build" theory (Fredrickson, 2001), which states that positive emotions build personal resources by stimulating a variety of approach-related thought-action tendencies: urges to engage with the environment and be open to new possibilities. Consistent

with this account, Basso, Schefft, Ris and Dember (1996) found that dispositional optimism predicts broadened attentional scope. In the context of health behavior, this openness to new possibilities could manifest as a decision to cycle to work, or to take a positive perspective on a long-standing health concern. Through repetition, these singular changes are transformed into enduring personal resources, such as a disciplined exercise regime or a more resilient mindset, which lead to sustained improvements in mental and physical health. These resources can be conceptualized as mediators of the optimism-health relationship.

Optimism and health

In the case of physical well-being, behavioral mediators seem to be important. Since optimists believe that desired outcomes are attainable, they may engage in more goal-directed efforts, and many studies have shown that optimism is positively related to engagement in health-related behaviors (Carver et al., 2010). For example, optimism scores of participants of a cardiac rehabilitation program are positively associated with health-promoting behaviors, such as ingesting lower levels of saturated fat and engaging in physical activity (Shepperd et al., 1996). In a sample of healthy adults, optimism was positively related to healthier dietary habits and negatively related to smoking (Kelloniemi et al., 2005). Similarly, optimism has been positively associated with a variety of health-promoting behaviors in college students (Ayres and Mahat, 2012), the elderly (Steptoe et al., 2006), and cardiac outpatients (Glazebrook and Brawley, 2011). In turn, health-promoting behaviors have consistently been found to predict better physical health outcomes (Dalton et al., 2010).

Resilience

Cognitive factors, rather than behaviors, are generally seen as the primary mediators of the optimism-mental health relationship. Of particular interest in this regard is resilience, a

multifaceted construct that confers strength in times of adversity, enabling individuals to bounce back from stress. It is widely-accepted that resilience is a broad trait (Hoge, Austin, and Pollack, 2007), arising through the interaction of several more distal psychological variables which together exert a generalized protective effect. As such, resilience is well-placed to mediate the effects of individual difference variables such as optimism on mental and physical health outcomes. Consistent with this notion, optimism predicts benefit finding—a form of resilience—in cancer patients (Dunn et al., 2010), while optimism has also been associated with resilience in victims of ethnic conflict (Riulli, Savicki, and Cepani, 2002). In turn, enhanced resilience has been found to predict both positive affect (Smith et al., 2010) and physical functioning in older adults (Tomás et al., 2012). Importantly, resilience has been associated with engagement in health-related behaviors, providing evidence of a link between the cognitive and behavioral mediators of the optimism-health relationship. Perna et al. (2012) reported that resilient elderly are more likely to consume fruits and vegetables and to engage in physical activity, while Yi et al. (2008) found that resilience predicts self-care behaviors and physical health in diabetics.

Self-rated health

Another potential cognitive mediator of the optimism-health relationship is self-rated health (SRH): a subjective, global evaluation of one's own health status, and an enduring aspect of one's self-concept (Bailis et al., 2003). Optimism has been found to influence other health-related cognitions, such as self-efficacy and perceived susceptibility (Carver and Scheier, 1994), and evidence suggests that it affects SRH in a similar way. Optimism is positively associated with SRH in the general population (Bosompra et al., 2000-2001), while genes predisposing optimism also predispose individuals to possess good SRH (Mosing et al., 2009). The association between SRH and health behaviors and outcomes is also well established. Levy and Myers

(2004) found that elderly individuals with better SRH practiced more preventive health, while Page and Suwanteerangkul (2009) found that Thai adolescents with low SRH were less physically active and more likely to be overweight. SRH also predicts favorable psychosocial characteristics, such as coping ability and self-esteem (Kristenson et al., 2005), as well as mortality (Idler and Benyamini, 1997).

The present research

Using the structural equation modeling (SEM) technique of path analysis, we examined the relationships between these variables and their effects on quality of life (QOL) in a sample of Chinese university students. Specifically, we sought to accommodate both cognitive and behavioral mediators of the optimism-QOL relationship in a single explanatory framework. While cognitive and behavioral mediators have frequently been examined in isolation, this is to our knowledge, the first attempt to simultaneously examine mediation by both cognitive and behavioral variables. In a recent review of the optimism and QOL literature, Conversano et al. (2010, p27), suggested that “optimism facilitates adaptive behaviors and cognitive responses” and that “these coping strategies are in turn predictive of behaviors targeted at avoiding, and if necessary facing positively, health problems”. Such statements resonate with Fredrickson’s broaden-and-build theory and Segerstrom’s resource accumulation hypothesis, and suggest a two-stage mediation process in which the effects of optimism on health outcomes are sequentially mediated by cognitive and behavioral variables.

Consequently, we hypothesized that a two-stage model, in which optimism is the most distal predictor of health outcomes and behavior the most proximal, with cognition positioned between the two, would exhibit substantial explanatory power and provide a good fit to our data. To this end, we compared the fit of different configurations of this two-stage model of the

optimism-QOL relationship. In both the physical QOL (PQOL) and mental QOL (MQOL) analyses, we hypothesized that optimism would predict the acquisition of cognitive resources, namely positive SRH and resilience, and that these resources would predict the tendency to engage in health-promoting behaviors, such as exercise, which would in turn predict both MQOL and PQOL. We also hypothesized that cognitive resources link directly to health outcomes in the best-fitting model, since the associations between resilience, SRH, and health outcomes are well-established in literature and unlikely to be mediated solely by engagement in health-related behavior.

We hypothesized one key difference between the PQOL and MQOL models. In the case of optimism and PQOL, we hypothesized full mediation by the cognitive and behavioral variables, while in the case of MQOL we hypothesized only partial mediation, allowing for a direct effect of optimism on MQOL. Numerous studies suggest that optimism is capable of exerting a direct effect on mental health outcomes, independent of cognitive or behavioral mediators (e.g. Aspinwall and Taylor, 1992; Hooker et al., 1998), whereas cognitive and behavioral factors are thought to play a critical mediating role for the effects of optimism on physical health.

Method

Participants

A total of 365 Chinese students ($M_{\text{age}} = 20.6$ years, age range: 18-32 years, 49.9% female,) from Hong Kong universities were surveyed at their campuses in 2010. Ethical approval was granted by the University Ethics Committee, written informed consent was obtained and participation was voluntary.

Measures

Optimism. Optimism was measured by the 10-item Revised Life Orientation Test (LOT-R; Scheier et al., 1994), a widely-used self-report measure of dispositional optimism that has been shown to exhibit good reliability and validity in a wide range of samples, including those comprising Asians and adolescents/young adults (e.g. Roberts et al., 1999). Four items are filler items, three items are positively worded (e.g., Overall, I expect more good things to happen to me than bad), and three items are negatively worded (e.g., I hardly ever expect things to go my way). Respondents were asked to rate each item on a 5-point Likert scale ranging from 0 (*strongly agree*) through 4 (*strongly disagree*). Factor analysis of the items showed that there were two factors, optimism and pessimism. Thus the three items related to optimism were summed to indicate optimism in this study, with higher scores reflecting higher levels of optimism. The reliability of the subscale was $\alpha = .70$.

Resilience. Resilience was measured by the Connor-Davidson Resilience Scale (CD-RISC; Connor and Davidson, 2003), a measure which exhibits good psychometric properties in Chinese adolescents (Yu et al., 2011). The scale comprises 25 statements, such as “I believe that coping with stress strengthens me” and “I tend to bounce back after illness or hardship”, which respondents endorsed on a 5-point Likert scale ranging from 0 (*not true at all*) through 4 (*always true*). Thus, higher CD-RISC scores reflect higher levels of resilience. The reliability of the scale was $\alpha = .93$.

Self-Rated Health. SRH was measured by a single item “how would you describe your health status compared with others at your age”, rated on a 5-point Likert scale ranging from 1 (*much better*) through 5 (*much poorer*). This item was reverse scored with a higher score indicating better perceived health status compared to others of the same age.

Exercise. Exercise was measured by the Chinese University of Hong Kong Physical

Activity Rating for Children and Youth (CUHK-PARCY; Kong et al., 2010). The CUHK-PARCY was modified from the Godin-Shephard Activity Questionnaire for adolescents (Godin and Shephard, 1985) and the Jackson Activity Coding (Baumgartner and Jackson, 1999), and was developed and validated in Chinese youth samples (Kong et al., 2010; Li et al., 2013). It is a single 11-point scale ranging from 0 (*no exercise at all*) to 10 (*vigorous exercise in most of the days*) which assesses the frequency, duration and intensity of physical activity.

Quality of Life. QOL was measured by the 12-item Short Form Health Survey (SF-12, Ware et al., 1996), a commonly used measure which has previously been validated in Chinese samples (Lam, Tse, and Gandek, 2005). The SF-12 consists of two subscales, one for PQOL and one for MQOL. Sample items include: “during the past month have you accomplished less with your work or other regular activities as a result of your physical health?” (PQOL) and “how much of the time have you felt calm and peaceful during the past month?” (MQOL). Scores for PQOL and MQOL range from 0 to 100, with higher scores indicating better QOL. The reliability of the PQOL subscale was $\alpha = .60$, while the reliability of the MQOL subscale was $\alpha = .45$.

Analysis

Using SPSS AMOS 20.0, a series of explanatory path analysis models were constructed to examine different possible relationships between optimism, resilience, SRH, exercise and PQOL/MQOL, with the two QOL outcome variables being subjected to separate analyses.

Results

Optimism and physical quality of life

In the PQOL analysis, models varied in four dimensions: a) full vs. partial mediation of the optimism/exercise relationship by cognitive variables, b) full vs. partial mediation of the resilience/PQOL relationship by exercise, c) full vs. partial mediation of the SRH/PQOL

relationship by exercise, and d) the presence or absence of a linkage between resilience and SRH. Examining every possible combination of these dimensions yielded a total of 16 models to be compared.

The models were split into four sets: I, II, III, and IV. Set I contained the two simplest models, A and B, in which the optimism-exercise, resilience-PQOL, and SRH-PQOL relationships were fully mediated. Model B was only marginally more complex than model A, featuring a linkage between SRH and resilience. Set II contained models C and D, which featured a direct linkage between optimism and exercise, indicating a partial mediation of the optimism-exercise relationship. The resilience-PQOL and SRH-PQOL relationships remained fully mediated in these models. Set III models E, F, G, H, I, and J featured direct linkages between resilience or SRH (or both) and PQOL, indicating partial mediation by exercise. Finally, the most complex models of set IV—K, L, M, N, O, and P—featured partial mediation of both the optimism-exercise and cognition-PQOL relationships.

Path analysis of the set II and set IV models found the optimism-exercise linkage to be non-significant in each case, indicating that the optimism-exercise relationship was completely mediated by the cognitive variables. As such, these models were discarded, and the goodness-of-fit indices of the remaining models eight were compared. The model that provided best fit to the data was model I ($\chi^2 = 11.27$, $df = 16$, $p = .793$, $RMSEA = .001$, $NFI = .981$, $CFI = 1.000$). The chi-square difference between model I and the comparison models (all of which were more parsimonious) was significant at $p = .001$ in each case, indicating that the improvement in fit was sufficient to justify the inclusion of additional explanatory linkages. The model explained 30.02% of the variance in PQOL.

Figure 1 presents the maximum likelihood estimates of model I. According to this model, optimism positively predicts PQOL of life via a two-stage mediation process. Firstly, optimism positively predicts both SRH and resilience, which in turn positively predict exercise. Optimism does not directly predict exercise, suggesting that the effect of optimism on exercise is fully mediated by the aforementioned cognitive variables. Resilience, SRH, and exercise all positively predict PQOL, suggesting that the effects of cognitive variables on PQOL are only partially mediated by exercise.

INSERT FIGURE 1 HERE

Optimism and mental quality of life

In the MQOL analysis, models were varied in six key dimensions. The first four dimensions—a, b, c, and d—were identical to those in the PQOL analysis, while two further dimensions were introduced to examine more possibilities: e) the presence or absence of a direct linkage between optimism and MQOL, and f) the presence or absence of exercise as a mediating variable. The former possibility was examined on the grounds that optimistic thought can directly engender positive affect, while exploration of the latter reflected the literature's emphasis on cognitive predictors of MQOL. Combining these dimensions yielded a total of 38 comparison models, which were split into six sets: I, II, III, IV, V and VI. The first four sets were identical to those in the PQOL analysis, only with MQOL as the outcome variable. Set V contained all the models above plus a direct linkage between optimism and MQOL (16 models). Finally, set VI models—Q, R, S, T, U, and V—featured optimism-cognition-MQOL relationships without exercise as a mediator.

Path analysis of these models found the optimism-exercise linkage, the optimism/MQOL linkage, the exercise/MQOL linkage, and the SRH/MQOL linkage to be non-significant. As such,

the models featuring these paths were discarded, leaving only one model—model S ($\chi^2 = 9.99$, $df = 7$, $p = .189$, $RMSEA = .034$, $NFI = .953$, $CFI = .984$,)—which provided good fit to the data.

Figure 2 presents the maximum likelihood estimates of model S. According to this path model, optimism positively predicts MQOL via a single stage mediation process. Specifically, optimism positively predicts both SRH and resilience, but of the two, only resilience predicts MQOL. SRH does however predict resilience. Exercise does not mediate the relationship between resilience and MQOL. The model explained 36.95% of the variance in MQOL.

INSERT FIGURE 2 HERE

Discussion

Our results demonstrated a positive relationship between optimism and PQOL and MQOL in Chinese university students. In the case of PQOL, a two-stage model featuring sequential mediation by cognitive and behavioral variables, provided excellent fit to the data. This offers support for the broaden-and-build (Fredrickson, 2001) and resource accumulation (Segerstrom, 2007) hypotheses, suggesting that dispositional optimism exerts its positive effects by facilitating the acquisition of cognitive resources, and that these resources subsequently promote engagement in health-promoting behaviors, which in turn predict physical health. The best-fitting model featured a complete mediation of the optimism-exercise relationship by resilience and SRH, suggesting that cognitive resource accumulation is a necessary intermediary step in the translation of dispositional optimism into tangible health-improving activity. However, the model also indicates that the cognition-PQOL relationship is only partially mediated by exercise, with both SRH and resilience exerting significant direct effects. One explanation of this finding relates to our failure to examine the full spectrum of health promoting behaviors, a limitation that will be further discussed below. Nonetheless, our final two-stage

mediation model provides excellent fit to the data, and represents a valuable first attempt to integrate both cognition and behavior in a single framework for understanding the optimism-PQOL relationship.

However, our hypothesis regarding two-stage mediation of the optimism-MQOL relationship was not borne out by the data. Of the many models examined, only a single-stage model, in which the effects of optimism on MQOL are mediated solely by cognitive variables, provided good fit to the data. Only resilience was found to be directly predictive of MQOL, although SRH was found to exert an indirect effect on MQOL via resilience. Nonetheless, this model provided excellent fit to the data, and suggests important differences between the mechanisms through which optimism affects PQOL versus MQOL.

This implication is intuitively appealing, since cognitive resources seem more likely to exert a direct influence on psychological outcomes than physiological ones, a position with support in the personality and health psychology literatures (Aspinwall and Taylor, 1992; Hooker et al., 1998). For instance, cognitive styles such as acceptance and self-efficacy are related to better MQOL, but not to PQOL in clinical populations (Pope et al., 2012), while a review of the optimism/MQOL literature demonstrates that most studies focused on the cognitive mediators, rather than behavioral mediators (e.g., Schou et al., 2005). These findings suggest that cognitive variables exert a stronger effect on MQOL than behavioral variables, underscoring their primacy in our model. Although there is an extensive literature documenting the association between exercise and MQOL (e.g., Scully et al., 1998), the majority of studies examine the effects of exercise as a predictor (e.g., Windle et al., 2010), rather than as a mediator of a cognition-MQOL relationship. Our SEM findings corroborate such an approach, suggesting that exercise is better conceptualized as a predictor in its own right.

Our research has implications for the management of physical and mental well-being. Optimism has been consistently linked to a variety of health outcomes and consequently researchers and clinicians have been keen to develop health-promoting interventions based on bolstering optimism. While some of these efforts have been successful in enhancing optimism in specific mental health domains (e.g. depression; Gillham Reivich, Jaycox, and Seligman, 1995), generalized optimism is frequently characterized as a trait exhibiting reasonable temporal stability (Segerstrom, 2007) that is not particularly amenable to change. As such, interventions targeting generalized dispositional optimism may not always be successful. Nonetheless, if optimism's health promoting effects are fully mediated by the acquisition of cognitive resources such as resilience and positive health-related beliefs, then it should be possible to target more proximal constructs downstream in the optimism-QOL relationships. Successful attempts to instill positive health-related beliefs and foster skills that promote psychological resilience should mitigate the effects of low optimism on both mental and physical health outcomes. Since our results suggest that optimism may exert its effects via a process of resource accumulation, interventions that stimulate development of these resources should replicate the health-promoting effects of dispositional optimism, and our identification of the different paths by which optimism effects physical versus mental health outcomes offers further guidance as to where such interventions should be targeted. Specifically, efforts to foster resilience and instill positive health-related beliefs are likely to be effective in enhancing both physical and mental QOL.

As an illustrative example, imagine a middle-aged man exhibiting both low optimism and poor physical health. While one might intuitively expect low dispositional optimism to hinder interventions based on increased exercise (on the grounds that the individual does not believe the program will be successful), our results suggest otherwise. The absence of a direct link between

optimism and exercise shifts emphasis onto other variables, such as SRH and resilience, which fully mediate optimism's effects, meaning that interventions aimed at bolstering these qualities may be effective in stimulating exercise and thus improving physical health.

An intervention targeting health-related beliefs could take the form of a deliberate re-framing of health-related feedback in terms of downward comparisons, in which the patient's current status and recent progress are compared with those in a worse position. Such re-framing may in time facilitate the development of better self-rated health, which may in turn promote increased physical activity. Interventions based on enhancing resilience sometimes take the form of stress-management programs (e.g. Steinhardt and Dolbier, 2008), which may be effective in reducing the negative impact of external stressors on engagement in health-promoting behavior. Future research should investigate the potential for such interventions to mitigate the detrimental effects of low optimism.

There are several limitations that should be noted. Firstly, the present study is cross-sectional in nature. As such, we cannot make definitive statements regarding causality in our models, and longitudinal studies are needed to substantiate hypothesized causal relationships. Secondly, while we investigated the mediating roles of several important cognitive and behavioral variables, it is likely that other cognitive and behavioral variables could exert similar effects. As such, further research is needed to provide a more comprehensive understanding of the mediators underlying the link between optimism and QOL. Thirdly, the study focused on an Asian university student population and this may limit the generalizability of findings to other populations. However, given that much work linking optimism to health outcomes has been conducted in clinical populations our employment of an understudied sample represents another useful contribution to literature.

In conclusion, while previous research has indicated that both cognitive and behavioral variables might mediate the positive effect of dispositional optimism on physical and mental health outcomes, few attempts have been made to accommodate these constructs into a single explanatory framework. We found that a two-stage model of the optimism-PQOL relationship, in which optimism's effects are sequentially mediated by cognitive and behavioral constructs, provides excellent fit to self-report data from a university student sample. A one-stage model, with sole mediation by cognitive variables, provided better fit to the MQOL data. These results suggest optimism may exert its health-promoting effects via a broaden-and-build process of resource accumulation.

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Figure 1. Path analysis between optimism, self-rated health, resilience, exercise, and physical quality of life, including standardized regression weights.

Note: QOL= quality of life

Figure 2. Path analysis between optimism, self-rated health, resilience, and mental quality of life, including standardized regression weights.

Note: QOL= quality of life