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Dispositional Optimism and Physical Health: A Long Look Back, A Quick Look Forward

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Abstract

Dispositional optimism is the generalized, relatively stable tendency to expect good outcomes across important life domains. This article provides a representative review of 30 years of research on dispositional optimism and physical well-being. Assessment of optimism is described, along with data regarding its stability. A review of the research linking optimism and physical health is then presented. Included in the review are initial studies suggesting that optimism and physical well-being might be linked, as well as more recent, larger scale epidemiological studies that make the point more emphatically. Also considered are potential pathways—behavioral, biological, and social—that might explain these associations. The paper concludes with a brief look to the future, describing several issues and questions that still need to be answered. These questions include the relationship of optimism and pessimism to each other (and the implications of that relationship for physical well-being), the origins of optimism and pessimism, and interventions that might be implemented to reduce the negative impact of a pessimistic outlook.

Keywords

Dispositional optimism; physical health; behavioral and biological pathways; future research

As psychology emerged as a discipline over the past century, a wide range of constructs were introduced. Among their sources were lay observations of ways in which people behave in various contexts, and theoretical formulations that generally took the form of whatever was the meta-theory of the time. This article is about a construct that has been part of lay psychology for a very long time, but is also grounded in psychological theory. We became interested in it via the route of theory, and via an evolving, discipline-wide movement called health psychology. The construct has since assumed a level of scientific rigor that its common-sense origin lacked, a rigor due largely to the many researchers that have joined forces to understand it more fully.

In the 1980s, we were deeply involved in research on processes involved in behavioral self-regulation (Carver & Scheier, 1981). One of the principles we found important in that work

was the role of expectancies in goal-directed action: specifically, the idea that people will work toward outcomes they think they can attain, but not toward those they think they cannot attain. This principle embedded our work into a large family of expectancy-value theories of motivation (e.g., Atkinson, 1964; Bandura, 2006; Feather, 1982).

The expectancy construct has a broad range of applicability. Confidence and doubt can pertain to very narrow contexts (e.g., the ability to place a call to 911 about an accident you see), to contexts a bit broader (e.g., the ability to administer first aid to someone in need), to very broad contexts (e.g., the ability to live the life of a helpful person). The optimism and pessimism we became interested in was the kind that was very broad in scope: an optimism and pessimism that had implications for perhaps all of life circumstances.

Thinking about optimism and pessimism as broad in scope moved us down another road as well. We became aware that we were interested in an optimism that people brought to diverse contexts, rather than being situation-specific. Put simply, we found ourselves interested in generalized dispositional optimism, a stable attribute of personality.

This article provides a sampling of the research that has been done over more than three decades relating optimism to physical well-being. The review focuses primarily on studies with “harder” physical health endpoints: studies with objective outcomes such as clinically identifiable disease, biomarkers related to disease, and mortality. The studies reviewed (with one exception) go beyond reports of physical symptom or self-rated health. The terms physical well-being and physical health will be used interchangeably throughout. The review is not intended to be exhaustive. Rather, it is designed to reflect the broad range of topics that have been pursued by researchers in the field. Included are studies that simply document associations between optimism and physical health, but also studies that identify some of the pathways whereby these associations come to be. The paper concludes with brief discussion of future questions and issues. We begin with a consideration of how optimism is assessed.

Measuring Optimism

Expectancy-value models of motivation suggest that optimism is but a reflection of the favorability of the person’s underlying expectations. Consistent with this view, Scheier and Carver (1985) defined dispositional optimism as the relatively stable, generalized expectation that positive outcomes will occur across important life domains. Thus, from the perspective of expectancy-value theories, assessing optimism is akin to assess expectancies.

Another conceptual approach focuses not on expectancies per se, but on the mechanisms that underlie those expectations. Most notably, Alloy et al. (1984) have focused on what they call attributional style—the manner in which a person explains the causes of prior outcomes. Attributing prior negative outcomes to causes that are internal to the person, stable in nature, and broadly applicable are deemed pessimistic (because negative outcomes are likely to recur). The opposite attributional pattern is thought to reflect optimism. This conceptual orientation gives rise to assessment techniques that focus less directly on expectancies, and more on measuring the causes people identify for the outcomes that they experience.

Assessing Expectancies Directly

Expectancy-based approaches assess expectancies directly. One widely used approach is simply to ask people if they generally expect good or bad things to happen to them in the future. The Life Orientation Test (LOT, Scheier & Carver, 1985) and the Life Orientation Test–Revised (LOT–R; Scheier, Carver, & Bridges, 1994) are examples of this strategy. In these scales, respondents indicate their agreement with items such as “I’m optimistic about my future” and “I rarely count on good things happening to me” (reverse coded). The LOT–R is short, containing only 6 items that are scored (along with 4 filler items). Most of the research linking optimism to physical health has used one or the other of these scales, in part because of their brevity.

Other direct measures of optimism exist. Another approach asks respondents how optimistic they are about outcomes in specific situations (Fibell & Hale, 1978), sampling a wide variety of situations. Responses to individual items are then combined into an overall index, reflecting the average level of optimism across domains. This measurement strategy yields a longer test. Additionally, this approach assumes that optimism is the sum of its parts, which may or may not be warranted. Optimism might be an emergent phenomenon, arising from situation-specific expectancies but being distinct from them. If this is the case, such scales may not do as well capturing that higher-order construct.

Assessing Attributional Style

Attribution-based approaches focus on a person’s explanations for prior events (Seligman, 1991). Respondents are typically asked to imagine being in outcome scenarios and to indicate how they would explain the outcomes described (Peterson et al. 1982). As noted, pessimism and optimism are inferred from the pattern of attributions made. An interesting variant of the attributional style approach is to analyze naturally occurring verbatim materials (e.g., newspaper articles or speeches) for explanatory style (Schulman, Castellon, & Seligman, 1989).

Other Considerations About Assessment

Two additional points need to be made about assessment. Researchers often refer to people as optimists or pessimists. This suggests a typology of some sort, but that is not intended. This labeling is largely a matter of linguistic convenience. All approaches to the assessment of optimism provide scores that vary continuously across the distribution. Thus, people actually range from very optimistic to very pessimistic, with the majority falling somewhere between.

One final point about assessment. Research exists (which we will discuss later) which suggests that optimism and pessimism may not anchor the two ends of one dimension. Rather, they might reflect two related, but separate dimensions. Use of separate terms in this context thus reflects more than linguistic efficiency. Inasmuch as the vast majority of existing research has treated optimism and pessimism as bipolar in nature, we will adopt this perspective in the review that follows. However we will return to the structure of optimism and pessimism when discussing directions for future research.

Stability of Optimism

Dispositional optimism is thought to be trait-like in nature. This in turn suggests a certain level of stability across time. How stable is it? The answer has two parts. The first part deals with mean-level group fluctuations across the life span. For example, are younger people less optimistic than older people? When do levels of optimism peak across the life span? What changes occur to optimism across the life span?

These questions are hard to answer, because few studies have collected data relevant to the issue. The available data suggest that people may become more optimistic over time. For example, Scheier et al. (1994) reported a mean LOT-R score for undergraduates of 14.33 ($SD = 4.28$), whereas Jobin, Wrosch, and Scheier (2013) reported a mean LOT-R score of 16.46 ($SD = 3.45$) from participants in their early 70's. Although the absolute difference in means is small, it is statistically significant ($p < .001$). Consistent with these findings, Segerstrom (2007) tracked a group of law students from their mid-20's to mid-30's. She reported that optimism (assessed by the LOT) increased slightly, but significantly, over the 10-year follow-up period. Taken together, these findings suggest that optimism may slowly trend upward from earlier to later life.

Data are also available to suggest that optimism can be eroded by events that are very negative in nature. For example, one study tracked the change in optimism that occurred during the 18-month period following diagnosis for advanced stage cancer involving the hepatobiliary-pancreatic system (Krane, Terhorst, Bovbjerg, Scheier, Kuicinski et al., in press). They found that levels of optimism declined slightly, but significantly, over the time period studied.

The second part of stability is the stability of rank ordering across time. As with most traits, test-retest correlations are relatively high, ranging from .58 to .79 over periods from a few weeks to 3 years (Atienza, Stephens, & Townsend, 2004; Scheier & Carver, 1985; Scheier, Carver, & Bridges, 1994). Reliability has been found to be high even across longer time periods. For example, Matthews, Räikkönen, Sutton-Tyrrell, and Kuller (2004) found a retest correlation of .71 across a 10-year period in a group of middle-age women.

High test-retest correlations have not always emerged, however. Segerstrom (2007), in her study on lawyers, reported a test-retest correlation of only .35 over a 10-year follow-up period. It is noteworthy that Segerstrom examined the stability of optimism across a period of time in which the lives of the participants were going through major changes. That is, the study interval bracketed the time that participants transitioned from law school students to lawyers in practice. Perhaps optimism is more changeable during times of life transition, when there is a break from prior experience, and outcomes become more uncertain.

Effects of Dispositional Optimism on Physical Health

Older Research—Smaller Scale Studies

The first study on dispositional optimism and physical health (Scheier & Carver, 1985, Study 3) was informed by a self-regulation theory (Carver & Scheier, 1981, 1998). The

theory assumes that people regularly engage in goal-directed activities. If no obstacles are encountered, people attain their goals and are freed to take up new ones. If difficulties are encountered, people assess the likelihood of goal attainment. Positive expectancies result in continued goal pursuit. Negative expectancies yield goal disengagement. Optimism is one variable that impinges on emergent expectancies. Optimistic people reassert effort when adversity is encountered. To the extent that the obstacles are surmountable, optimism should result in better outcomes.

In this initial study, a group of undergraduates were tracked across the final 4 weeks of a semester, and the development of physical symptoms was monitored. The focus on symptoms was prompted by the belief that most undergraduates experience some problems in self-management during this time period, as they struggle to navigate finals and end-of-term projects, and that difficulty in negotiating this adversity would be reflected in physical symptoms. The results were as anticipated. Students higher in optimism reported fewer physical symptoms over time than those lower in dispositional optimism, controlling for initial symptom levels.

The first study to link dispositional optimism to an *objective* physical health outcome came from a group of patients who were recovering from coronary artery bypass graft surgery (Scheier et al., 1989). Although the primary focus of this study was on quality of life, measures of perioperative complications were also obtained. Analyses of EKGs and blood enzymes indicated that persons higher in optimism were significantly less likely than those lower in optimism to have suffered a heart attack during their surgery.

Other studies on cardiovascular health have produced conceptually similar findings. For example, Scheier et al. (1999) followed a second sample of patients undergoing CABG, again tracking their recovery. Optimism, assessed at baseline, predicted less need for rehospitalization 6 months post-procedure. This effect was independent of a host of disease and surgery-relevant variables. Interestingly, this study also showed that the effect of optimism was independent of self-esteem, depressive symptoms, and neuroticism, suggesting that something about optimism over and above its correlation with these variables was producing the effect (a point we return to later). The findings from this study have since been replicated in a different sample of CABG patients (Tindle, Belnap, Houck, Mazumdar, Scheier, Matthews, He, & Rollman, 2012).

Dispositional optimism also predicts rate of wound healing. Ebrecht et al. (2004) administered a standardized 4mm punch biopsy to the sample of men in their study, all non-smokers. Rate of wound healing was then assessed over several weeks of time, and the participants were divided into a “slow healing” or “fast healing” group. Slow healers were significantly lower in optimism than were fast healers. Other studies have shown that optimism predicts positive pregnancy-related outcomes, such as birth weight and gestational age (Lobel et al., 2000), as well as in vitro fertilization success (Bleil et al., 2012).

What about disease progression? Matthews et al. (2004) studied the association between dispositional optimism and progression of atherosclerosis. Two carotid artery ultrasound scans were conducted on healthy, community-dwelling women 3 years apart to assess intima

media thickness (IMT). Across the two scans, optimistic women were less likely than pessimists to have an increase in carotid IMT, even when controlling for lifestyle, biological, and medication covariates. In fact, those high in optimism showed virtually no increase in IMT over time.

Optimism also seems to predict the progression of HIV disease. One study tracked disease progression over a 2-year period in a group of persons with HIV, who were in the midrange of disease at study entry (Ironson et al., 2005). Participants who were more optimistic maintained a significantly higher number of CD4 cells and a lower index of viral load over time than those who were lower in optimism. Similar results have also been reported by Milam et al., (2004), although not all studies find significant associations (e.g., Tomakowsky et al., 2001).

More Recent Research—Large-Scale Epidemiological Studies

When discussing assessment, we mentioned that a positive feature of the LOT-R was the brevity of the scale. This feature likely was partly responsible for the scale's inclusion in several larger epidemiological studies. The protocol for such studies almost always gets designed by a committee, whose members have diverse interests. Given this format, particular measures are unlikely to be acceptable unless they are straightforward and minimize burden for participants. Although psychometric reasons might exist to argue for scales with more items, as a practical matter, shorter is better.

The data generated by epidemiological studies are extremely important. Typically, these studies enroll samples of initially healthy participants and measure the incidence (number of new cases) of disease over many years. Long periods of follow-up time are necessary, as many diseases, such as cardiovascular disease and cancer, take years and even decades to develop. Moreover, because most people do not develop the disease, these studies have to accrue large numbers of participants, in order to have adequate statistical power to detect associations. Participant numbers in these studies have ranged from the 1000's to upwards of 100,000.

Tindle et al. (2009) conducted one of the largest epidemiological studies involving optimism. They administered the LOT-R to over 95,000 initially healthy Caucasian and African American women who were participating in the Women's Health Initiative. Participants were free of cancer and cardiovascular disease at study entry and were followed over an 8-year period.

The results were clear and striking: Optimists were less likely than pessimists to develop new cases of coronary heart disease (CHD), less likely to die from CHD-related causes, and less likely to be dead from all-cause mortality. The advantage due to optimism (comparing top and bottom quartiles on the LOT-R) ranged from 9% for incident CHD to 30% for CHD-related mortality. These associations were independent of multiple demographic characteristics, risk factor variables, and co-morbidities, as well as hostility, depressive symptoms, and a number of health-related behaviors.

Participants in a second large epidemiological study (Kim et al., 2016) were drawn from the Nurse's Health Study, with over 70,000 women. Optimism was assessed using the LOT-R at baseline in 2004. Mortality then was assessed from 2006 to 2012. After adjusting for health behaviors and depressive symptoms, those in the lowest quartile of optimism had a 9% greater risk of all-cause mortality at follow-up than those in the highest quartile of optimism. Optimism was also a significant predictor of various types of cause-specific mortality, including heart disease, cancer, stroke, respiratory disease, and infection.

Another study (Kim, Smith, & Kubzansky, 2014) followed over 6,000 older adults who were participating in the Health and Retirement Study. Participants were tracked for a 4-year period and had an average age at baseline of 70 years. A wide variety of sociodemographic, behavioral, biological, and psychological covariates relevant to heart failure were also assessed. The data revealed a dose-response relationship between optimism and heart failure, with those in the highest quintile of optimism showing 48% lower odds of heart failure, compared to those in the lowest quintile of optimism. Importantly, optimism remained a significant predictor of heart failure, even after adjusting for depressive symptoms, hostility, and anxiety.

Participants from the Health and Retirement cohort have also been used to assess the association between optimism and stroke (Kim, Park, & Peterson, 2011). Participants who were stroke free at baseline (over 6,000 people) were followed for a 2-year period. Higher optimism was significantly associated with lower risk of stroke. Specifically, each 1-unit increase in LOT-R score was associated with an age-adjusted odds ratio of .90 for stroke. Importantly, the relation between optimism and stroke remained after adjusting for a comprehensive set of sociodemographic, behavioral, biological, and psychological risk factors for stroke.

The findings for the psychological set of covariates warrants emphasis. Included in the covariate list were positive affect, anxiety, hostility, depressive symptoms, negative affect, and neuroticism. Separating the effects of optimism from these other variables was important, because anxiety, depressive symptoms, negative affect, and neuroticism were all independent predictors of stroke. When the entire list of factors (not just those related to stroke) were entered as covariates in a combined model, the association between optimism and stroke remained significant, implying that optimism protects against stroke over and above what is predicted by these other factors.

Taken together, results of these large-scale epidemiological studies are very consistent with the smaller-scale studies that preceded them and make a strong case that optimism is associated with a variety of important physical health outcomes, including mortality, heart failure, and stroke. Although the sample size of the studies has been very large, it is also worth noting that similar associations have been reported in smaller scale studies. For example, Giltay et al. (2006) found that optimism predicted risk of cardiac-related mortality over a 15-year period, and Engberg et al. (2013) reported that optimism was associated with lowered risk of all-cause mortality in a sample of very old adults.

How Consistent Are the Findings?

As noted, this review was not intended to be exhaustive, but to convey a sense of the types of relationships that have emerged between dispositional optimism and a sampling of different physical health outcomes. Given the less than exhaustive coverage, it is reasonable to ask how consistent the findings are. Clearly, not every study produces positive findings. For example, sometimes an association is found for cancer-specific mortality (Kim et al., 2016) and sometimes not (Krane et al., in press; Tindle et al. 2009). Variations and inconsistency do exist.

What we can say is that the number of published studies reporting information about the associations between optimism and physical health is impressive and extensive. A Google search for “dispositional optimism and physical health” yields over 30,000 hits. A constrained search, requiring “dispositional optimism” to occur as a unit, still yields over 10,000 hits. It is hard to provide an accurate summary of a database this large. However, one meta-analytic study on dispositional optimism and physical health does exist (Rasmussen, Scheier, & Greenhouse, 2009). As with all meta-analyses, not all relevant studies were included, primarily because effect sizes could not always be estimated. Still, analysis of the studies included ($K = 83$) showed a significant overall association between optimism and physical health. Stratification in various ways (e.g., by study design, nature of sample studied, type of physical health outcome examined) confirmed that the association of optimism and health was robust.

Interestingly, the total number of participants ($n = 18,361$) in the studies focusing on physical health reviewed by Rasmussen et al. (2009) was less than 20% of the number included in just one of the larger epidemiological studies. It is unlikely, however, that the conclusions reached by Rasmussen et al. need major revision. The larger, well controlled studies have tended to replicate the findings produced by the older, lower powered studies. Thus, confidence in the associations between optimism and physical well-being has only become stronger. Will associations hold for all physical health outcomes? Will it be stronger for some physical health outcomes than others? It would be surprising if nuances did not emerge. Given what we now know, however, dispositional optimism is likely to remain an important factor linking personality to physical well-being in general (see also Boehm & Kubzansky, 2012).

Is It Really Optimism?

Another important question is whether the associations attributed to optimism are really due to optimism, or to some related third factor. Smith, Pope, Rhodewalt, and Poulton (1989) first raised this issue with respect to trait anxiety, and Marshall and Lang (1990) raised similar concerns about self-mastery. Smith et al. (1989) showed that the LOT-R and measures of trait anxiety are moderately correlated. They also showed that associations between optimism, symptom reports, and several different coping strategies were eliminated when trait anxiety was controlled. Controlling for optimism did not eliminate significant associations between trait anxiety, symptom reports, and coping.

As Scheier et al. (1994) pointed out, though, there is an important issue concerning the predictors being compared. Constructs such as trait anxiety, neuroticism, and negative affectivity are conventionally seen as multifaceted, with most representations including an element of pessimism. Thus, there is a distinct conceptual link between pessimism and these constructs. Pessimism is often seen as a component embedded within these larger multifaceted models.

This consideration provides a different perspective on the results of Smith et al. (1989). The focus of the LOT-R is strictly on the person's generalized expectancies for future outcomes. The comparison instruments are multifaceted, containing an element of optimism and pessimism, but other qualities as well. Thus, in a sense, controlling for these multi-faceted constructs already controls for optimism. If the variance due to optimism is removed via the multifaceted variables, there is little remaining variance for a separate measure of optimism to predict. Conceptually, there is no way for optimism to have an effect. Controlling for optimism, on the other hand, removes variance from the multifaceted construct related to optimism, but only that variance. If the other components of these multifaceted constructs are also significantly related to the outcome under study, significant effects for those different facets will remain. Thus, the pattern of findings reported by Smith et al. (1989) may not speak to the importance of optimism per se.

An analytic strategy exists, however, that can help resolve some of this predictive ambiguity. It involves including all the items from the relevant scales into one large factor analysis, done at the *item* level. If optimism/pessimism is an important factor, the items from the LOT-R should form a core around which some items from other scales will coalesce. One can then use the factor scores generated from the analysis to determine which factors matter in predicting outcomes. Use of an orthogonal final rotation technique such as Varimax enhances this process, as it ensures that the final factors extracted are independent of each other.

Scheier et al. (1994) used this factor analytic procedure to assess the importance of optimism in predicting symptom reports and coping strategies. Two analyses were performed: one combining optimism with 3 constructs with negative valence (neuroticism, trait anxiety, and depressive symptoms), and one combining optimism with 2 constructs with positive valence (self-mastery and self-esteem). In each case, a distinct optimism factor emerged. In each case, the optimism factor was a significant predictor of symptom reporting and coping. Indeed, the optimism factor was a more robust predictor than the other factors that emerged, although each of those other factors also predicted a significant amount of variance in some outcomes.

We have always been proponents of decomposing multifaceted variables into their underlying constituents, rather than aggregating variables into higher-order composites. We take this position because aggregation makes it more difficult to identify which facets within the composite are responsible for producing any effects observed (Carver, 1989). It may be that there is only one facet that is particularly important, accounting for all of variance in the aggregated scale. Alternatively, it could be that each facet adds a little something to prediction, and it is the collective contribution of the facets that generates the overall effect.

The strategy just described is an interesting one (indeed, it was the very strategy that was used to discover the Big 5 personality factors). It would certainly be possible to implement it in research going forward, although it may not be realistic to expect researchers to do this on a regular basis. Perhaps the biggest limitation is that it does not help us to gain any insight about the potential confounding that might have occurred in prior studies.

Fortunately, many published studies have included personality factors other than optimism. When they are included, these other factors are almost always statistically controlled when evaluating associations with optimism (as this review has helped highlight). Although no one study includes all potential confounders, across studies a very wide range of confounding variables have been assessed, including self-esteem and self-mastery (Scheier et al., 1999), depressive symptoms (Kim et al., 2011, 2016; Scheier et al., 1999; Tindle, 2009), hostility (Tindle et al., 2009), positive affect, anxiety, hostility, depressive symptoms, negative affect, and neuroticism (Kim et al., 2011). In each case, significant associations between optimism and physical health were found, even after controlling for these additional psychosocial factors.

In retrospect, the study by Smith et al. (1989) benefited the evolving literature on optimism in a profound way. Prompted in part by this early critique, health researchers have repeatedly included other psychosocial predictors in their research. This has led to a rigor within the line of optimism research that may not have an equal among other personality factors. Along the way, optimism has competed against many alternative predictors. More often than not associations between dispositional optimism and physical health outcomes remained strong.

Mechanisms Underlying Links Between Optimism and Physical Health

Given the extant findings, it is hard not to believe that dispositional optimism predicts better physical well-being. The question then becomes why these associations exist. Do optimists and pessimists do something differently that might account for the observed relationships? The biobehavioral model of health (e.g., Andersen, Kiecolt-Glaser, & Glaser, 1994) provides some insight. The biobehavioral model delineates the interplay between behavior and biology in the promotion or inhibition of disease.

Two major pathways are identified. One pathway works via health promoting and health damaging behaviors. If a psychosocial factor matters for physical health, it could be because it influences the kinds of health behaviors in which a person engages. Alternatively, the factor could influence a person's underlying biological responses to stress, which ultimately promotes better physical health. There is evidence that dispositional optimism operates along both pathways.

Behavioral Pathways

Why might the health behaviors of optimists and pessimists differ? One reason concerns differences in the coping strategies used by optimists and pessimists more generally. The ways in which optimists and pessimists cope resemble the differences in behavioral tendencies described earlier. That is, people who are optimistic about eventual success continue trying, even when things are hard. People who are doubtful about the future are less

likely to take action that could make that future more positive. They also are more likely to engage in off-task thinking, employ temporary distractions, and just give up.

Such differences in coping have emerged in numerous studies (for a review, see Carver & Scheier, 2017). Optimism is related to the use of active, approach-oriented coping styles, which directly address the problem being confronted or alter thoughts about the stressor in a positive way. Pessimism, on the other hand, is related to the use of avoidant coping strategies, such as denial or mental disengagement (for a detailed meta-analytic review of optimism, pessimism, and coping, see Solberg Nes, & Segerstrom, 2006).

Optimism, behavior, and disease progression.—Several studies have documented that optimists are more likely than pessimists to take steps that might slow disease progression. One study looked at the benefits of participation in a cardiac rehabilitation program (Shepperd, Maroto, & Pbert, 1996). Optimism predicted greater increases in exercise, and greater success in lowering levels of saturated fat, body fat, and an index of overall coronary risk. Another study examined the lifestyles of coronary artery bypass patients five years after surgery and found that optimists were more likely than pessimists to be taking vitamins, eating low-fat foods, and to be enrolled in cardiac rehabilitation (Scheier & Carver, 1992).

A very recent study looked at lifestyle variables in a large group of patients diagnosed with a variety of late stage cancers, all related to the hepatobiliary-pancreatic system (Krane et al., in press). Life style factors included alcohol use, diet, smoking status, and physical activity. Optimists were more likely than pessimists to report low levels of tobacco use and high levels of physical activity. The latter finding is particularly noteworthy as physical inactivity after diagnosis was associated with increased risk of mortality during the 18-month follow-up period.

Optimism, behavior, and disease prevention.—If optimists are more likely to take action when problems are confronted, perhaps they are also more likely to enact their approach-oriented strategies further upstream. Proactive coping refers to steps that people take to prevent an unwanted event from occurring, rather than just reacting to adversity after it has already arisen. Perhaps optimists are more likely to engage in proactive coping. If so, optimists should be more likely than pessimists to engage in more health promoting and less health damaging behaviors, in order to stay physically healthy. A variety of studies suggest this is the case.

Consider the tendency to seek knowledge about a potential health risk. One study examined knowledge related to heart attacks in a group of middle-aged adults (Radcliffe & Klein, 2002). Those higher in dispositional optimism knew more about the risk factors than those who were less optimistic.

Another proactive health-related behavior concerns HIV risk. By avoiding certain sexual practices (e.g., sex with unknown partners), people reduce risk of infection. One study of HIV-negative gay men found that optimists reported fewer anonymous sexual partners than

pessimists (Taylor et al., 1992). This suggests that optimists were making efforts to reduce their risk, safeguarding their physical health (see also Carvajal, Garner, & Evans, 1998).

This same pattern emerges for a variety of other health-promoting and health-damaging behaviors. For example, optimists have better diets (e.g. eat more fruits and vegetables), are more physically active, and are more likely to consume alcohol in moderation (Giltay et al. 2007; Krane et al., in press; Steptoe et al., 2006). In contrast, pessimists are more likely to be smokers (Giltay et al., 2007) and to suffer from substance abuse problems (Carvajal et al., 1998).

Interestingly, we are aware of no study that has formally tested whether these health behaviors mediate the relationship between optimism and objective physical health outcomes. Some evidence does suggest, however, that these health behaviors have physiological effects. Boehm et al. (2013a) found that the tendency of optimists to eat a better diet and smoke less had a beneficial impact on their serum levels of antioxidants.

Biological Pathways

A second way optimism could affect physical health is through its influence on stress and the downstream impact that stress has on the biological systems underlying health and disease. We have noted that optimists cope with adversity differently than pessimists. If these differences in coping strategies result in reduced stress and distress when life circumstances become challenging, the enhanced sense of psychological well-being provided could result in more adaptive biological responses and better physical health.

Do optimists respond to adverse events in a more psychologically beneficial way? The answer seems to be a clear yes. It has been shown in the context of students beginning college (Brisette, Scheier, & Carver, 2002) and participating in collegiate athletics (Vealey & Perritt, 2015); among caregivers of patients with cancer (Given et al., 1993) and spousal caregivers of patients with Alzheimer's disease (Hooker, Monahan, Shifren, & Hutchinson, 1992; Shifren & Hooker, 1995); in the context of medical diagnoses such as cancer (Carver et al., 1993; Friedman et al., 1992) and the progression of AIDS (Taylor et al., 1992); among individuals undergoing medical procedures such as bone marrow transplants (Curbow et al., 1993), in vitro fertilization (Litt et al., 1992), and coronary bypass surgery (Scheier et al., 1989); in the context of childbirth (Carver & Gaines, 1987); and among survivors of missile attacks (Zeidner & Hammer, 1992).

Is there evidence that the advantage in subjective well-being carries over to biology? The answer here also seems to be yes. For example, one physiological pathway implicated in a number of cardiovascular diseases is atherosclerosis, or the development of plaque, which narrows and hardens the arteries. Atherosclerosis is a progressive condition, normally increasing with age. As previously described, Matthews et al. (2004) investigated whether optimism might slow this progression and found that it did so.

Another important risk factor for cardiovascular disease is high blood pressure, which can damage the heart and the arteries over time. Several studies have shown that pessimists have higher systolic and diastolic blood pressure throughout the day (Räikkönen & Matthews,

2008; Rääkkönen et al., 1999) and tend to have larger blood pressure responses to stressors (Terril, Ruiz, & Garofalo, 2010; Williams, Riels & Roper, 1990).

In addition to atherosclerosis and blood pressure, optimism has been linked to a number of other risk factors for cardiovascular disease such as obesity, cholesterol, and triglyceride levels (Boehm et al., 2013b), as well as metabolic syndrome, a cluster of conditions (high blood pressure, high blood sugar levels, excess abdominal fat, and high cholesterol levels) that puts an individual at risk for cardiovascular diseases and diabetes (Cohen et al., 2010).

Dispositional optimism has also been studied in relationship to immune functioning. The findings here, however, are less straightforward. The immune system has multiple interacting components, and psychological factors can have positive and negative effects on different components. These effects can further be moderated by specific contexts and situations.

Associations between optimism and immune functioning are most consistent for components of the immune system that reflect systemic inflammation. One of the more important studies in this area was conducted by Roy et al. (2010), who sampled over 6,000 participants from the Multi-Ethnic Study of Atherosclerosis. Their study showed that pessimism was significantly associated with several elevated inflammatory markers, including IL-6, C-reactive protein, and fibrinogen, after adjusting for demographics, depressive symptoms, cynical hostility, and health behaviors. The effect of pessimism on fibrinogen remained significant in a fully adjusted model that added body mass index, hypertension, and diabetes to the equation. Other research has produced similar findings and extended observed associations with optimism to include homocysteine and intercellular adhesion molecule 1 (Brydon et al., 2009; O'Donovan et al., 2009; Ikeda et al., 2011; Catov et al., 2014).

In contrast to the effects on inflammation, optimism has shown a more qualified relationship with indicators of cell-mediated immunity (e.g., circulating levels of T cells and natural killer cell cytotoxicity). More specifically, optimism seems to be associated with enhanced cell-mediated immunity when stressors are brief and controllable, but associated with diminished immunity when people face more prolonged and uncontrollable stressors (for a review, see Segerstrom et al., 2005).

Segerstrom and colleagues have proposed an explanation for these varied associations between optimism and immunity (Segerstrom, 2001; Segerstrom, Castañeda, & Spencer, 2003). They argued that optimists tend to persist in overcoming stressors despite difficulties. During a prolonged stressor, this strategy may have costs reflected in a sustained physiological stress response and reduced cell-mediated immunity. However, this strategy likely has long-term benefits in terms of eventual stressor resolution. Pessimists, who are more likely to give up dealing with a stressor, may not incur the physiological costs during a prolonged stressor, but they may also be less likely to deal with the stressor adaptively. Subsequent research has generally supported this explanation (Segerstrom et al., 2003).

Taken together, these various findings provide support for the idea that links between optimism and physical health are at least partly mediated by differences in underlying

physiology. The data are clearer for some biological markers than others. Associations between optimism and cell-mediated immunity would seem to be in particular need of further research.

An Additional Pathway to Physical Health: Social Support and Social Integration

An third pathway may also link optimism to physical well-being. A large body of research has demonstrated that socially relevant variables such as social network size, social integration, and perceived social support are strong predictors of physical health (Cohen, 2004; Holt-Lunstad, Smith, & Layton, 2010). People with larger networks, more integration, and high perceived support are healthier physically. Data are beginning to accumulate that optimism promotes more beneficial social relationships and networks.

In this regard, research shows that optimists report a warm, slightly dominant interpersonal style, whereas pessimists report an interpersonal style that is more hostile and submissive (Smith et al., 2013; Terrill et al. 2010). Not surprisingly, optimists are perceived as more likeable and attractive than are pessimists (Böhm et al., 2010; Vollman et al., 2007), as well as more likely to be accepted by their peer group (Carver, Kus, & Scheier, 1994).

Optimism is also associated with greater social network size and to ties with others that cross age, educational, and racial boundaries (Andersson, 2012). Optimists are more satisfied with their relationships and report greater social support than pessimists (Srivastava, et al., 2006; Assad, et al., 2007). The social effects of optimism can be seen across the life span. Compared to pessimists, optimists who enter college show larger increases in close friends during the first semester of school (Brissette et al., 2002). In late life, optimism predicts greater resilience to developing loneliness (Rius-Ottenheim, et al., 2012).

Until now research relating optimism to social factors and research relating social factors to physical health have evolved independently. It may be time to integrate these research streams to determine if social variables, such as social integration, network size, and perceived support, might not provide yet an additional set of mechanisms that link optimism to physical well-being.

A Brief Look Forward: Questions That Still Need Answers

Origins of Optimism and Pessimism

Little attention has been directed toward the developmental antecedents of optimism and pessimism. A few studies have tested the heritability of optimism and a few have explored the impact of early childhood environments. Both sets of studies have something useful to say.

Data from twin studies suggest that approximately 35% of the variability in optimism and pessimism is due to genetic factors (e.g., Caprara et al., 2009; Plomin et al., 1992). Identification of the exact genes promoting optimism, however, has proven more difficult (e.g., Cornelis et al., 2012). The sole genome wide association study to date has also failed to find genetic correlates of optimism (Eriksson et al., 2010). The failure to identify

specific genes promoting a characteristic known to be heritable is not uncommon, though (see, e.g., Zuk, Hechter, Sunyaev, & Lander, 2011).

On the environmental side, socioeconomic status (SES) during childhood is important. Ek, Remes and Sovio (2004) followed a sample of participants from infancy to age 31 and found that high SES at birth predicted higher levels of optimism later. Heinonen et al. (2006) reported similar findings.

A number of other environmental factors have been implicated in the development of optimism. For example, Ek et al. (2004) found that higher school achievement in adolescence, the completion of vocational education, and the experience of stable employment in early adulthood predicted higher levels of optimism in adulthood. Adulthood optimism was also higher when parents indicated they had wanted a child and planned their pregnancy. Finally, Heinonen et al. (2005) found that mothers who saw their children as difficult and so developed hostile childrearing practices had children who were more pessimistic as adults.

An important antecedent may be the manner in which parents teach their children to deal with adversity. As noted earlier, the coping strategies of optimists and pessimists are quite different. Compared to pessimists, optimists cope with adversity in ways that are more adaptive. Perhaps parents who are more optimistic, and who cope in more functional ways, transmit those coping strategies to the offspring, which then enhances optimism in the offspring. This could occur through either modeling of more adaptive responses to stress or direct instruction. We think it would be profitable if future research investigated these possibilities more fully.

Does Optimism Protect or Pessimism Harm?

Throughout this review, optimism has been treated as a bipolar dimension, anchored at one end by optimism and the other by pessimism. This view is taken by most researchers in the field. As noted earlier, however, some have also explored the possibility that optimism might be better construed as two separate but correlated dimensions.

Interest in the dimensionality of optimism arose after several factor analyses suggested that a 2-factor model of the items on the LOT and LOT-R better fits the data than a model with a 1-factor solution (e.g., Chang & McBride-Chang, 1996; Hjelle, Belongia, & Nesser, 1996). In these analyses, items assessing expectations for positive outcomes loaded on one factor (reflecting affirmation of optimism or not), whereas items assessing expectations for negative outcomes loaded on a second factor (reflecting affirmation of pessimism or not). Consistent with these factor analytic results, correlations between the “optimism” and “pessimism” subscales are modest (Mens et al., 2016).

Some believe that the two-factor structure is simply an artifact of response style, and that optimism should still be conceptualized as a single dimension (e.g., Monzani, Steca, & Greco, 2014). Others have argued that optimism and pessimism are distinct properties that may have differential effects on various aspects of physical well-being (e.g., Kubsansky et al., 2004). Several attempts have used item response theory to resolve the issue. This

research suggests that a single dimension may fit the LOT-R better (e.g. Steca, Monzani, Greco, Chiesi, & Primi, 2014). However, the issue is far from resolved psychometrically.

On the other hand, extant data from twin studies support the idea that optimism and pessimism may represent somewhat different constructs. For example, Plomin et al. (1992) found that optimism and pessimism were equally heritable, but also found that shared environmental factors were important in determining optimism and not determining pessimism. More recent twin study research further supports the idea that optimism and pessimism have different genetic and environmental underpinnings (Bates, 2015).

Recent research on physical health contributes to the discussion of dimensionality by documenting that optimism and pessimism can be related to health differentially. For example, research on inflammation suggests that pessimism mainly produces associations, not optimism (Roy et al., 2010, Ikeda et al., 2011; O'Donovan et al., 2009). Pessimism was also found to be a stronger predictor than optimism of in vitro fertilization success (Bleil et al., 2012). In contrast, Kim et al. (2011) showed that optimism, not pessimism, predicted incidence of stroke. Although only a handful of studies speak directly to this issue, the available evidence suggests that pessimism might be toxic rather than optimism protective. Clearly, however, more research is needed on this issue.

An organization called the Optimism Meta-Analytic Consortium has been formed to pool data from across studies to examine more systematically the effects of optimism and pessimism on physical well-being. Each member of the consortium has reanalyzed published data from a previous study in such a way that the effects of optimism and pessimism can be separated. At this point, the data have been aggregated from across the studies and meta-analytic analyses are scheduled to begin shortly. Although only 55 studies are included in the dataset, several of the larger epidemiological studies described earlier in the paper are included.

Interventions to Promote Optimism

Given the benefits of optimism and the costs of pessimism, it is reasonable to consider ways in which optimism might be enhanced and/or pessimism reduced. To date, there have been few systematic attempts to intervene on these variables. One approach has been to guide persons to make less pessimistic explanations for events in their lives (Seligman, 1991). Another recent study tested whether optimism can be increased through a very simple intervention in which individuals imagined their best possible self for five minutes each day (Meevissen, Peters, & Alberts, 2011). Compared to a control condition, those in the intervention group reported greater increases in optimism during the intervention period (two weeks). However, the longer-term effects of that intervention are unknown.

One might argue, however, that many traditional approaches to psychotherapy aim in part to increase optimism among clients, despite generally having more specific focuses as well. For example, cognitive-behavioral therapies almost universally aid people in approaching life in more optimistic ways, as well as instructing them on how to better detect automatic thinking and exchange those automatic thoughts for more adaptive thinking (Beck, 1976).

Another interesting approach to intervention concerns targeting the maladaptive coping strategies that pessimists use and help the person to replace them with the more adaptive responses of optimists. Many stress management programs are designed to focus on improving coping responses in this fashion (Nezu & Nezu, 2016). Perhaps if the concrete behavior underlying a person's dispositional outlook can be altered in a positive manner, the improved behavioral responses will trickle up and slowly push the person's level of dispositional optimism in a positive direction as well. Such a cycle could become mutually reinforcing, the behavior changes in a positive direction, the person's higher-order representation changes in a positive way, which then feeds back again to the behavior, inducing further positive change there.

We do not know if such an approach would work. It is interesting to note, however, that a similar model has been suggested as platform for inducing positive change to conscientiousness (Magidson, Roberts, Collado-Rodriguez, & Lejuez, 2014). We think that the strategy has definite merits and is worth a try, especially since there are established protocols already available that could be adapted to the purpose. At a minimum, targeting maladaptive behaviors should help improve the coping strategies of pessimists.

Concluding Comment

We have learned a lot over the last three decades about associations between optimism and physical well-being. In the aggregate, the literature strongly suggests that dispositional optimism is a robust predictor of diverse physical health outcomes. In spite of what we have come to know, however, the work is far from done. It seems particularly useful to clarify which component, optimism or pessimism, is most important in predicting physical health outcomes, to learn more about how optimism and pessimism develop, and to discover how best to intervene to facilitate adjustment among those whose orientation to is more pessimistic. Hopefully, future research will address these issues and more.

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