Canonical Correlation Reveals Important Relations between Health Locus of Control, Coping, Affect and Values

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Abstract

This article explored advantages of canonical correlation using the Multidimensional Health Locus of Control (MHLC) scales in relation to measures of coping, affect and values. Survey data collected from 659 participants demonstrated significant canonical correlations between the MHLC and synthetic variables representing all three of these constructs. Results verified some previously hypothesized relations (e.g. external health control relates to passive coping) and introduced new findings pertaining to the relations between networks of MHLC variables and networks of the other three constructs (e.g. positive affect relates to collaborative control between self and God regarding health). Canonical correlation promotes greater understanding of relations between health loci of control and other multidimensional variables than can be obtained through simpler analytic strategies.

Keywords

affect, canonical correlation, coping, health locus of control, MHLC, religion, values

HEALTH locus of control, or more accurately *perceived* health locus of control (Wallston, 1992), is an important component in social learning theory models designed to predict behaviors and cognitive processes relevant to mental and physical health. As demonstrated by this Special Issue, attributions regarding the nature, source and extent of various sources of control over one's health have been the subject of empirical investigation for over two decades. Central to the measurement of health locus of control are the Multidimensional Health Locus of Control (MHLC) scales developed by Wallston and colleagues (Wallston, Stein, & Smith, 1994; Wallston, Wallston, & DeVellis, 1978). The MHLC scales traditionally include three dimensions: internal, powerful others and chance. There are two forms of the instrument (A & B) designed to measure perceptions of control regarding overall health among generally healthy populations and a separate instrument (Form C) to measure perceptions of health control over a particular health condition among those having the condition (e.g. diabetes, arthritis, cancer, etc.). Recently, in response to comments from subjects in a study of cancer patients, Wallston and colleagues (Wallston et al., 1999) added a fourth scale to the MHLC, i.e. God Locus of Health Control (GLHC). The items for the GLHC scale were constructed and tested in like manner to how Wallston and colleagues developed the MHLC Form C. The GLHC scale was formatted as the other MHLC scales and each contains six items scored on the same metric.

The general concept of perceived health locus of control is both theoretically and practically significant because it has meaningful relations with health attitudes, behaviors, coping styles and outcomes (e.g. Armitage, 2003; Haslam & Lawrence, 2004; Legranger, & Kraft, 2003; Perlman, Bobak, Steptoe, Rose, & Marmot, 2003; Schäfer, Riehle, Wichmann, & Ring, 2003; Spilkmans et al., 2003; Wu, Tang, & Kwok, 2004). This Special Issue provides testimony to the heuristic value of health locus of control. Indeed, studies over the last several years demonstrated that an *internal* sense of personal control is related in positive ways to psychological and physical adaptation to illness as well as engagement in beneficial health behaviors (Affleck, Tennen, Pfeiffer, & Fifield, 1987; Shapiro, Schwarz, & Astin, 1996). Relatively excluded from this literature, however, are investigations of the external dimensions; i.e. powerful others, chance and, more recently, God.

Perhaps more startling than the lack of research on external perceptions of loci of health control is the nearly complete absence of studies utilizing multivariate methods of estimating relationships between health loci of control and other theoretically and practically important variables. Instead multiple univariate analyses have been the order of the day. Canonical correlation is the principal multivariate technique that can provide estimates of the strength of the relations between potentially complex variables. It is not a new statistical procedure. In fact, it was known to psychologists in the mid-1960s (Barcikowski & Stevens, 1975), but it remains underutilized. Overall, however, multivariate analyses are gaining popularity among behavioral researchers. This is no doubt in part because of the availability of powerful statistical packages that provide multivariate computations of even large data sets in a matter of seconds or even less. Of greater theoretical importance, multivariate analyses have a decided advantage over univariate computations because the multivariate techniques allow researchers to simultaneously consider networks of variables in relation to each other. Campbell and Taylor (1996) and Thompson (1991) noted that by being able to simultaneously consider large numbers of variables, multivariate techniques are able to more accurately capture the world of variables that behavioral research is designed to investigate. That is, multiple causes relating to multiple outcomes and multiple effects are the reality of the behavioral world. Eason (1991) and Tatsuoka (1973) warned that failure to consider these multiple variables may distort researchers' interpretations of the phenomena under investigation.[1]

Canonical correlation is the multivariate method applied in this study. Briefly, canonical correlation provides a means of analyzing the association of two sets of variables. It is appropriate when the researcher desires to parsimoniously describe the number and nature of independent relationships that exist between the two sets (Stevens, 1996). Like multiple regression and principal components analysis,

canonical correlation is a mathematical maximization procedure. It partitions the total association between latent variables into uncorrelated pairs of linear combinations. Thompson (1991), and more recently Campbell and Taylor (1996), demonstrated in some detail that canonical correlation is a general parametric procedure that subsumes as special cases other parametric methods such as analysis of variance, multivariate analysis of variance or multiple regression.

The general purpose of this article is to demonstrate how the use of an innovative procedure such as canonical correlation can illuminate relations between the MHLC scales and other important variables. Of specific focus are the associations between the MHLC scales and the scales of the Brief COPE Inventory (BCI; Carver, 1997), the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and a modified version of the terminal values from the Rokeach (1973) Values Survey (VS; Smith & Wallston, 1992; Wallston, Maides, & Wallston, 1976). The association between coping style and locus of control has been of interest for many years. In their initial development of the COPE, Carver, Scheier and Weintraub (1989) hypothesized and confirmed positive bivariate relations between the active coping and planning COPE scales with dispositional variables of perceiving a sense of control and internality. Essentially it has been thought that those who believe they have more control will engage in more active coping strategies whereas those who perceive themselves as lacking control will be more passive in their coping attempts. This general hypothesis has received support; however, it has not been investigated from a multivariate perspective.

The association between health locus of control and characteristic affect state, described as positive or negative, is also of interest. Presumably indices of perceptions of internal health control would relate to more positive affect whereas perceptions of external health control would relate to the experience of negative affect. It is unclear, however, how the GLHC subscale would align with the other MHLC scales in relating to affect. Would those who believe control over their health resides with God be more or less likely to report positive or negative moods? Finally, social learning theory as posited by Rotter (1954) indicates that individuals engage in goal-directed behavior only if two conditions are met: (a) they value the particular reinforcers (goals) available; and (b) they believe that their actions will be effective in obtaining these reinforcers. Consequently, two variables, the relative value of health for individuals and the type and extent of health locus of control, when combined, may be potent factors predicting health behaviors (Wallston et al., 1976). An interesting question, however, is how do the various loci of health control relate to important terminal values, including the value of health? For example, are there constellations of health locus of control scales that relate with particular sets of values? Calculating and understanding these relationships may afford more precise prediction of behaviors directed not only toward health, but toward other desirable ends as well.

Method

Participants and procedures

Data were collected at different points in time via surveys of college students who were attending either private (37%) or public (63%) universities in Alabama; Tennessee; Washington, DC; Iowa; and central California. The sample consisted of 659 students (68% female), 51 percent were white, 44 percent African-American, 2 percent Hispanic and 2 percent Asian-American. They were primarily freshmen (45%) and sophomores (21%).

Measures

Enhanced Multidimensional Health Locus of Control scales—Form A (MHLC) All participants completed the 24-item enhanced MHLC, including the newly added GLHC scale (Wallston et al., 1978, 1999). This self-report instrument measures the extent to which participants believe their health is due to: (a) their own behavior (internal); (b) the behavior of significant others (powerful others); (c) chance; and (d) God. Reliability and validity for the first three scales has been documented. (Detailed information on the MHLC and references are available at http://www.vanderbilt.edu/nursing/kwallston/mhlcscales.htm.) In this study the internal consistency of the MHLC scales was as follows: internal α = .68; chance α = .56;

powerful others $\alpha = .65$; God $\alpha = .93$. The GLHC has also received attention (Chaplin et al., 2001; Masters, Wallston, & DeBerard, 2005; Wallston et al., 1999; Willis, Wallston, & Johnson, 2001). The new GLHC was embedded within Form A of the MHLC. All subscales consist of six items on which individuals make a rating (1 = 'strongly disagree' to 6 = 'strongly agree') to assess the degree to which they believe the entity described by the item controls their health.

Brief COPE Inventory (BCI) The BCI is a shortened version of the COPE (Carver et al., 1989) consisting of two items for each of fourteen coping strategies that people might use when they confront difficult or stressful events. These include Humor, Active Coping, Planning, Using Instrumental Support, Using Emotional Support, Venting, Positive Reframing, Acceptance, Denial, Self-Blame, Behavioral Disengagement, Self-Distraction, Substance Use and Religion. Participants responded to each of the 28 items with a rating from 1 ('I usually *don't* do this *at all*') to 4 ('I usually do this *a lot*'). Carver (1997) indicates Cronbach's alphas for the subscales range from .50 (Venting) to .90 (Substance Use) with all but 3 subscales achieving alphas greater than .60. In this study we found that alphas on the BCI ranged from .43 (acceptance) to .86 (instrumental support) with a median of .68. Carver also reports evidence supporting the factorial validity of the BCI (Carver, 1997).

Positive and Negative Affect Schedule (PANAS) The PANAS consists of 20 mood descriptive items that form two independent scales, one measuring positive affect and the other measuring negative affect.[2] Respondents indicate on a 1 ('very slightly or not at all') to 5 ('extremely') scale how well each term describes them. Watson et al. (1988) provided preliminary evidence attesting to the internal consistency, reliability, factor structure and external validity of the PANAS. Subsequently, it has been the subject of numerous investigations and has been translated for use in several languages. Although there has been some controversy over the independence of the negative and positive affect scales, their independence when using dispositional instructions has been strongly supported (Kercher, 1992; Schmukle, Egloff, & Burns, 2002). Additional support for the construct validity of the scales has been provided (DePaoli & Sweeney, 2000; Kercher, 1992; Robles & Páez, 2003) and some have suggested further differentiation of the positive affect scale (Egloff, Schmukle, Burns, Kohlmann, & Hock, 2003). In general, higher scores on the positive affect scale indicate that the person feels enthusiastic, alert, active with energy, has high concentration and pleasurable engagement. Low scores on this scale reflect sadness and lethargy. The negative affect scale reflects subjective distress and subsumes a variety of aversive mood states that may include depression, anger, contempt, fear and nervousness. Low scores reflect calmness and serenity.

Values Survey (VS) A version of the VS that Wallston and his colleagues have used since the 1970s to assess health value (see Smith & Wallston, 1992; Wallston et al., 1976) was administered as part of the questionnaire battery. This technique, borrowed from Rokeach (1973), typically consists of asking participants to rank 10 'terminal values' (i.e. preferable end states of existence, e.g. Freedom, Happiness, Health, Inner Harmony) 'in order of their importance to YOU, as guiding principles in YOUR life'. For this study, an 11th value—Religion/Spirituality (faith in a higher being)—was added to the list. The rank attached to each of the 11 values was subtracted from 12 so that the more important values had a higher score.

Analysis

Canonical correlational analyses were conducted to identify primary independent relations: (a) between the scales of the MHLC and the BCI; (b) between the scales of the MHLC and the PANAS; and (c) between the scales of the MHLC and the VS. The canonical correlation (R^c) depicts the strength of the correlation between pairs of synthetic (or latent) scores based on the original variables. These synthetic scores are arrived at by the formation of linear composites based on weighting of the original variables (see Stevens, 1996 or Thompson, 1991 for further details). The number of canonical correlations in any one analysis is determined by the *lesser* number of variables in the two sets. Thus, in the first and third analyses the possible number of canonical correlations is four, and in

the second analysis (involving the PANAS) it is two. The process of interpreting the canonical data in this article followed the suggestions of Stevens and Thompson. Specifically, R^c values were first examined to determine statistical significance. Significant values were then further analyzed by inspection of *both* the standardized canonical coefficients and the canonical variate–variable correlations. The correlations provide the basis for substantive interpretation of the synthetic variables, i.e. naming, whereas the coefficients determine which variables are redundant. For both the coefficients and correlations it is the ones largest in magnitude that form the basis for interpretation of the canonical variate. Further, variables with a high correlation may be found to be redundant with other variables in the set if their standardized coefficient is small. Consequently these correlations do not contribute to naming the canonical variate. Standardized coefficients and canonical variate–variable correlations above .30 were considered important for the interpretive process.

Results

MHLC and BCI

Standardized canonical coefficients are displayed in Table 1 and canonical variate–variable correlations are found in Table 2. All four canonical correlations were significant. The first $R^c = .56$, $p < .001$ accounted for 31 percent of the variance. The synthetic variables included in this correlation were strongly influenced by God locus of health control on the one hand and religiously based coping on the other, both positively related. Although positive reframing had a correlation of .32 examination of the standardized coefficient (.046) revealed it to be redundant. The second $R^c = .31$, $p < .001$ accounted for 10 percent of the variance. The relevant latent variables were heavily influenced by chance and powerful others loci of control, i.e. the original external dimensions, on one side of the equation and seeking emotional support, behavioral disengagement, and self-distraction coping on the other side. Again all variables

Table 1. Standardized canonical coefficients summary table for MHLC scales and BCI scales

	Canonical variates			
Scale	*1*	*2*	*3*	*4*
MHLC (Set 1)				
IHLC	.112	.128	.931	−.376
CHLC	−.216	.384	−.222	−1.005
PHLC	.108	.799	.064	−.146
GLHC	.996	−.176	−.093	−.146
BCI (Set 2)				
Acceptance	−.120	−.130	.163	−.418
Active Coping	.047	.157	.789	−.057
Behavioral Disengagement	−.032	.401	.271	.468
Denial	.149	.181	−.042	−.284
Emotional Support	−.098	.742	.037	.046
Humor	−.093	.108	−.168	−.380
Instrumental Support	.038	−.200	.042	.086
Planning	−.081	−.246	−.147	.297
Positive Reframing	.046	−.071	.462	.330
Religion	.956	−.101	−.307	−.319
Self-Blame	−.109	.005	.281	−.579
Self-Distraction	.160	.306	.026	−.087
Substance Use	.099	.154	−.183	−.125
Venting	.142	−.091	−.168	.464

MHLC = Multidimensional Health Locus of Control; IHLC = Internal Health Locus of Control subscale; CHLC = Chance Health Locus of Control subscale; PHLC = Powerful Others Health Locus of Control subscale; GLHC = God Locus of Health Control subscale; BCI = Brief COPE Inventory

Table 2. Canonical variate–variable correlations summary table for MHLC scales and BCI scales

	Canonical variates			
Scale	*1*	*2*	*3*	*4*
MHLC (Set 1)				
IHLC	.080	.097	.973	−.195
CHLC	−.013	.660	−.357	−.661
PHLC	.207	.926	−.026	.315
GLHC	.970	.032	−.184	−.156
BCI (Set 2)				
Acceptance	.063	−.150	.369	−.326
Active Coping	.298	−.160	.756	.043
Behavioral Disengagement	−.038	.610	−.019	.087
Denial	.143	.537	−.065	−.223
Emotional Support	.186	.603	.127	.182
Humor	−.037	.225	−.010	−.416
Instrumental Support	.176	.326	.222	.176
Planning	.213	−.265	.293	.135
Positive Reframing	.320	−.083	.627	.113
Religion	.948	−.142	.042	−.109
Self-Blame	−.166	.240	.173	−.513
Self-Distraction	.170	.427	.137	−.029
Substance Use	−.042	.401	−.181	−.187
Venting	.240	.240	−.069	.313

MHLC = Multidimensional Health Locus of Control; IHLC = Internal Health Locus of Control subscale; CHLC = Chance Health Locus of Control subscale; PHLC = Powerful Others Health Locus of Control subscale; GLHC = God Locus of Health Control subscale; BCI = Brief COPE Inventory

were positively related. Here again is an example where this time three variables with high correlations (denial, self-distraction, substance use) were not used in naming the variate due to their small function coefficients (Table 1). The third $R^c = .27, p < .001$ accounted for 7 percent of the variance. The variables influencing the third canonical variate were internal health locus of control on one side and active coping and positive reframing on the other, all positively related. This time acceptance showed a high variate–variable correlation but a low standardized coefficient and was dropped from the interpretation as was chance locus of health control. Finally, the fourth $R^c = .20$, $p < .01$ accounted for 6.4 percent of the variance. This canonical variate demonstrated a smaller correlation and was more complex to describe. One side of the equation was influenced in a negative direction by chance loci of control and in a positive direction by powerful others locus of control. On the coping side, negative weightings were found for acceptance, self-blame and use of humor whereas a positive weighting was observed for venting.

MHLC and PANAS

Standardized canonical coefficients are displayed in Table 3 and canonical variate–variable correlations are found in Table 4. Only one of the two canonical correlations was significant $R^c = .26$, $p < .001$, and it accounted for 7 percent of the variance. The significant canonical variate had a positive loading for positive affect and a negative loading for negative affect. On the other side of the equation, the MHLC subscales demonstrated positive loadings for internal and God loci of health control and a negative loading for chance locus of health control. For these sets of variables there was agreement in magnitude between the structure (correlation) and function (standardized) coefficients, consequently, interpretation based on either alone would be substantially the same as interpretation based on both.

Table 3. Standardized canonical coefficients summary table for MHLC scales and PANAS scales

	Canonical variates	
Scale	*1*	*2*
MHLC (Set 1)		
IHLC	.706	.218
CHLC	−.417	.407
PHLC	−.041	.702
GLHC	.619	.157
PANAS (Set 2)		
Positive Affect	.938	.354
Negative Affect	−.288	.960

MHLC = Multidimensional Health Locus of Control; IHLC = Internal Health Locus of Control subscale; CHLC = Chance Health Locus of Control subscale; PHLC = Powerful Others Health Locus of Control subscale; GLHC = God Locus of Health Control subscale; PANAS = Positive and Negative Affect Schedule

Table 4. Canonical variate–variable correlations summary table for MHLC scales and PANAS scales

	Canonical variates	
Scale	*1*	*2*
MHLC (Set 1)		
IHLC	.727	.153
CHLC	−.433	.688
PHLC	−.084	.901
GLHC	.488	.348
PANAS (Set 2)		
Positive Affect	.958	.287
Negative Affect	−.353	.936

MHLC = Multidimensional Health Locus of Control; IHLC = Internal Health Locus of Control subscale; CHLC = Chance Health Locus of Control subscale; PHLC = Powerful Others Health Locus of Control subscale; GLHC = God Locus of Health Control subscale; PANAS = Positive and Negative Affect Schedule

MHLC and VS

Standardized canonical coefficients are displayed in Table 5 and canonical variate–variable correlations are found in Table 6. Three of the four canonical correlations were significant. The first $R^c = .49, p < .001$ accounted for 24 percent of the variance. This canonical variate had a positive loading for God locus of health control on the

Table 5. Standardized canonical coefficients summary table for MHLC scales and VS

	Canonical variates			
Scale	*1*	*2*	*3*	*4*
MHLC (Set 1				
IHLC	.134	−.118	.998	.040
CHLC	−.448	−.995	.108	.169
PHLC	.067	.259	−.038	−1.071
GLHC	.996	−.176	−.093	−.146
VS (Set 2)				
A Comfortable Life (prosperous life)	−.020	−.289	−.048	−.584
An Exciting Life (a stimulating, active life)	−.080	−.539	.096	.535
Freedom (independence, free choice)	−.070	.102	−.105	−.096
Happiness (contentedness)	−.465	−.407	.646	.073
Health (physical and mental well-being)	.004	.257	.512	−.474
Inner Harmony (freedom from inner conflict)	−.126	.299	.133	.228
Pleasure (an enjoyable, leisurely life)	−.155	−.080	−.577	−.282
Religion/Spirituality (faith in a higher being)	.792	−.487	.007	−.060
Self-Respect (self-esteem)	−.142	−.117	.090	.012
Accomplishment (lasting contribution)	−.206	.102	−.011	−.379
Social Recognition (respect, admiration)	.096	−.454	.591	−.294

MHLC = Multidimensional Health Locus of Control; IHLC = Internal Health Locus of Control subscale; CHLC = Chance Health Locus of Control subscale; PHLC = Powerful Others Health Locus of Control subscale; GLHC = God Locus of Health Control subscale; VS = Values Survey

Table 6. Canonical variate–variable correlations summary table for MHLC scales and VS

	Canonical variates			
Scale	*1*	*2*	*3*	*4*
MHLC (Set 1)				
IHLC	.130	.046	.990	–.016
CHLC	–.274	–.929	–.064	–.240
PHLC	.075	–.199	.006	–.977
GLHC	.888	–.425	–.168	–.042
VS (Set 2)				
A Comfortable Life (a prosperous life)	–.142	–.419	–.186	–.556
An Exciting Life (a stimulating, active life)	–.285	–.545	–.219	.348
Freedom (independence, free choice)	–.092	.253	–.192	.108
Happiness (contentedness)	–.421	–.205	.499	.187
Health (physical and mental well-being)	.130	.416	.445	–.301
Inner Harmony (freedom from inner conflict)	.047	.579	.090	.446
Pleasure (an enjoyable, leisurely life)	–.373	–.229	–.613	–.154
Religion/Spirituality (faith in a higher being)	.863	–.001	.149	.144
Self-Respect (self-esteem)	.035	.221	.146	.048
Accomplishment (lasting contribution)	–.214	.104	–.025	–.321
Social Recognition (respect, admiration)	–.028	–.422	.104	–.291

MHLC = Multidimensional Health Locus of Control; IHLC = Internal Health Locus of Control subscale; CHLC = Chance Health Locus of Control subscale; PHLC = Powerful Others Health Locus of Control subscale; GLHC = God Locus of Health Control subscale; VS = Values Survry

MHLC side and also a positive loading for the value of religion/spirituality on the values side along with a negative loading for happiness. The large correlation for pleasure was countered by its small function coefficient (–.155). The second $R^c = .20, p = .001$ accounted for 4 percent of the variance. The synthetic variables were strongly negatively loaded by both chance and God loci of control for set one. For the second set the dominant values were negative loadings for an exciting life and social recognition along with a positive loading for inner harmony (or freedom from inner conflict) and to some extent a comfortable life. The final significant canonical correlation had an $R^c = .19$, $p = .01$ that accounted for 3.5 percent of the variance. On the MHLC side this variable was dominated by a positive loading for internal locus of health control and on the values side it was characterized by positive loadings for happiness and health with a negative loading on pleasure (an enjoyable, leisurely life).

Discussion

The general purpose of this study was to demonstrate some of the advantages of using a multivariate analytic procedure, i.e. canonical correlation, in studies of health locus of control. To accomplish this goal, examples of canonical correlations depicting the relationships between the MHLC scales with measures of coping, affect and values were presented. Each of these constructs, i.e. coping, affect and values, has a history of research and conceptual linkage to the MHLC. The results of this study verified some previously hypothesized relations, introduced new findings pertaining to the relations between networks of MHLC variables and networks of the other three variables, and opened the door to future explorations involving multivariate analyses with the MHLC. In each instance presented in this article the canonical correlations were statistically significant, of sufficient magnitude to account for

notable amounts of variance, and, of equal or perhaps greater importance, were interpretable. Consequently these analyses allow for a greater understanding of the relations between health locus of control and the other multidimensional variables presented.

The use of canonical correlation provides an alternative to the early typology approach proposed by Wallston and Wallston (1982). The Wallstons recognized the multidimensional, as opposed to unidimensional, nature of the locus of control construct and consequently proposed a $2 \times 2 \times 2$ typology. Thus, a person could score high or low on each of the three original dimensions, i.e. internal, chance and powerful others, and the pattern of scores would determine an individual's particular type. (At this time there was no God locus of health control scale.) Eight types were described: a 'pure' internal would score high on internal and low on the other two scales; a 'believer in control' would score high on both internal and powerful others but low on chance; a 'nay-sayer' would score low on all three scales, and so forth.

Since the God scale has now been added, the multidimensional typology could now be expanded to include 16 different types. Imagine trying to conduct a comprehensive research project wherein all 16 types would be utilized. This would present formidable challenges both in terms of recruiting adequate numbers of participants to represent each type (if one were to recruit 30 subjects per type a total of 480 *eligible* participants would be needed) and interpreting how to best describe or characterize each unique type. Indeed, one might wonder if some types even exist! Though graduate students could be encouraged at the endless possibilities for thesis and dissertation projects, the likelihood that utilizing this typological approach could form the basis for developing a programmatic, substantive and meaningful research contribution seems limited. Nevertheless, recognition of the multidimensional nature of health locus of control is both essential and significant. The advantages of canonical correlation become clear when considered in this light. Namely, canonical correlation provides an analytic method that can simultaneously consider all four MHLC scales and their relations with other multidimensional constructs that are similarly measured with multiple scales or it could simultaneously consider the relations of the MHLC with several different constructs. This allows the researcher to proceed with investigations that respect the multidimensional real-world nature of the psychological variables under study.

In the particular set of analyses reported here, informative relationships were observed. For example, when the MHLC was considered along with the BCI the strongest correlation indicated that those scoring high on God control over health also tended to score high on the use of religious coping. Though this finding is intuitive, predictable and easily understood, it does not represent a triumph of the multivariate approach. Analysis of other relations with the BCI, however, is more compelling. The second largest canonical correlation depicts the relation between a variable represented by the two original external health loci of control (i.e. powerful others and chance) with the coping strategies of behavioral disengagement, emotional support and self-distraction. The second set of variables could be generally classified as portraying passive coping. This analysis provides good evidence that externalization of health locus of control, but externalization that does not include God, is related to the use of passive coping strategies. Previous examinations consisting of exploration of bivariate correlations (e.g. Smith, Wallston, & Dwyer, 2003) have displayed this general finding, but the elegance of the canonical correlation method is apparent. Similarly, the next canonical correlation provides evidence that internal health locus of control is positively related with what are considered in many circumstances healthy or active coping strategies, i.e. active coping and positive reframing. Finally, a synthetic variable simultaneously characterized by an emphasis on powerful others and chance health loci of control related to a complex variate largely characterized by the use of venting as a coping strategy and the non-use of acceptance, self-blame and humor as coping strategies. This suggests that individuals prone to see their health as due to the actions of others or fate are also prone to vent but not accept their condition or any culpability for it. Health care providers who are uncomfortable with emotion-focused interactions may have interpersonal difficulty working with patients characterized by this

combination of health loci of control and coping variables. Physicians and nurses could potentially become the targets of patient anger, particularly if the illness is chronic. On the other hand, these may be good referrals for health psychology interventions designed to help patients better understand their role in coping with the illness and developing more adaptive coping strategies.

The significant relation between the synthetic variable comprised of the internal and God health locus of control scales, on the one hand, and the synthetic variable characterized positively by positive affect and negatively by negative affect on the PANAS on the other hand, was also notable. This provides support for the suggestion made by Pargament and colleagues (1988, 1990) and McIntosh and Spilka (1990) that individuals who view their health as the result of an active partnership between the individual and God, termed the collaborative approach, are characterized by positive affect which may be a mediator between the collaborative approach and better mental and physical health. The collaborative perception of health is potentially both emotionally comforting and empowering of engagement in beneficial health-related behaviors. In a related conceptualization, Welton and colleagues (Welton, Adkins, Ingle, & Dixon, 1996) argued that the concept of God control of health may represent either an external or internal/collaborative locus and that its relations with health variables must be considered in light of the person's depth of religious commitment and overall locus of control profile. At any rate, it is important to know that those who are characterized by this collaborative approach are also characterized by the presence of positive affect and absence of negative affect.

The final set of relationships examined was between the MHLC and the VS. Perceiving oneself as the locus of health control correlated with a set of values characterized by happiness and health and negatively by pleasure. In fact, of the three significant canonical correlations involving values variables, this is the only one that included health as a characteristic component. This finding combined with the relationship of internal health control with active coping suggests that those who value health and are internal are likely to be active copers, thus, supporting the Wallstons' modification of Rotter's (1954) social-learning theory discussed earlier (see Wallston, 1992; Wallston & Wallston, 1982).

The most powerful correlation, however, relating MHLC with the set of values was found for the relation between viewing God as a locus of health control with a synthetic value variable characterized by an emphasis on religion/spirituality but not happiness. This, and the findings for internality mentioned above, is interesting when viewed in light of the PANAS data and may, indeed, provide further support that when God is included as a locus of health control it is best to have the God–internal combination in terms of both happiness and health. It also seems clear that the God scale on the MHLC is strongly related to endorsement of both religious coping and religious values and when this scale is present in canonical correlations with coping and values it accounts for substantial amounts of variance as compared to the other MHLC scales. Interestingly, the final canonical correlation to be discussed relates a variable defined by the simultaneous rejection of God and chance health loci of control with a set of values characterized by the high importance placed on inner harmony and the low importance of both an exciting life and social recognition. This case demonstrates how, at times, canonical correlations can be difficult to interpret. Of the significant relations found in this study, this one is the most difficult due to the fact that it presents with a number of negative loadings. Nevertheless, it suggests the possibility that those who do not endorse either God or chance do endorse the value of inner harmony as opposed to excitement and recognition. Follow-up research to better understand this relationship might include assessment of personality variables. For example, is there a relationship between introversion, valuing inner harmony and not endorsing God or chance loci of health control? Similarly, inclusion of concepts, such as the Quest orientation (Batson & Schoenrade, 1991a, 1991b), in multivariate analyses may lead to additional ways of relating and understanding personality, religious and perceived health control variables.

Taken as a whole, then, this set of canonical correlations provides: (a) additional support for previously documented relations; (b)

enlightening new combinations of variables in relation to each other; and (c) at least one multivariate combination of variables that is difficult to interpret or understand but could have heuristic value. The overall message, however, speaks to the potential value of utilizing canonical correlation and other multivariate methods in analyses involving the MHLC. The distinct advantage that multivariate methods provide of simultaneously examining variables that, in the real world, actually occur in synchrony is important. This ability allows investigators to analyze their constructs in a manner that is more indicative of the world as it functions and should, therefore, allow them to more accurately portray the relationships that exist between important psychological and other constructs. We suggest that future investigators employ multivariate conceptualizations and analytic techniques in their examinations of the MHLC scales. By doing so they will shed light on the complexity and structure of the health locus of control construct.

Notes

1. It should be noted that many behavioral researchers give the appearance of using a multivariate approach when, in fact, they are only using a multivariate technique and are univariate in their conceptualization of the study and interpretation of findings. The most common example of this is the use of a multivariate analysis of variance (MANOVA) as a prelude to multiple univariate analyses. The typical strategy is to follow a significant MANOVA with computation of multiple univariate analyses of variance, which then form the basis for interpretation. The apparent rationale for this approach is that the MANOVA provides protection against what has been called experimentwise error rate inflation (Thompson, 1991). This is only true, however, if the entire experiment is analyzed with multivariate techniques. Conducting multiple univariate tests following a significant MANOVA is still simply the conduct of multiple univariate analyses; the MANOVA has changed nothing in this regard. Since researchers utilizing this methodology are clearly conceptualizing their research at a univariate level, a better and more rationally and statistically consistent approach in this case is to simply adjust the alpha level of each univariate analysis to protect the integrity of the significance tests throughout the experiment. Perhaps of greater importance, however, is this approach eliminates the major advantage of multivariate statistical procedures, i.e. the ability to simultaneously consider numerous dependent variables. The choice of analytic techniques should be based on the researcher's conceptualization of the variables of interest. For a more complete and excellent discussion, please refer to Huberty and Morris (1989).
2. Because of an oversight, the PANAS administered in this study was missing one item from the positive affect scale (i.e. strong) and one item from the negative affect scale (i.e. nervous). Internal consistency of the scales, however, remained intact (positive affect $\alpha = .86$; negative affect $\alpha = .85$).

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