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Path Analysis of a Self-Esteem Model Across a Competitive Swim Season

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An adaptation of the previously developed Exercise and Self-Esteem Model (Sonstroem & Morgan, 1989) was tested longitudinally with 93 male interscholastic swimmers from nine high schools who were evaluated at pre-, mid-, and postseason. Swimmers completed three self-perception scales that ranged from evaluations of specific swim skills (SKILL) through broader perceived physical competence (PC) to global self-esteem (SE). Performance scores (PERF) were calculated across events by standardizing swim times to a mean of 0 and a standard deviation of 1. Structural modeling analysis across the three time waves indicated an excellent data fit ($\chi^2 = 25.46$, $p > .15$). The model was able to explain 84, 83, and 80% of PC, SKILL, and PERF, respectively, at the third testing period. Swim improvement tended to be small (median change = 2.9%). Relationships among variables at each testing period and among the same variables at different testing periods were large and as hypothesized. Several significant relationships occurred between different variables across different testing periods. These were not extinguished when social desirability was added to the model. Social desirability failed to significantly influence subsequent measures of any model variable.

Key words: perceived physical competence, self-esteem model, physical self-perceptions

Current theory on the self-concept tends to regard it as a multidimensional and hierarchically organized system, exemplified by research designed for school settings (Shavelson, Hubner, & Stanton, 1976). General self-concept at the apex of the structure is divisible into academic and nonacademic components. In turn, the former can be separated into the more specific self-concepts of English, history, math, and science. Each of these is divisible further into conceptions of specific behaviors related to the respective self-perception facet. Component stability is hypothesized to be positively related to hierarchical level, with lower level, more situationally specific components believed to be more susceptible to environmental influence. Although the Shavelson model has been modified by subsequent investigation (Marsh, Byrne, & Shavelson, 1988), it has provided a major contemporary stimulus to research and theory in self-esteem. The value of considering self-concept as a self-system rather than as a single unidimensional construct can be seen in research results of Marsh, Richards, and Barnes (1986). Their replications found that Outward Bound experiences influenced self-regard facets relevant to course activities significantly more than they influenced components less relevant to training activities.

The recently developed Exercise and Self-Esteem Model proposes that sport and exercise experiences can influence self-esteem along a dimension of perceived competence (Sonstroem & Morgan, 1989). Components of self-regard are arranged on a vertical continuum of specificity–generality, with situation-specific assessment at the lower end of the continuum and broad, content-free, global self-esteem measurement at its upper end. As people develop increased self-efficacies (expectancies) at performing tasks specific to a sport or exercise setting, these perceptions of ability transfer to more general evaluations of overall physical competence. Perceived physical competence (PC) has been shown to be related to self-esteem (SE) and is regarded as one of the components of global self-esteem (Fox & Corbin, 1989; Sonstroem, 1974, 1978). Earlier research by Sonstroem (1978) found that physical fitness in adolescent boys was associated with PC rather than with SE. SE is considered to be the evaluative component of self-concept (Rosenberg, 1979), broadly defined as individuals' cognitive perceptions of themselves (Shavelson et al., 1976). Global SE at the top or more general end of the self-perception continuum is often identified as the variable best indicative of favorable life adjustment (Rosenberg, 1979; Wylie, 1979).

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Structure of the Exercise and Self-Esteem Model has received recent confirmatory factor analysis validation with data collected from males and females (mean age = 54.2) at a single time point (Sonstroem, Harlow, Gemma, & Osborne, 1991). These authors found that responses to all inventory items were incorporated into three independent, though correlated, latent variables. Moreover, the paths hypothesized by the model (i.e., self-efficacy and PC; PC and SE) were significant, and the model accounted for 29% of SE and 46% of PC variance. Additionally, at the lower end of the model, self-efficacy scores were significantly related to physical performance (step test scores). Because the idea of change is inherent in the model, validity would be extended by testing variable change in the model over time.

The original model emphasized the upward direction of component influence over time, from more specific to more general psychological levels. Although this direction appears fundamental to a self-esteem improvement model, the motivational properties of self-esteem must also be considered. Self-esteem has been found to influence both the direction and intensity of subsequent behavior (Coopersmith, 1967; Felson, 1984). Conceivably, higher levels of self-regard in the present model (i.e., SE or PC) could influence subsequent measures of lower level components.

The question of causal ordering of self-concept and achievement is prominent in current educational studies. This research has been stimulated by national attention and monies directed toward improving student academic achievement via enhanced self-esteem (e.g., California State Department of Education, 1990). Calsyn and Kenny (1977) and Newman (1984) were unable to identify a salutary effect of academic self-concept on academic achievement (often termed *the self-enhancement model*). Their data tended to support a positive influence of academic achievement on academic self-concept (termed *the skill development model*). However, analyses utilizing structural equation models have tended to support the self-enhancement rather than the skill development model (Marsh, 1990).

Our study examined a longitudinal path analysis of the Exercise and Self-Esteem Model in 93 male high school varsity swimmers. Data collections were conducted in November (preseason), January (midseason), and March (postseason). This study was delimited to the competence dimension and modified the proposed model in that evaluations of swim mechanics (SKILL) were substituted for self-efficacies at the most specific level of the self-perception continuum. Figure 1 presents a path diagram of proposed model relationships and incorporates both self-enhancement and skill development hypotheses. Inasmuch as valid path analysis procedures involve the necessity of considering alternative solutions (Bentler, 1987), Figure 1 represents the first of three models tested in the study. Each model characteristic within a vertical time period was expected to be associated only with the most adjacent characteristics along the continuum from swim peformance (PERF) up through SE. Thus, both within and across time periods PERF was expected to be related to SKILL, which in turn was expected to be associated with PC, which in turn was expected to be related to SE. Within Figure 1, hypothesized directional influences of variables are indicated by one-way arrows directed at the influenced variable. Because of considerations discussed earlier and because of the exploratory nature of this research, both self-enhancement and skill development aspects are included in tests of models. For example, PC at the second time period (PC2) is hypothesized to be influenced by SKILL1 (skill development) and by SE1 (self-enhancement). Analyses of the three models tested are discussed more completely in the Method section. Because social desirability has been implicated as a confounding variable in self-concept research (Arlin, 1976; Wylie, 1979), this study included an examination of its effects on model components over time.

Method

Participants

Participants were 93 male interscholastic varsity swimmers representing nine Rhode Island high schools. They (or parents of those under age 18) signed an informed consent and completed self-perception inventories administered by one of the investigators during practice sessions. Data were collected in November at the beginning of formal training, in January (at midseason), and in March (postseason).

Measures

Self-esteem. Global SE was assessed by the Rosenberg Self-Esteem Scale (Rosenberg, 1965). This frequently

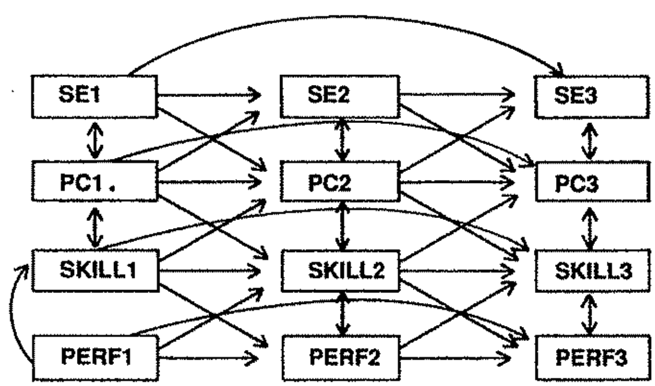

Figure 1. Test of Model 1. Self-esteem (SE), perceived physical competence (PC), perception of swim skills (SKILL), and swim performance (PERF) scores for November (1), January (2), and March (3).

used inventory assesses self-esteem devoid of situational contexts and is regarded as one of the better self-regard scales (Wylie, 1979).

Perceived physical competence. An adaptation of the Estimation Scale of the Physical Estimation and Attraction Scales (Sonstroem, 1974) was employed to assess PC. The Estimation Scale consists of 33 items assessing perceptions of individual competence in a wide range of athletic and fitness activities. Scores have consistently been related to both indices of physical fitness and global self-esteem (Pearson *r*s have ranged from .31 to .53) (Dishman, 1978; Sonstroem, 1978). A 2-week test–retest coefficient of .92 was obtained in high school boys (Sonstroem, 1978). A previous model validation study with middle-aged to older adults used exploratory factor analysis to separate items from a similar estimation scale into two components (Sonstroem et al., 1991). Confirmatory factor analysis established a higher order PC factor. Six items written for the present study supplemented the 33-item Estimation Scale. Item–total correlation was used to delete all items with a coefficient less than .30. Three of the older and two of the newer items were dropped, resulting in a scale of 34 items. New items tended to refer to possession of well-conditioned, healthy bodies. Deleted items referred to abilities in specific sports other than swimming. A 5-point Likert response format was employed for the SE, PC, and social desirability (SD) scales.

Perception of swim skills. The evaluation of specific personal swim skills (SKILL) was substituted for the model component, self-efficacy. This replacement was made in the present research because swimming performance is believed to greatly depend on the conscious cognitive monitoring of swim strokes. This substitution agreed with the model's principle of greater situational specificity in self-perceptions lower in the hierarchy. Subjects were asked to evaluate themselves on five swim skills: starts, turns, arm stroke, kick, and coordination of strokes. Response scales ranged from 1 *(much below average)* to 7 *(much above average)*. Observation of interitem and item total coefficients indicated a high similarity in size and direction. Therefore, scales were summed to provide a single SKILL score with possible range of 5–35.

Swim performance (PERF). In November, January, and March swimmers were asked to indicate their best event and best competitive high school swim time for the event. Swim events assessing individual performances consisted of the 50-, 100-, 200-, and 500-yd freestyle and the 100-yd backstroke, breaststroke, and butterfly. Because swim times vary across events, standard scales (where $M = 0$, $SD = 1$) were constructed for each swim event at each time period and were labeled PERF1, PERF2, and PERF3. This permitted performance comparisons across events.

Social desirability (SD). The Jackson Social Desirability Scale from the Personality Research Form (Jackson, 1984) consists of 20 items assessing tendencies to respond in a socially desirable manner. It is considered free of psychopathological content.

Statistical Analyses

Structural equation modeling. Structural equation modeling (SEM), using the computer program EQS (Bentler, 1989), was employed. Several indices of overall model fit were provided, including: chi-square (χ^2), degrees of freedom (df), comparative fit index (CFI), and root mean square residual (RMSR). For well-fitting models, the χ^2 should be small relative to df, the CFI should be close to 1.0, and the RMSR should be close to zero, indicating that most of the covariation in the data is explained by the model.

Research on structural modeling (e.g., Cudeck, 1989) indicated that longitudinal models should be analyzed with a covariance matrix instead of a correlation matrix. This is because within-wave variances may differ across time points and should be considered when estimating parameters. Because of this, study models are analyzed using the covariance matrix among variables. Results are then presented in standardized form for ease of interpretation.

To identify each model, the following procedures were implemented. The variance of all independent variables (variables with no one-way arrows headed toward them) were freely estimated, as were hypothesized covariances among independent variables and prediction errors for each dependent variable. Hypothesized directional predictions across adjacent time points were also estimated. Finally, the three-wave nature of the model allowed estimation of the stabilities within constructs across all three time points. Gollob and Reichardt (1987) discuss the importance of considering autoregressive effects, defined as the influence of prior values on subsequent values of the same variable. All possible autoregressive effects as depicted in Figure 1 were included in each of the three models tested. The significance of proposed paths within models was tested at an alpha of .05.

Model development. Gollob and Reichardt (1987) specify that effects can be caused only by variables that are collected prior in time rather than by synchronous variables collected at the same point in time. They argue that synchronous associations are best examined by covariance estimates, a concept endorsed by Anderson (1987) and Bentler (1987). Proposed synchronous associations in Figure 1 are denoted by two-way arrows. One departure from this procedure was implemented. PERF1 scores representing the swimmer's previous best time were collected at least 7 months prior in time to the Test 1 psychological assessment. Therefore, Figure 1 incorporates a directional influence from PERF1 to SKILL1.

Also note that because SEM procedures do not allow correlations among dependent variables (i.e., any variable with a one-way arrow headed toward it), some of the hypothesized synchronous associations are among the prediction errors for variables. This is consistent with the current model, indicating that (unexplained) variance for adjacent characteristics is expected to be associated.

Model 1. Figure 1 presents Model 1, discussed earlier. The feature of this model may be considered as a "staircase effect" in that progress along the vertical competence continuum necessitates touching each of the steps (components) along the way. Previous structural analysis of the model has failed to identify significant direct associations between self-efficacies and self-esteem (Sonstroem et al., 1991).

Model 2. This model is similar to Model 1 except that directional paths and synchronous associations were tested for variables that were up to two vertical levels distant from each other on the continuum. Essentially, this hypothesized additional skill development and self-enhancement hypotheses involving PC and PERF and SE and SKILL. This model suggests that although component variance may be explained best by adjacent components, elements further removed may add appreciably to the identification and prediction of dependent variables.

Model 3. It was decided a priori to examine the effects of SD by subsequent addition to the better fitting model of the above two.

Results

Descriptive Statistics and Change Scores

Table 1 presents means, standard deviations, ranges, kurtoses, skewnesses, and internal consistency values for psychological variables at each of the three testing periods. Kurtosis and skewness values represented only small departures from normality; therefore, the maximum likelihood estimator of EQS was employed in the SEM. Research has shown that maximum likelihood is robust against mild violations of normality (Boomsma, 1983; Harlow, 1985; Huba & Harlow, 1987). The reliability analyses represented fair to excellent Cronbach alphas for all measures except social desirability, where questionable internal consistency values were obtained. The comparably higher reliability values of the study-developed scales (PC and SKILL) to the better known SE and SD scales is notable.

Table 2 lists Test 1 means for psychological variables and swim times in its second column. Subsequent columns to the right present change times in original units from November to January (Test 2), from January to March (Test 3), significance of changes (t test for dependent samples), and percent change values as compared to the immediately previous temporal value. Self-esteem changed significantly from November to January ($p < .01$), whereas PC values increased significantly from January to March. SKILL scores improved significantly ($p < .05$), whereas SD values remained constant over both time periods.

Times for the 100-yd freestyle decreased significantly over both time periods ($p < .01$), whereas 50-yd freestyle times decreased significantly from Test 2 to Test 3 (see Note 1). Only one other significant change (i.e., 100-yd backstroke from Test 2 to Test 3) in swim performance was noted. Because lack of significance could be attributable to small sample size in many of the events, percent changes from previous times are included in Table 2. In conclusion, significant psychological change appeared to be as evident as physical performance change across the experimental time span. Additionally, change in both self-perception and swim performance represented improvement. The median percent change across swimming events was 2.9%.

Table 1. Scale descriptive statistics

Variable[a]	*M*	*SD*	Range	Kurtosis	Skewness	Cronbach's alpha
SE1	3.96	.51	2.20 – 4.90	.67	-.64	.73
SE2	4.08	.56	2.30 – 5.00	.13	-.50	.80
SE3	4.10	.58	2.40 – 5.00	-.04	-.43	.79
PC1	3.70	.49	2.47 – 4.97	.26	.31	.90
PC2	3.77	.45	2.79 – 4.88	.14	.30	.89
PC3	3.83	.48	2.65 – 5.00	.02	-.00	.88
SKILL1	22.01	5.44	8.00 – 33.00	-.34	.13	.87
SKILL2	22.76	4.84	8.00 – 35.00	.03	-.04	.85
SKILL3	23.31	4.57	11.00 – 35.00	.11	.00	.86
SD1	3.76	.37	2.37 – 4.47	.98	-.68	.63
SD2	3.77	.39	2.89 – 4.68	-.24	.06	.70
SD3	3.79	.40	2.89 – 4.79	-.23	.15	.65

[a]SE = Rosenberg Self-Esteem; PC = perceived physical competence (estimation); SKILL = self-perception of swimming skills; SD = social desirability. Numerals that follow acronyms indicate one of three testing periods.

Model 1. Sixteen of the 25 hypothesized paths of Figure 1 were found to be significant as well as 4 of the 8 hypothesized covariances (synchronous relations). Relations were in the direction hypothesized except for the SKILL2–PC3 association, which was negative. The chi-square value (see Table 3) was significant, and the RMSR value was .123, indicating the presence of sizable unexplained variance. Significant self-enhancement directional paths were developed for SE1 to PC2 and for SE2 to PC3. Closer examination revealed that all of the nine standardized residuals ≤.30 involved all of the nine possible PC–PERF relationships. A large number of smaller standardized residuals (≥.17) involved SE–SKILL associations. These data provided preliminary evidence for the comparative theoretical validity of Model 2.

Model 2. This analysis replicated that of Model 1 with the addition of tests for relationships between variables that were two vertical levels removed from each other. A nonsignificant chi-square value was obtained, indicating that data did not depart significantly from the proposed model (see Table 3). The CFI approached unity, and the RMSR value was only .039 (see Table 3). These values indicate that data fit the model extremely well. Table 4 presents the standardized solution for Model 2. Dependent variables appear in the first column followed by columns listing each hypothesized independent variable with its respective standardized coefficients. Unexplained prediction error is identified at the end of each equation. Subtracting the standardized prediction error from 1 provides an estimate of the proportion of variance in the dependent variable, which is accounted for by the predictors. The prevalence of high values contained in the furthest column to the right in Table 4 provides empirical support for the model's ability to explain psychological outcomes of sport experience. For example, 84% of PC3 variance was accounted for by five model predictors. Self-esteem at Time 1 influenced self-reports of perceived competence at Time 2, and PC at Time 1 influenced swim performance at Time 2. As posited by the model, prior swim performance significantly predicted perception of swim skills and perceived physical competence at Time 1.

SE and PC covariances were significantly associated within all three waves, as were those of PC and SKILL. A comparison test of Models 1 and 2 (see Table 3) obtained a significant chi-square value of 33.41 ($p < .05$). Therefore, Model 2 was shown to be superior to Model 1 in providing a fit for the data.

Model 3. As discussed earlier, this model incorporates SD as a variable and hypothesizes reciprocal paths between SD and SE and between SD and PC as well as covariances with the same variables within each time point. Otherwise, the test of Model 3 was identical to that of Model 2. While the obtained chi square was significant, an excellent data fit was indicated by the CFI value of .985 and the RMSR value of .043. Figure 2 presents Model 3 components, significant paths, and standardized coefficients. Of special interest is that the presence of social desirability failed to extinguish the significant cross-variable, time-lagged relationships identified in Model 2 and the size of these relationships was not appreciably diminished. In fact, Model 3 identified three new cross-variable, time-lagged associations: PC2 significantly predicted SD3, and SE2 and SKILL2 significantly predicted PC3. Additionally, PC1 now significantly predicted PC3. The association between SKILL2 and PC3 was negative, which is contrary to model theory.

Of special importance in Figure 2 are those associations indicative of causal priority between social desirability and more general indices of self-regard.

Table 2. Psychological and swim performance change scores

Variable[a]		TEST 1 M	TEST 2 Change	TEST 2 % Change	TEST 3 Change	TEST 3 % Change
SE		3.96	+.12**	3.00	+.02	0.56
PC		3.70	+.07	1.86	+.06**	1.62
SKILL		22.01	+.75*	3.42	+.55*	2.41
SD		3.76	+.01	0.26	+.02	0.39
50-yd Freestyle	($n = 17$)	29.05	-.84	2.89	-0.65**	2.37
100-yd Freestyle	($n = 31$)	65.14	-3.43**	5.27	-1.79**	2.90
200-yd Freestyle	($n = 6$)	128.07	-1.05	0.82	-3.92	3.08
500-yd Freestyle	($n = 8$)	375.76	+.64	0.17	-19.15	5.09
100-yd Backstroke	($n = 11$)	67.81	-1.18	1.74	-2.56*	3.84
100-yd Breaststroke	($n = 13$)	71.09	-.18	0.25	-7.87	10.34
100-yd Butterfly	($n = 2$)	65.41	+.40	0.61	-2.25	3.42

[a]SE = Rosenberg Self-Esteem; PC = perceived physical competence (estimation); SKILL = self-perception of swimming skills; SD = social desirability.
*$p < .05$. **$p < .01$.

Social desirability failed to influence significantly subsequent values of either SE or PC; however, it was significantly predicted at Time 2 by SE1 and at Time 3 by PC2. Standardized residuals between SD and SKILL were all low (<.141) across the three waves. These data indicate that model validity and model relationships are not compromised when the effects of social desirability are included in the analyses.

Discussion

This research documented significant improvements in performance and three levels of self-perception across a varsity swim season. It demonstrated also that prior swim times could affect subsequent SKILL and PC scores, that SE could influence subsequent PC, and that PC could influence future swim performance. Ideally it was hoped that the correspondence of performance and psychological change would be mirrored by the significance of a greater number of cross-variable, across-time paths. The amount of performance change may have been the factor in the model's inability to develop more significant paths. Almost all of these boys had been swimming for the previous 5–8 years in amateur and high school competition. Perhaps self-perceptions as well as swim performances were relatively stable. When group self-esteem scores have been found to improve over a formal training program, this improvement has been generally found in subjects initially lower in self-regard or in those lower in ability who attached a great deal of importance to that ability (Sonstroem, 1984). While significant improvements in performance and associated self-perceptions were found in this research, it is inferred that more cross-variable, across-time associations in the model would have achieved significance with a greater amount of improvement.

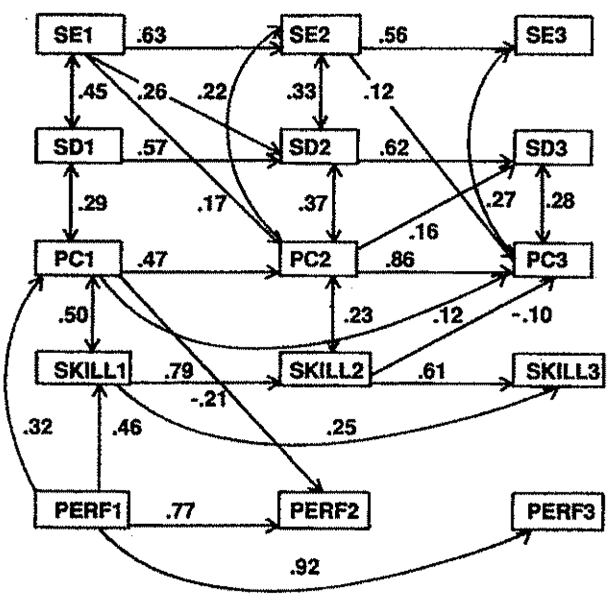

Figure 2. Test of Model 3: Standardized Parameter Estimates. (Values represent standardized coefficients.) Self-esteem (SE), social desirability (SD), perceived physical competence (PC), perception of swim skills (SKILL), and swim performance (PERF) Scores for November (1), January (2), and March (3).

Our research validated the potential of the Exercise and Self-Esteem Model to delineate the manner in which sport or exercise can impact the psychological self-system of high school male athletes over time. The data fit for Model 2 was excellent. Additionally, prediction error was noticeably small.

Of the 14 cross-variable, across-time hypothesized associations in Model 2, 4 were significant and an additional 5 approached significance ($z = 1.96$) with values >1.50. All coefficients were in the direction hypothesized except in the case of SKILL1–SE2 and SKILL2–PC3.

Although tests of the model did not necessarily deny the presence of a staircase effect, a significant improvement in predictability was experienced when associations between variables two vertical levels removed from each other were included in the model. Because previous research failed to find significant associations beyond adjacent levels, present results enable the development of newer perspectives for investigation and interpretation. Model 2 explained 84, 83, and 80% of the variance in PC3, SKILL3, and PERF3, respectively. Although much of this is attributable to construct stability, the self-enhancement paths identified by the analysis present newer prospects for this self-system model. SE1 predicted PC2, and PC1 predicted PERF2 in Model 2. This provides evidence for the directive influence of PC on subsequent swim performance and represents an addition to the perceived physical competence literature. The importance of SE resides in the fact that people behave as they perceive themselves to be. Present results extend this property to a more specific component in the self-system. People behave athletically as warranted by their perceived physical competence.

Because exercise and sport research is customarily criticized for its lack of attention to response biases (Morgan, 1978), it is important to recognize the inclu-

Table 3. Goodness-of-fit indices for models

Model	χ^2	df	*p*	CFI	RMSR
1	58.87	33	.003	.974	.123
2	25.46	19	.146	.993	.039
3	59.89	41	.028	.985	.043

Model Comparisons	χ^2 diff	df difference	*p*
1–2	33.41	14	.01

Note. CFI = Comparative Fit Index; RMSR = Root Mean Square Residual.

sion of social desirability in the present research. Contrary to the conclusions of Arlin (1976), self-esteem appeared to have causal priority over social desirability. SE1 significantly predicted SD2, whereas SE2 and SE3 did not experience significant cross-wave correlations with SD1 or SD2, respectively. This same condition existed for perceived physical competence. PC2 significantly predicted SD3, but, in turn, PC was not significantly related to any prior SD score. In summary, social desirability failed to extinguish any of the significant cross-wave, between-variable relationships of Model 2.

With its presence in Model 3, two additional cross-wave, between-variable relationships not involving SD were identified. Significant SD covariance links with SE and PC need not awaken fears of response contamination. Controversy has centered around the issue of whether to depict social desirability as a tendency to distort item responses or as a personality trait indicative of the need for approval (Crowne & Marlowe, 1960). Recent theory and factor analytic research by Paulhus (1991) has identified two components of socially desirable responding. *Impression management* is believed to represent a purposeful tailoring of answers to create a positive social image. *Self-deception*, however, represents "...an honest but overly positive self-presentation" (Paulhus, 1991, p. 21). This latter exaggeration component has been linked to favorable life adjustment, optimism, health, and self-esteem (Paulhus, 1991). Factor analysis shows that the instrument employed in the present research focuses exclusively on this latter self-deception component. Therefore, we may infer that self-deception is a positive characteristic linked to both self-esteem and perceived physical competence. Its contribution within the model is insufficient to impair the identity of self-esteem and perceived physical competence or to exert causal priority over either of these constructs.

It is important for researchers to examine the model with females and with different methods than used here. For example, latent variable structural modeling would provide more powerful results than those from the current path analysis. In latent variable modeling, several measures are used to anchor each construct. This provides a more valid representation of each major variable and insures more reliable, unbiased estimates of relationships among variables.

The Exercise and Self-Esteem Model is presented as an interim model to explain how self-esteem interacts with exercise. Rather than considering a unitary construct, it erects a network of self-perception variables capable of developing hypotheses in the study of exercise and self-esteem.

References

Anderson, J. G. (1987). Structural equation models in the social and behavioral sciences: Model building. *Child Development, 58*, 49–64.

Arlin, M. (1976). Causal priority of social desirability over self-concept: A cross-lagged correlation analysis. *Journal of Personality and Social Psychology, 33*, 267–272.

Bentler, P. M. (1987). Drug use and personality in adolescence and young adulthood: Structural models with nonnormal variables. *Child Development, 58*, 65–69.

Table 4. Standardized solution for Model 2

Dependent variable	Predictors	Explained variance
PC1	= -.27 PERF1* + .93	7
SKILL1	= -.45 PERF1* + .79	21
SE2	= .67 SE1* + .14 PC1 - .10 SKILL1 + .51	49
PC2	= .54 PC1* + .21 SE1* + .05 SKILL1 - .13 PERF1 + .52	48
SKILL2	= .78 SKILL1* - .00 PC1 + .04 SE1 - .06 PERF1 + .33	67
PERF2	= .78 PERF1* - .21 PC1* - .03 SKILL1 + .23	77
SE3	= .60 SE2* + .11 SE1 + .11 PC2 + .11 SKILL2 + .42	58
PC3	= .84 PC2* + .10 PC1 + .08 SE2 - .09 SKILL2 - .03 PERF2 + .16	84
SKILL3	= .61 SKILL2* + .25 SKILL1* + .07 SE2 + .09 PC2 - .04 PERF2 + .17	83
PERF3	= -.06 PERF2 + .92 PERF* - .07 PC2 - .01 SKILL1 + .20	80

Significant Covariances: SE1, PC1; PC1, SKILL1, SE2, PC2; PC2, SKILL2; SE3, PC3; PC3, SKILL3

Note. PC = perceived physical competence; SKILL = self-perception of swimming skills; SE = self-esteem; PERF = swim performance. Values under predictors represent standardized regression paths. The final value in each equation represents standardized prediction error. Subtracting this value from 1.00 provides the explained variance value.
*$p < .05$.

Bentler, P. M. (1989). *EQS: Structural equations program manual.* Los Angeles: BMDP Statistical Software.

Boomsma, A. (1983). *On the robustness of LISREL (maximum likelihood estimation) against small sample size and nonnormality.* Unpublished doctoral dissertation, University of Groningen, The Netherlands.

California State Department of Education. (1990). *Toward a state of esteem: The final report of the California Task Force to Promote Self-Esteem and Personal and Social Responsibility.* Sacramento: Author.

Calsyn, R. J., & Kenny, D. A. (1977). Self-concept of ability and perceived evaluation of others: Cause or effect of academic achievement? *Journal of Educational Psychology, 69,* 136–145.

Coopersmith, S. (1967). *The antecedents of self-esteem.* San Francisco: Freeman.

Crowne, D. P., & Marlowe, D. (1960). *The approval motive.* New York: Wiley.

Cudeck, R. (1989). Analysis of correlation matrices using covariance structure models. *Psychological Bulletin, 105,* 317–327.

Dishman, R. K. (1978). Aerobic power, estimation of physical ability, and attraction to physical activity. *Research Quarterly, 49,* 285–292.

Felson, R. B. (1984). The effect of self-appraisals of ability on academic performance. *Journal of Personality and Social Psychology, 47,* 944–952.

Fox, K. H., & Corbin, C. B. (1989). The Physical Self-Perception Profile: Development and preliminary validation. *Journal of Sport and Exercise Psychology, 11,* 408–430.

Gollob, H. F., & Reichardt, C. S. (1987). Taking account of time lags in causal models. *Child Development, 58,* 80–92.

Harlow, L. L. (1985). *Behavior of some elliptical theory estimators with nonnormal data in a covariance structures framework.* Unpublished doctoral dissertation, University of California, Los Angeles.

Huba, G. J., & Harlow, L. L. (1987). Robust structural equation models: Implications for developmental psychology. *Child Development, 58,* 147–166.

Jackson, D. N. (1984). *Personality research form manual* (3rd ed.). New York: Research Psychologists Press.

Marsh, H. W. (1990). Causal ordering of academic self-concept and academic achievement: A multiwave, longitudinal panel analysis. *Journal of Educational Psychology, 82,* 646–656.

Marsh, H. W., Byrne, B. M., & Shavelson, R. J. (1988). A multifaceted academic self-concept: Its hierarchical structure and its relations to academic achievement. *Journal of Educational Psychology, 80,* 366–380.

Marsh, H. W., Richards, G. E., & Barnes, J. (1986). Multidimensional self-concepts: The effect of participation in an Outward Bound program. *Journal of Personality and Social Psychology, 50,* 195–204.

Morgan, W. P. (1978). Sport personology: The credulous-skeptical argument in perspective. In W. F. Straub (Ed.), *Sport psychology: An analysis of athlete behavior* (pp. 218–227). Ithaca, NY: Mouvement Publications.

Newman, R. S. (1984). Children's achievement and self-evaluations in mathematics: A longitudinal study. *Journal of Educational Psychology, 76,* 857–873.

Paulhus, D. L. (1991). Measurement and control of response bias. In J. P. Robinson, P. R. Shaver, & L. S. Wrightsman (Eds.), *Measures of personality and social psychological attitudes* (Vol. 1, pp. 17–24). San Diego: Academic.

Rosenberg, M. (1965). *Society and the adolescent self-image.* Princeton: Princeton University Press.

Rosenberg, M. (1979). *Conceiving the self.* New York: Basic Books.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research, 46,* 407–441.

Sonstroem, R. J. (1974). Attitude testing examining certain psychological correlates of physical activity. *Research Quarterly, 45,* 93–103.

Sonstroem, R. J. (1978). Physical Estimation and Attraction Scales: Rationale and research. *Medicine and Science in Sports, 10,* 97–102.

Sonstroem, R. J. (1984). Exercise and self esteem. In R. L. Terjung (Ed.), *Exercise and sport sciences reviews* (Vol. 12, pp. 123–155). Lexington, MA: Collamore.

Sonstroem, R. J., Harlow, L. L., Gemma, L. M., & Osborne, S. (1991). Test of structural relationships within a proposed exercise and self-esteem model. *Journal of Personality Assessment, 56,* 348–364.

Sonstroem, R. J., & Morgan, W. P. (1989). Exercise and self-esteem: Rationale and model. *Medicine and Science in Sports and Exercise, 21,* 329–337.

Wylie, R. C. (1979). *The self-concept: Theory and research in selected topics* (Vol. 2, rev. ed.). Lincoln: University of Nebraska Press.

Note

1. Better swim performance is indicated by lower swim times. Therefore, positive performance changes and positive performance relationships throughout the manuscript are characterized by a negative sign.

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