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The Tripartite Model and Dimensions of Anxiety and Depression: An Examination of Structure in a Large School Sample

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This study was designed to build on recent findings that (a) factors of the tripartite model in adults are not uniformly related to all anxiety disorder dimensions as recent research has suggested (T. A. Brown, B. F. Chorpita, & D. H. Barlow, 1998; S. Mineka, D. W. Watson, & L. A. Clark, 1998), and (b) the tripartite model of emotion appears to have increasing support and utility in child samples (e.g., C. J. Lonigan, E. S. Hooe, C. F. David, & J. A. Kistner, 1999). The structural relations were evaluated among tripartite factors and dimensions representing selected anxiety disorders and depression in a large multiethnic school sample of children and adolescents. General aspects of the tripartite model were supported. For example, Negative Affect was positively related with all anxiety and depression scales, and Positive Affect was negatively correlated with the depression scale. Consistent with previous observations in adult samples, Physiological Hyperarousal was positively related with Panic only, and was not significantly positively correlated with other anxiety syndromes. The structure of the best fitting model appeared robust across different grade levels and gender. In follow-up analyses, several interactions of grade level with structural parameters emerged, such that the relation of some of the tripartite factors with anxiety and depression were noted to increase or decrease across grade level.

KEY WORDS: anxiety; depression; children; adolescents; assessment; tripartite model.

INTRODUCTION

Clark and Watson's tripartite model of emotion (Clark & Watson, 1991) specifies a general factor, negative affect (NA), which represents a shared influence on anxiety and depression, and further specifies two specific factors, physiological hyperarousal (PH), common to anxiety, and (low) positive affect (PA), common to depression (Clark & Watson, 1991). Initially proposed to account for the high comorbidity of depressive and anxiety disorders and symptoms (Clark, 1989), the tripartite model has become increasingly well-specified and has found accumulating empirical support within adult and child samples (e.g., Brown, Chorpita, & Barlow, 1998; Chorpita, Albano, & Barlow, 1998; Joiner, Catanzaro, & Laurent, 1996; Lonigan, Hooe, David, & Kistner, 1999; Watson et al., 1995).

The model has a number of important implications with respect to psychopathology. First, evidence suggests that NA and PA are heritable, temporally stable risk factors (Clark, Watson, & Mineka, 1994; Lonigan & Phillips, 2001), such that these variables may ultimately shed light on the development of anxiety and depressive disorders. For example, NA and PA may be of considerable value in predicting the future emergence of affective pathology, and measuring such variables with precision precludes outlining the mechanisms by which these putative risks lead to dysfunction. Second, the model allows for the improved understanding of the comorbidity among affective disorders, offering a theoretical basis for the high co-occurrence of anxiety and depression in children as well as adults. Third, increased understanding of the core dimensions of affect and arousal related to anxiety and depressive disorders offers the possibility for an improved

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understanding of the nosology for classifying these syndromes. For example, knowledge about whether generalized anxiety disorder in children is characterized primarily by negative emotionality versus autonomic arousal has important implications for articulating the key features of that disorder within a diagnostic rule system. Finally, recent tests of the model in the context of dimensions of anxiety and depressive disorders have revealed the benefit of moving beyond a single-order assessment strategy to a hierarchical one. That is, it appears important to assess not only the symptoms of particular disorders or syndromes but also the core affective and arousal dimensions related to those syndromes. In this way, the degree to which the symptoms are related to general features of temperament or physiology can be determined, which has implications for course, chronicity, and emerging comorbidity. This is consistent with the notion of heterotypic continuity, whereby the symptomatic expression of an underlying, temporally stable pathology differs over the course of development (e.g., Caspi, Elder, & Bem, 1988).

To address these important considerations, several recent investigations have begun to evaluate the tripartite model in child inpatient, outpatient, and school samples. For example, Lonigan, Carey, and Finch (1994) found in a sample of 233 clinically referred children that measures related to low PA discriminated children with depressive disorders from those with anxiety disorders. Joiner et al. (1996) conducted an exploratory factor analysis of self-report measures completed by 116 child and adolescent psychiatric inpatients and outlined three factors conceptually similar to those of the tripartite model. Chorpita et al. (1998) conducted a similar investigation with the use of confirmatory factor analysis of child and parent measures in 216 children and adolescents with anxiety and mood disorders and found corroborative support for a three-factor model of negative emotions. Recently, Lonigan et al. (1999) examined the relations of PA and NA measures with anxiety and depression measures in a school sample of 365 children and adolescents. Lonigan et al. (1999) found that NA and PA measures performed in a manner consistent with findings from adult samples, and that such findings were uniform across children and adolescents.

Although the tripartite model originally conceptualized anxiety as a unitary construct, recent investigations have begun to establish that the relation of tripartite dimensions to anxiety may not be uniform across specific anxiety syndromes or disorders (Mineka, Watson, & Clark, 1998). For example, Brown et al. (1998) evaluated the relations of tripartite dimensions to generalized anxiety, depression, social phobia, panic, and obsessions/compulsions in 350 adults with anxiety and mood disorders, and found that PH was significantly positively related to panic only. Further, in that same model, PH was significantly *negatively* related to measures of generalized anxiety.

Chorpita, Plummer, and Moffitt (2000) conducted an investigation of these issues in a sample of 100 children with anxiety and mood disorders. Children were between the ages of 7 and 17, and were diagnosed with structured clinical interviews. On the basis of the findings of Brown et al. (1998), two main structural models were tested. The first posited NA and PA as higher order factors explaining variance in the anxiety and depression dimensions, some of which in turn influenced PH. The second posited all three tripartite factors as higher order factors, explaining variance in the lower order anxiety and depression dimensions. In the first model, Chorpita, Plummer, et al. (2000) found that NA and PA were related to anxiety and depression in the expected manner, but that such relations were not uniform across specific anxiety syndromes. This was similar to the findings of Brown et al. (1998), in that NA was positively related to all anxiety and depression dimensions, and PH was not significantly related to depression, social anxiety, generalized anxiety, or obsessions/compulsions. Thus, the prediction that tripartite dimensions were related to several of the mood and anxiety disorders in a child population was confirmed and extended an examination of related constructs in adults (Brown et al., 1998). Nevertheless, in terms of model evaluations, both the initial model and second model fit the data well. Because differences in fit of the models were relatively minimal, Chorpita, Plummer, et al. (2000) felt it was premature to conclude that one structure was preferable to another. Thus, some clarification is needed with respect to what is the most interpretable and best fitting model to explain the relation of affective dimensions to symptoms of anxiety and depression.

To examine these issues further, this study involved a larger investigation of the structural relations among tripartite factors and dimensions representing symptoms of selected anxiety disorders and depression. Also, because relatively little is known about these dimensions in the population in general, a large school sample of children and adolescents seemed like the most appropriate starting point for such an investigation. It was hypothesized that general aspects of the tripartite model would be supported (i.e., NA positively related with anxiety and depression, PA negatively related with depression). Further, it was hypothesized that the relations of tripartite factors would not be uniform across all anxiety dimensions. Specifically, PH would show a positive relation to panic and perhaps to separation anxiety (Last, 1991), but not to other anxiety dimensions. Finally, the robustness of such models was evaluated by examining the equivalence of structure and parameters across age and gender, and the interaction effects of structural parameters with gender and grade level were examined, to determine whether certain parameters differed between boys and girls or across grade level. For example, given suggestions in the diagnostic nosology that worry in young children is characterized by autonomic arousal (e.g., "overanxious disorder," American Psychiatric Association [APA], 1987) more than worry in adults, which is characterized by a relative absence of autonomic arousal (cf. Brown et al., 1998), it was expected that such syndromes as generalized anxiety might show a higher relation to PH at earlier grade levels than that at later grade levels.

METHOD

Participants

Participants were 1,578 children and adolescents recruited from 13 public and private schools in Grades 3 through 12 on O'ahu, HI, (median grade = 7) for a series of studies involving assessment of anxiety and emotional factors. The mean age of the sample was 12.87 years ($SD = 2.82$; range = 6.17–18.92)[3] and the group consisted of 893 girls (54.4%) and 748 boys (45.6%). Over 20 different ethnicities were identified, including Japanese American ($n = 463$; 28.2%), Filipino ($n = 217$; 13.2%), Hawaiian ($n = 204$; 12.4%), Chinese American ($n = 138$; 8.4%), Caucasian ($n = 133$; 8.1%), or multiethnic ($n = 276$; 16.8%). The remaining participants ($n = 210$; 12.8%) identified principally with one of the following: Korean, Okinawan, Portuguese, African American, Hispanic American, Samoan, Southeast Asian, Puerto Rican, Native American, Tongan, Fijian, or Guamanian. The group was broadly representative of the economic and geographic diversity of the local population. With the exception of 63 participants excluded because of a listwise strategy for handling missing data, this sample was the same as the Study 1 sample reported on in Chorpita, Yim, Moffitt, Umemoto, and Francis (2000), described below.

[3]This age range may seem larger than the inclusionary criteria of grade levels would allow. However, of the 1,578 children, only 7 (0.4%) were below the age of 8. These children were accelerated in grade level because of their academic capability, and thus were considered to be cognitively equivalent to other 3rd graders (grade level being a better index of cognitive ability than age). Similarly, only two students (0.1%) were older than 18 years, 6 months and were judged to be cognitively equivalent to other 12th graders.

Model Indicators

Anxiety and Depression Factors

Children in this investigation were a subset of those participating in a larger series of studies designed to establish and evaluate new measures of tripartite factors and of *DSM* anxiety and depression (Chorpita, Daleiden, Moffitt, Yim, & Umemoto, 2000; Chorpita, Yim, et al., 2000). Briefly, 1,641 children were administered two sets of items. The first set included a 47-item adaptation of the Spence Children's Anxiety Scale (SCAS; Spence, 1997), which is a 45-item scale designed to assess children's report of anxiety symptoms corresponding to symptoms of *DSM-IV* anxiety disorders. The SCAS has 7 positively worded filler items and 38 anxiety items. The 7 filler items were dropped in this study, and were replaced with 9 new items intended to increase the item pool for several of the scales and to provide a new scale for depression. Items required respondents to rate how true each item was with respect to their usual feelings. Items were scored on a 4-point scale (0–3), from *never true* to *always true*. These items were factor analyzed, and the resulting scales were evaluated in a second sample of 246 children and adolescents for their reliability and validity properties (Chorpita, Yim, et al., 2000). Participants in the reliability and validity study of these scales were not overlapping with those in this study, and these independent tests suggested favorable reliability and validity across the intended age range. Items used for this study are listed in Table I.

Tripartite Factors

The second set of 27 items was intended to assess tripartite factors and was drawn from (a) items from the Children's Depression Inventory (CDI; Kovacs, 1980/1981) and the Revised Children's Manifest Anxiety Scale (RCMAS; Reynolds & Richmond, 1978) that had been previously identified as relevant to the tripartite model, (e.g., "Often I feel sick in my stomach," from the RCMAS Physiological Anxiety Scale); (b) adaptation of items from the Behavioral Inhibition System/Behavioral Activation System scale (Carver & White, 1994), (e.g., "I would love to win a contest," adapted from the Activation Scale); (c) adaptation of items from the Depression Anxiety Stress Scales (Lovibond & Lovibond, 1995); (e.g., "My mouth gets dry," adapted from the Anxiety Scale); and (d) items generated by a panel of experts in childhood anxiety (e.g., "Little things bother me"). Items required respondents to rate how true each item was with respect to their usual feelings. Items were scored on a 4-point scale (0–3), from

Table I. Items and Their Corresponding Latent Variables for the Models

Item	Latent variable
Often I have trouble getting my breath	PH
I have trouble breathing	PH
My heart beats too fast	PH
I have trouble swallowing	PH
I feel shaky	PH
My hands get sweaty	PH
Often I feel sick in my stomach	PH
I sometimes feel faint	PH
My mouth gets dry	PH
I get upset easily	NA
I get upset by little things	NA
Little things bother me	NA
Other people upset me	NA
I get upset	NA
I can't calm down once I am upset	NA
I overreact to things	NA
I don't like to wait for things	NA
When good things happen to me, I feel full of energy	PA
When I'm doing well at something, I really feel good	PA
I will try something new if I think it will be fun	PA
I love going to new places	PA
When I see a chance for fun, I take it	PA
I like being with people	PA
I would love to win a contest	PA
When I get something I want, I feel excited	PA
I have fun at school	PA
I have plenty of friends	PA
I feel afraid that I will make a fool of myself in front of people	Social Anxiety
I worry when I think I have done poorly at something	Social Anxiety
I worry I might look foolish	Social Anxiety
I worry what other people think of me	Social Anxiety
I worry about making mistakes	Social Anxiety
I feel scared when I have to take a test	Social Anxiety
I worry that I will do badly at my school work	Social Anxiety
I feel afraid if I have to talk in front of my class	Social Anxiety
I feel worried when I think someone is angry with me	Social Anxiety
My heart suddenly starts to beat too quickly for no reason	Panic
I suddenly start to tremble or shake when there is no reason for this	Panic
When I have a problem, I feel shaky	Panic
All of a sudden I feel really scared for no reason at all	Panic
When I have a problem, my heart beats really fast	Panic
I suddenly feel as if I can't breathe when there is no reason for this	Panic
I suddenly become dizzy or faint when there is no reason for this	Panic
I worry that I will suddenly get a scared feeling when there is nothing to be afraid of	Panic
When I have a problem, I get a funny feeling in my stomach	Panic
I have no energy for things	Depression
I feel sad or empty	Depression
I feel worthless	Depression
Nothing is much fun anymore	Depression
I cannot think clearly	Depression
I am tired a lot	Depression
I have trouble sleeping	Depression
I feel restless	Depression
I have problems with my appetite	Depression
I feel like I don't want to move	Depression
I feel scared if I have to sleep on my own	Separation Anxiety
I worry about being away from my parents	Separation Anxiety
I would feel scared if I had to stay away from home overnight	Separation Anxiety
I would feel afraid of being on my own at home	Separation Anxiety
I am afraid of being in crowded places	Separation Anxiety
I have trouble going to school in the mornings because I feel nervous or afraid	Separation Anxiety
I worry when I go to bed at night	Separation Anxiety
I worry that bad things will happen to me	Generalized Anxiety
I worry that something bad will happen to me	Generalized Anxiety
I think about death	Generalized Anxiety
I worry about what is going to happen	Generalized Anxiety
I worry that something awful will happen to someone in my family	Generalized Anxiety
I worry about things	Generalized Anxiety
I have to do some things over and over again	Obsessions/Compulsions
I have to do some things in just the right way to stop bad things from happening	Obsessions/Compulsions
I have to keep checking that I have done things right	Obsessions/Compulsions
I have to think of special thoughts (like numbers or words) to stop bad things from happening	Obsessions/Compulsions
I get bothered by bad or silly thoughts or pictures in my mind	Obsessions/Compulsions
I can't seem to get bad or silly thoughts out of my head	Obsessions/Compulsions

Note. NA = Negative Affect; PA = Positive Affect; PH = Physiological Hyperarousal.

never true to *always true*. These items were factor analyzed using a sample of 1,289 children and adolescents, and this factor solution was cross-validated using confirmatory analysis in an additional 300 participants. The resulting scales were evaluated for their reliability and validity in a second study using 390 children and adolescents. These items also appear in Table I.

It should be noted that the investigations described above involved several studies with factor analytic and reliability tests using these item pools, with the goal of establishing measures of the target constructs of anxiety and depression as well as tripartite factors. Because the present sample is a subset of one of the main factor analytic investigations described above, this study is not intended to be (nor can it be) a replication of the factor structures within each measure. The factor structures for these measures were in fact already cross-validated within the studies described above. Rather, the present investigation was designed to extend those previous factor analytic studies through the simultaneous investigation of tripartite dimensions and anxiety and depression scales within this sample, with the intent of identifying the structural (as opposed to the measurement) properties of competing models relating tripartite dimensions with anxiety and depression dimensions. The present investigation represents the first examination in this large sample investigating the relations of measures of tripartite dimensions with dimensions of anxiety disorders and depression.[4]

Procedure

All participants provided written parental consent and verbal assent prior to participation in the study. All participants were presented with the two-item sets. The order of presentation of these two sets was randomly varied. Questionnaires were completed in the participants' classrooms or in another quiet and well-lit room in the school (e.g., library). Following distribution of the questionnaires, participants were read a standardized set of instructions by one of the investigators, advising the participants to read each item and select the answer that seemed most appropriate. Participants were also told that their responses were confidential, and that these questionnaires were not a test and did not have right or wrong answers.

Analytical Strategy

Covariance among the observed variables was evaluated with a maximum likelihood solution with the use of LISREL 8.12a. Because different fit indices are sensitive to unique artifactual influences, multiple fit indices were used to provide a more conservative and reliable evaluation of the models. These indices included the traditional Goodness of Fit Index (GFI; Jöreskog & Sörbom, 1996), which tests the absolute fit of the model, the Comparative Fit Index (CFI; Bentler, 1990), which tests the fit of the model relative to a fully orthogonal "independence" model, the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), which evaluates the model relative to degrees of freedom, and Akaike's Information Criterion (AIC; Akaike, 1987), which is the model χ^2 plus 2 times the number of parameters. Conventionally, scores of .90 and above on the GFI and the CFI represent good model fit. Browne and Cudek (1993) suggest that RMSEA values below 0.08 represent acceptable fit, and that values at or below 0.05 represent good fit. An inferential test for close fit (defined as RMSEA < 0.05) was also employed, with a nonsignificant result ($p > .05$) suggesting good model fit (Browne & Cudek, 1993). The AIC was included because of its utility for comparatively evaluating nonnested models. Lower AIC values represent better model fit.

Items were combined by summing pairs or groups of items to create three indicators for each variable in the model (i.e., every third item in a scale was grouped). This strategy was intended (a) to provide more favorable distributions for each indicator (i.e., increased range and variability), (b) to reduce potentially poor fit in the model resulting from excessive overidentification of the measurement model, and (c) to address sample size concerns for the multisample analyses by increasing the indicator saturation and reducing the total number of observed variables (Guadagnoli & Velicer, 1988).

As mentioned above, evaluation of the measurement models (i.e., single-order confirmatory factor models) would be somewhat redundant, because of the fact that the indicators in this study were partially derived from

[4] This investigation essentially represents the second part of an evaluation of measurement and structural models in these item sets. The best measurement models were first established and cross-validated in an essentially overlapping sample (minor differences in sample size across factor analytic investigations are due to missing data within each measure). This study then aimed to evaluate the relationship among the latent variables identified in these earlier tests. In that way, this study is in no way a repetition of these previous analyses. Further, the reliability and validity of these scales were evaluated in separate studies with the use of independent samples. Nevertheless, to further address any concerns that tests of the present models may have capitalized on chance in building the measurement model, the solutions for Model 1 and 2 were tested and cross-validated by randomly splitting the sample into an index ($n = 789$) and validation sample ($n = 789$). In these tests, no substantive differences emerged from the findings on the entire sample presented in this paper (e.g., mean difference in structural parameter estimates was 0.025; fit statistics were essentially identical).

exploratory factor analyses on each item set with the use of this same sample. Therefore, confirmatory analyses were used only to determine whether poor model fit had been introduced by some unanticipated aspect of combining items to create new indicators. Again, the purpose of the present investigation was to evaluate the structural relation of tripartite factors with anxiety and depression factors, and the main analyses were designed to address these questions.

Evaluation involved testing a series of progressively elaborated models. These concerned the relation of tripartite factors to anxiety and depression first including only NA, then NA and PA, and finally NA, PA, and PH. The rationale was that those factors that were best understood in terms of their relation to anxiety and depression would be evaluated first. All models allowed the residual variances of the latent anxiety and depression factors to be correlated, reflecting the idea that covariance among the anxiety and depression factors was not due to tripartite dimensions alone, but could also involve other shared influences (e.g., method variance, criterion overlap of dimensions, or ecological factors).

For all models, modification indices (MIs) and residuals were examined to determine specific parameters in the model contributing to poor fit, and in the event that their modification was consistent with theory (see, Jöreskog, 1993), revisions were made.[5] Best model fit was determined by a differential χ^2 test for those models that were nested. When models were not nested, the following three criteria were used: overall fit as determined by the collective indices; the best model fit with the most parsimony, as quantified by the AIC; and interpretability of the model.

It was anticipated that some parameters might differ as a function of age, particularly those involving disorders whose phenomenology is thought to differ substantively as children develop (e.g., separation anxiety disorder, panic disorder, generalized anxiety disorder). Therefore, some parameters that were not statistically significant in the final full-sample model were retained, reflecting the possibility that although the main effects of these parameters were not significant, possible interaction effects of these parameters with gender or grade might mask statistically significant effects within specific levels of gender or grade.

The best fitting model was then evaluated for its equivalence across boys and girls in a multisample solution and across five groupings of grade levels in another multisample solution (e.g., Jaccard & Wan, 1996; Jöreskog & Sörbom, 1996). This approach allowed for the investigation of the moderational influence of gender or grade level on model parameters. These solutions first involved a test of whether the model fit all groups equally well (i.e., structural equivalence) followed by a test of whether the parameter estimates were similar across groups (parameter equivalence). The first test involves interpretation of goodness of fit indices, which reflect the degree to which the factor solution fits both groups successfully. The second test traditionally involves a comparative evaluation of the χ^2 test statistics from (a) an unrestricted model allowing for parameters to be estimated independently within groups and (b) a restricted model constraining some or all parameters to be equivalent across groups. Parameters are thought to differ across groups if a test of the differential magnitude of χ^2 is significant across the restricted and unrestricted solutions. In this study, all multisample models were restricted sequentially, such that all parameters were initially constrained to be equivalent across groups, and subsets of parameters were then freed to determine the source of poor fit in the model.

RESULTS

Full Sample

The measurement model (i.e., all latent variables freely correlated) for the tripartite factors and the anxiety and depression factors demonstrated the anticipated good model fit. The $\chi^2(288)$ was 1,152.64, and the GFI was 0.95. All other fit statistics corroborated good model fit (RMSEA = 0.044; Cfit = 1.00; RMR = 0.041; CFI = 0.95; AIC = 1332.64). No points of poor model fit were identified. Loadings of indicators on their latent variables ranged from 0.59 to 0.80 ($M = 0.72$; $SD = 0.05$). This finding indicated good empirical support for the factor structure of the *DSM* dimensions related to anxiety and depression.

The first structural model involved a test of the relation of NA to the anxiety and depression factors. The model fit statistics appear in Table II and suggested good model fit. Completely standardized path coefficients from NA to the disorder variables were (in order of decreasing magnitude) 0.58 (NA to Depression), 0.53 (NA to Generalized Anxiety), 0.53 (NA to Social Anxiety), 0.50 (NA to Obsessions/Compulsions), 0.46 (NA to Panic), and 0.29 (NA to Separation Anxiety). All of these path coefficients were statistically significant, which confirmed the prediction that NA is positively related to dimensions of anxiety and depressive disorders.

The next model added the PA variable, which was specified as orthogonal to NA. PA was modeled as having

[5] Modification indices represent the estimated change in χ^2 resulting from estimating a fixed parameter. Values of about 4.00 suggest that reestimation of the model with the corresponding parameter no longer fixed would result in a statistically significant decrease in χ^2.

Table II. Fit Statistics for Structural Models

	χ^2	*df*	*p*	AIC	RMSEA	Cfit	GFI	CFI	RMR
NA/disorders	754.04	168	.00	880.04	0.047	0.92	0.95	0.96	0.039
NA PA/disorders	1036.60	230	.00	1176.60	0.047	0.94	0.94	0.95	0.046
Model 1	1512.63	298	.00	1672.63	0.051	1.00	0.93	0.93	0.065
Model 1 revised	1403.38	297	.00	1565.38	0.049	1.00	0.94	0.94	0.060
Model 2	1195.03	297	.00	1357.03	0.044	1.00	0.94	0.95	0.043
Model 2 revised	1201.00	300	.00	1357.00	0.044	1.00	0.94	0.95	0.043

Note. AIC = Akaike's Information Criterion; RMSEA = root mean square error of approximation; Cfit = test for close fit (RMSEA < 0.05); GFI = goodness of fit index; CFI = comparative fit index; RMR = standardized root mean square residual; NA = Negative Affect; PA = Positive Affect; PH = Physiological Hyperarousal; disorders = all six scales for anxiety and depression. Model in italic was retained as best fitting full model.

a path only to the Depression latent variable. The fit statistics for this second model appear in Table II and also suggested good model fit. Path coefficients from NA to the anxiety and depression latent variables were unchanged, and the path from PA to Depression was −0.34. All structural parameters and indicator loadings were statistically significant. Again, these findings were consistent with predictions.

Full Model 1

Next, PH was introduced into the model as a third higher-order variable (see Fig. 1). The relation of PH to anxiety and depression factors was specified based on the collective findings from similar models suggesting that PH appears to be substantively related both to Panic and GAD in adults (Brown et al., 1998) and evidence that somatic arousal is correlated with separation anxiety in children (Chorpita, Plummer, et al., 2000; Last, 1991). For this model, the fit statistics demonstrated mixed support, with the RMSEA and standardized RMR both failing to fall under the 0.05 criterion for good model fit. Path coefficients appear in Fig. 1.

Evaluation of effects of specific fixed parameters in the model suggested that a path should be estimated from PH to the Depression factor. Although the tripartite model in adults specifies that PH is a dimension unique to anxiety, several studies suggest that depression among younger children is characterized by a greater degree of somatic complaints than depression in adolescents (e.g., Kashani & Carlson, 1987; Kashani, Rosenberg, & Reid, 1989). Thus, the model was revised to include a path from PH to Depression. This led to a significant decrease in χ^2, suggesting substantive improvement in model fit. Fit statistics for the revised model appear in Table II and are consistent with improved model fit. Nevertheless, the standardized

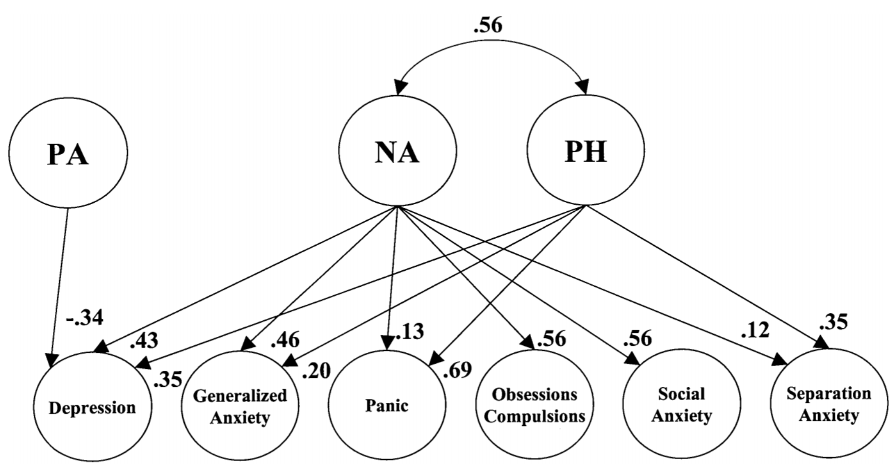

Fig. 1. Model with three higher order tripartite factors over *DSM* disorder factors. (NA = Negative Affect; PA = Positive Affect; PH = Physiological Hyperarousal. Path coefficients to the disorder variables appear to the right of the arrow. Residual variances of disorder variables are correlated.)

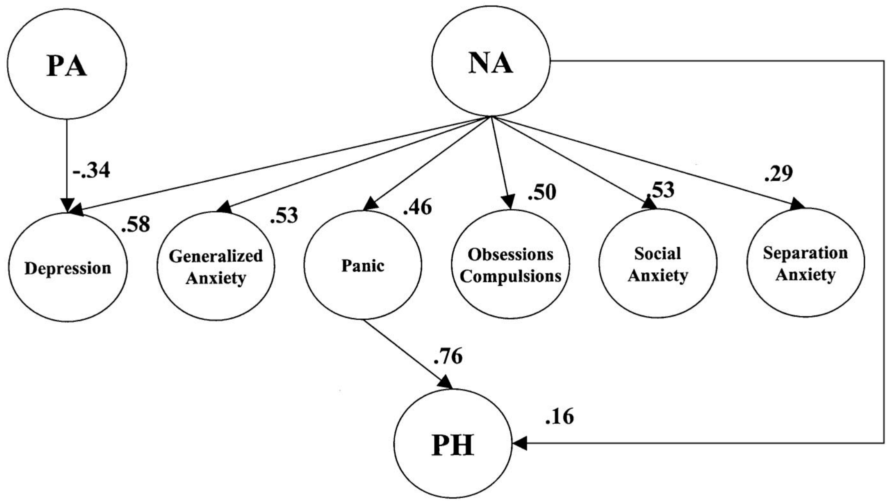

Fig. 2. Model with two higher order and one lower order tripartite factor with *DSM* disorder factors. Path coefficients to the disorder variables appear to the right of the arrow. Residual variances of disorder variables are correlated. (NA = Negative Affect; PA = Positive Affect; PH = Physiological Hyperarousal.)

RMR continued to fall above the .05 criterion for good model fit, suggesting possible problems with the model.

Model 2

A second structural model was specified similar to that articulated by Brown et al. (1998), which posited PH at a lower conceptual level relative to NA and PA (see Fig. 2). To be consistent with the findings from Model 1, this model initially included paths relating PH with Separation Anxiety, Panic, Generalized Anxiety, and Depression. Fit statistics for this model indicated good model fit (see Table II), and these were all equivalent to or better than fit statistics for Model 1. Specifically, a difference of over 300 points on the AIC, an index often used to compare nonnested models, suggested the superiority of Model 2. Overall, the model supported the idea that NA and PA are primary influences on the symptoms of anxiety and depression, whereas PH is consequential to specific anxiety syndromes.

Despite the improvement in fit, paths from Generalized Anxiety and Depression to PH were not significant in Model 2, which was therefore revised to remove these nonsignificant paths. Upon reestimation, the path from Separation Anxiety to PH also became nonsignificant. The model was revised again to exclude the path from Separation Anxiety to PH. Fit statistics for this revised model appear in Table II, and the revisions did not significantly degrade fit from the original Model 2, $\chi^2_{\text{diff}}(3) = 5.97$, $p =$ .11. The AIC also suggested that the model without these additional paths provided a slightly more parsimonious fit to the data. Thus, the revised Model 2 involving NA and PA over all the disorders and a path from Panic to PH was considered the best fitting model for the full sample.

Despite this conclusion, a number of observations suggested that additional analyses were warranted regarding the PH factor. Because of (a) mixed findings in the literature with respect to PH; (b) the ambiguity of the present findings related to PH noted above; and (c) the interest in potential developmental differences related to somatic aspects of depression, separation anxiety, and generalized anxiety, paths relating these disorders to PH were preserved for consideration. Thus, the original Model 2 was retained for further modeling to facilitate exploratory analyses across age and gender.

Multisample Solutions

Gender

The original Model 2 was then examined in a multisample analysis (e.g., Jöreskog & Sörbom, 1996) across boys and girls. This analysis first entailed testing whether the hypothesized structure would fit the data from both boys and girls equally well. This solution yielded a GFI of 0.93, a RMSEA of 0.032 (test of close fit, RMSEA $<$ 0.05: $p = 1.00$), a CFI of 0.94, and a standardized RMR of 0.047, suggesting that an equivalent structure across groups fit the data well. The χ^2 for this solution was 1,576.26 with 594 degrees of freedom ($p < .0001$).

Table III. Effects of Model Constraints Across Boys and Girls in a Multisample Analysis

Parameters	χ^2	*df*	*p*	Difference from full model χ^2_{diff}	*df*	*p*
None (full model)	1576.26	594	.0000	—	—	—
All parameters	1820.17	675	.0000	243.91	81	.0000*
All paths relating effects of latent variables on each other	1585.11	606	.0000	8.85	12	.7157
Covariance matrix of NA and PA	1576.82	596	.0000	0.56	2	.7558
All paths from latent variables to indicators (i.e., factor loadings)	1704.83	639	.0000	128.57	45	.0000*

Note. NA = Negative Affect; PA = Positive Affect. * $p < .05$.

Next, a second model was tested with the same structure, but with all parameters constrained to be equal across boys and girls. This model led to a significant increase in χ^2 (see Table III, row 2), suggesting that parameters differed across boys and girls. To identify the source of these differences, subsets of parameters were then constrained, and model fit was compared against the full unrestricted model. When the paths representing the effects of latent variables on each other were constrained to be equal across groups, the model fit was not degraded (see Table III), suggesting that the parameters representing relations among tripartite factors and anxiety and depression factors were not significantly different across boys and girls. Next, the variances of NA and PA were modeled as equal across boys and girls, and this also did not degrade model fit significantly (see Table III). Finally, all measurement parameters (i.e., factor loadings and unique indicator variances) were constrained to be equal across boys and girls. This led to a significant increase in χ^2, suggesting that the loadings of indicators on latent variables differed across boys and girls. Examination of the factor loadings and unique variances from within each group demonstrated that factor loadings were generally higher for girls ($M = 0.74$; $SD = 0.05$) than for boys ($M = .70$; $SD = 0.06$). Despite statistically significant differences, the true magnitude of these differences was small.

Grade Level

A multisample solution was then employed using grade level as a grouping variable. To ensure adequate sample size for within-group solutions, grades were combined in the following manner: 3rd and 4th, $n = 282$; 5th and 6th, $n = 338$; 7th and 8th, $n = 463$; 9th and 10th, $n = 247$; and 11th and 12th, $n = 248$. A solution that specified equivalent form across all groups yielded good model fit. The test yielded a GFI of 0.86, a RMSEA of 0.023 (test of close fit, RMSEA < 0.05; $p = 1.00$), a CFI of 0.93, and a standardized RMR of 0.066, suggesting mixed support for the generalizability of the model across grade levels.

Problems with specific parameters were identified in the measurement model only, however, with the largest MI being 46.53 representing the fixed path from Generalized Anxiety to the first OCD indicator in the 11th and 12th grade group. In other words, this suggested that estimating an additional path such that the second OCD indicator would load on both OCD and Generalized Anxiety in the 11th and 12th grade group would allow for a decrease in the χ^2 of approximately 46.53 points. Within the structural model, there were few parameters associated with poor fit. Of 95 MIs corresponding to all possible paths to add to the model structure, only 4 of them independently exceeded a value of 10.00. These parameters corresponded to the following: (a) in the 3rd and 4th graders, freeing paths from Depression to Panic (MI = 17.18); (b) in the 3rd and 4th graders, freeing a path from Depression to Generalized Anxiety (MI = 10.89); (c) in the 7th and 8th graders, freeing a path from Depression to OCD (MI = 10.32); and (d) in the 11th and 12th graders, freeing a path from Depression to Separation Anxiety (MI = 10.41). These indices appeared to suggest possible problems with children's discrimination of depression from dimensions of panic, generalized anxiety, and OCD at various ages. Nevertheless, these MIs were extremely small relative to sample size, and because no theoretical arguments supported further modification to the model, this same general model was retained for further analyses.

Next, a model constraining all parameters to be equal across groups was tested. This model significantly degraded fit (see Table IV, row 2). To localize the source of these differences, specific sets of paths were again constrained allowing for comparisons with the unrestricted model. Constraining the paths representing the effects of latent variables on each other to equivalence across groups led to a significant increase in the χ^2 (see Table IV, row 3), suggesting that the values for at least some of

Table IV. Effects of Model Constraints Across Grade Levels in a Multisample Analysis

Parameters	χ^2	*df*	*p*	Difference from full model χ^2	*df*	*p*
None (full model)	2726.51	1485	.0000	—	—	—
All parameters	4338.26	1809	.0000	1611.75	324	.0000*
All paths relating effects of latent variables on each other	2818.77	1533	.0000	92.26	48	.0001*
Covariance matrix of NA and PA	2737.55	1493	.0000	11.04	8	.1994
All paths from latent variables to indicators (i.e., factor loadings)	3806.39	1665	.0000	1079.88	180	.0000*
All paths relating the effects of disorders on PH	2754.26	1501	.0000	27.95	16	.0321*
GA to PH only	2738.74	1489	.0000	12.23	4	.0157*
DEP to PH only	2731.46	1489	.0000	4.95	4	.2925
SEP to PH only	2736.91	1489	.0000	10.40	4	.0342*
P to PH only	2731.09	1489	.0000	4.57	4	.3343
All paths from NA and PA to disorders	2775.13	1517	.0000	48.62	32	.0301*
PA to DEP only	2727.18	1489	.0000	0.67	4	.9550
NA to all disorders	2767.85	1509	.0000	41.34	24	.0153*
NA to SEP	2741.54	1489	.0000	15.03	4	.0046*
NA to SOC	2731.63	1489	.0000	5.12	4	.2752
NA to OC	2728.48	1489	.0000	1.97	4	.7413
NA to P	2742.36	1489	.0000	15.85	4	.0032*
NA to GA	2738.39	1489	.0000	11.88	4	.0183*
NA to DEP	2731.93	1489	.0000	5.42	4	.2469
NA to PH	2730.40	1489	.0000	0.389	4	.4211

Note. NA = Negative Affect; PA = Positive Affect; PH = Physiological Hyperarousal; SEP = Separation Anxiety; SOC = Social Anxiety; OC = Obsessions and Compulsions; P = Panic; GA = Generalized Anxiety; DEP = Depression. $^*p < .05$.

these parameters differed across groups. Constraining the variances of the NA and PA did not significantly degrade model fit (see Table IV, row 4). A test constraining the measurement parameters to be equivalent across groups also degraded fit significantly. Examination of the within-group solutions suggested that the loadings of indicators on their latent variables increased slightly after 4th grade. Mean factor loadings for the indicators were 3rd and 4th, $M = 0.70$, $SD = 0.06$; 5th and 6th, $M = 0.73$, $SD = 0.07$; 7th and 8th, $M = 0.73$, $SD = 0.07$; 9th and 10th, $M = 0.73$, $SD = 0.07$; and 11th and 12th, $M = 0.73$, $SD = 0.06$.

Because of the finding that relations among latent variables were different across groups, the interaction of these parameters with grade level was examined in more detail. A model constraining only the paths from anxiety and depression variables to PH to be equivalent across groups significantly degraded model fit (see Table IV, row 6). To narrow the focus still further, each of these paths was constrained in separate analyses. These tests revealed that the path from Panic to PH and from Depression to PH did not change significantly across grade levels (i.e., panic effects remained uniformly high across grade level, and depression effects remained uniformly low across grade level). However, the paths from Generalized Anxiety to PH and from Separation Anxiety to PH did change across grade levels. These parameter estimates across grade level are shown in Fig. 3. Inspection of these coefficients suggested that the relation of Generalized Anxiety to PH generally decreased across grade level, and the relation of Separation Anxiety to PH tended to increase across grade level.

Similar tests were then conducted to examine interaction of grade level with the effects of NA and PA on other variables in the model. Constraining these parameters to be equivalent across grade levels produced a significant drop in model fit (see Table IV, row 10). Further examination revealed that these differences were largely attributable to effects of grade level on the paths from NA and not the path from PA (see Table IV, rows 11 and 12). In other words, the path from PA to Depression remained uniform across grade levels. Tests constraining individual parameters from NA demonstrated significant differences across groups for the paths from NA to Separation Anxiety, NA to Panic, and NA to Generalized Anxiety. These parameters appear in Fig. 4 and generally showed minor decreases across grade level.

DISCUSSION

The findings confirm many of the basic tenets of the tripartite model in children and adolescents. For example,

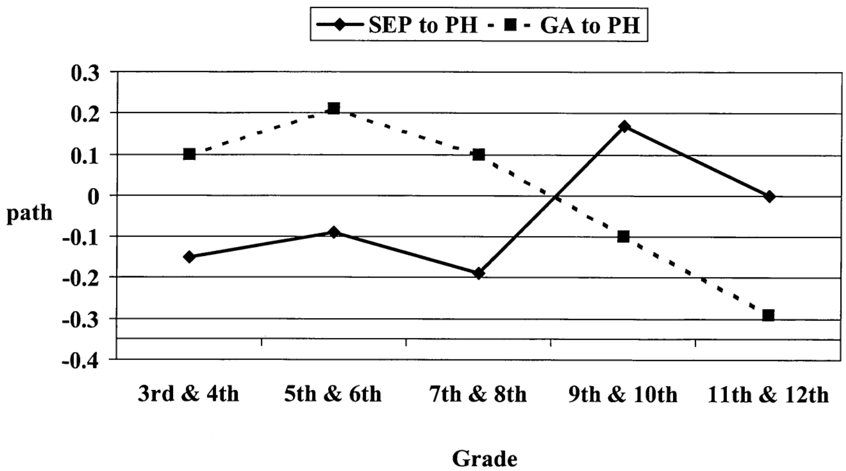

Fig. 3. Changes in effects of generalized anxiety and separation anxiety on PH across grade level. (PH = Physiological Hyperarousal; SEP = Separation Anxiety; GA = Generalized Anxiety.)

the best fitting overall model posited NA and PA as orthogonal factors, showed PA to be negatively correlated with depression, and showed NA to be positively correlated with depression and anxiety. Given that this model has been evaluated in adult and child samples, both clinical and nonclinical, the model appears to be reasonably robust. Moreover, the model appears not to be an artifact of a single measurement strategy, as the present findings resulted from assessment measures developed independently from the more traditional Positive and Negative Affect Scales (PANAS; Watson, Clark, & Tellegen, 1988) and the child version (Laurent et al., 1999). The generalizability of the model is also demonstrated through the suggestion of uniformity in the multisample analyses. Consistent with the findings of Lonigan et al. (1999), the factorial and convergent validity of NA and PA in this sample were generally consistent across grade level and across gender.

Few studies have evaluated PH in the context of child psychopathology measures, and the present findings suggest that PH may not possess a general relation with all anxiety dimensions. Rather, consistent with the findings of Brown et al. (1998), PH was positively associated with Panic only. The finding that PH best fits the model when specified at a lower conceptual level also supports the idea that although NA and PA appear to be temperamental in nature (Clark et al., 1994), PH may represent a more transient emotional dimension (Lonigan & Phillips, 2001). This same pattern was identified by Brown et al. (1998),

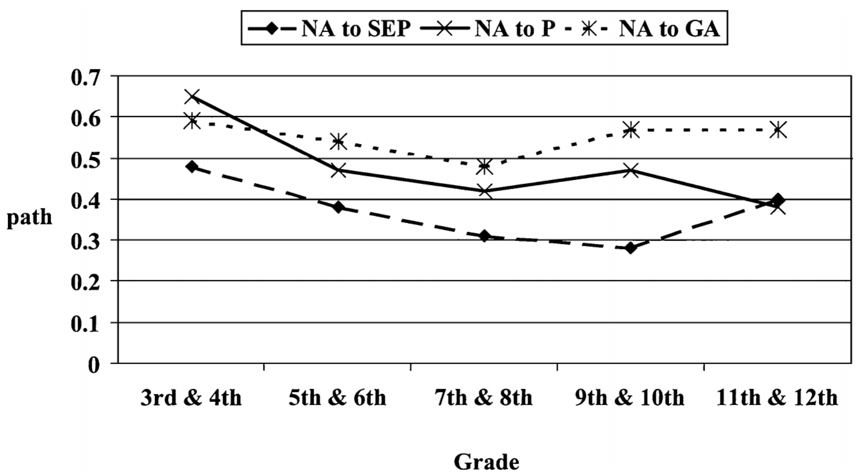

Fig. 4. Changes in effects of NA on separation anxiety, panic, and generalized anxiety across grade level. (NA = Negative Affect; SEP = Separation Anxiety; P = Panic; GA = Generalized Anxiety.)

who found superior model fit when specifying PH as a lower-order factor.

Brown et al. (1998) also found that Generalized Anxiety and PH were negatively associated in their final model; however, this pattern did not emerge in this study. Although speculative, one explanation for this inconsistency may involve developmental changes in the nature of worry, particularly with regard to its physiology. The developmental changes associated with worry are well documented (Vasey & Daleiden, 1994), as are the specific physiological correlates of worry in adults (Borkovec, Shadick, & Hopkins, 1991). The collective findings suggest that a formal worry process may begin later in development, and that while central nervous system arousal better characterizes worrying in adults, autonomic arousal better characterizes worry in children (e.g., Marten et al., 1993; Tracey, Chorpita, Douban, & Barlow, 1997). In the diagnostic classification system, these differences were previously addressed with the diagnosis of Overanxious Disorder for children (APA, 1987) and are now handled by having a lower threshold for children on the associated symptom criterion for Generalized Anxiety Disorder (APA, 1994). Our exploratory finding of a decreasing trend in the relation between Generalized Anxiety and PH is consistent with the notion of a changing somatic profile for worry over development. Again, these findings are preliminary and merit considerable additional investigation.

Another interesting finding that emerged involved the measurement of Separation Anxiety in adolescents. The tendency for the association of Separation Anxiety and PH to increase with grade level was initially somewhat surprising, particularly in light of the findings of Last (1991) that demonstrated higher levels of somatic complaints in separation anxious children relative to other children with anxiety disorders. However, inspection of the items on the Separation Anxiety scale revealed that some items were likely measuring different constructs in children than in adolescents. For example, the items "I'm afraid of being in crowded places," "I have trouble going to school in the morning," and "I would feel scared if I had to stay away from home overnight" suggest that adolescents with agoraphobic concerns should score high on the Separation Anxiety scale. In this sense, the increasing relation observed between Separation Anxiety and PH is likely an artifact of the lower discriminant validity (or poor scale naming) of the Separation Anxiety scale in older children.

Some caveats are important to address with respect to these findings in general. One point of concern involves the singular reliance on self-report measures to assess the constructs of interest (Cole, Truglio, & Peeke, 1997). As has been discussed elsewhere, monomethod assessment can yield problems distinguishing trait variance from method variance. Nevertheless, given the poor correspondence between child report and observer report of negative affect (Achenbach, McConaughy, & Howell, 1987; Loeber, Green, & Lahey, 1990), it was felt that the fine distinctions among internalizing affective factors necessary to detail such a model could only be obtained through the child's perspective (see Lonigan et al., 1999), and that observer report would not have yielded a sufficiently valid measurement tool. Given that these issues were investigated in a nonclinical sample and bear replication in children with anxiety and depressive disorders, it may be helpful to consider inclusion of clinician report (which may have greater correspondence with child report) in future models, particularly with respect to the *DSM* dimensions.

In a related fashion, one must be careful not to conclude that the anxiety and depression dimensions in these models are equivalent to true disorders. The relationship of self-reported dimensions of anxiety disorders to actual diagnoses is only beginning to be understood (e.g., Beidel, Turner, & Fink, 1996; Chorpita, Tracey, Brown, Collica, & Barlow, 1997). Nevertheless, preliminary data from clinical samples on the relation of these measures to diagnoses are supportive (Moffitt, Gray, & Chorpita, 2000).

Another issue that may need to be addressed in future studies involves the implications of such a model for longitudinal influences. Although much has been written about the temperamental nature of NA and PA (e.g., Clark et al., 1994; Lonigan & Phillips, 2001), most research on the tripartite model in children has been purely cross-sectional (although see Lonigan, Kistner, Hooe, & David, 1997). Investigations of the relation of tripartite factors to specific anxiety disorder and depression dimensions over time will have important implications for understanding the development of these disorders and hence for their early identification and treatment. Presumably, NA and PA should be better predictors of future affective pathology than symptom or diagnostic measures.

As suggested by Cronbach and Meehl (1955), "learning more about a theoretical construct is a matter of elaborating the nomological network in which it occurs, or of increasing the definiteness of its components" (p. 290). This is certainly the case with anxiety and depression in children. As these findings continue to point to higher-order relations among affective and symptom dimensions and highlight important differences among the anxiety disorders, the imperative to refine and evaluate assessment measures for these constructs is clear. Along those lines, the present finding that dimensions of specific anxiety disorders relate differently to dimensions of affect suggests that the measurement of childhood negative emotions will likely benefit from increased specificity of its measures. The ubiquitous observation that most childhood anxiety and depression measures appear to tap a single, higher-order construct (Joiner et al., 1996; Lonigan et al., 1994; Wolfe et al., 1987) could perhaps be addressed by considering separately items that measure dimensions of mood and affect from those that measure specific symptoms of psychiatric disorders. This general idea is consistent with the assertion of Lonigan et al. (1999) that the difficulty discriminating childhood anxiety from depression may be more a problem of measurement than a problem of construct overlap. Future research on the assessment of negative emotions and their disorders in children should consider the existence of multiple conceptual strata when detailing the relations among these dimensions.

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