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Latent class analysis of co-occurring symptoms in a sample of youth referred for anxiety disorders

Jessica Dahan

Florida International University

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FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

**LATENT CLASS ANALYSIS OF CO-OCCURRING SYMPTOMS
IN A SAMPLE OF YOUTH REFERRED FOR ANXIETY DISORDERS**

A thesis submitted in partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE

in

PSYCHOLOGY

by

Jessica Dahan

2011

To: Dean Kenneth Furton
College of Arts and Sciences

This thesis, written by Jessica Dahan, and entitled Latent Class Analysis of Co-Occurring Symptoms In a Sample of Youth Referred for Anxiety Disorders, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this thesis and recommend that it be approved.

Jeremy Pettit

William Kurtines

Wendy K. Silverman, Major Professor

Date of Defense: March 3, 2011

The thesis of Jessica Dahan is approved

Dean Kenneth Furton
College of Arts and Sciences

Interim Dean Kevin O'Shea
University Graduate School

Florida International University, 2011

ABSTRACT OF THE THESIS

LATENT CLASS ANALYSIS OF CO-OCCURRING SYMPTOMS

IN A SAMPLE OF YOUTH REFERRED FOR ANXIETY DISORDERS

by

Jessica Dahan

Florida International University, 2011

Miami, Florida

Professor Wendy K. Silverman, Major Professor

The current study applied Latent Class Analysis methods to identify internalizing and externalizing symptoms in a sample of children and adolescents referred for anxiety disorders. Covariates, assessed from the perspective of youth and parents, included youth friendship (positive, negative), youth social skills, parental control, and parental acceptance were used to further distinguish the classes.

Overall, results indicated that a three class solution fit the data best. The first class, consisting of 36 participants (16%) was labeled the Internalizing-Externalizing Class. Class 2, the Anxious-Depressed Class consisted of 94 participants (43%). Lastly, Class 3, labeled the Non-Clinical Class included 90 participants (41%).

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I. INTRODUCTION

Adapted relatively recently in the fields of psychology and psychiatry for classification, Latent Class Analysis is a useful approach for identifying patterns of co-occurring internalizing and externalizing symptoms in child and adolescent groups. Unlike traditional structural equation modeling (SEM), which focuses on relations or correlations between variables, latent class analysis (LCA) is a method for identifying and classifying individuals with diverse symptoms. Latent Class Analysis is used to identify exclusive groups or classes based on individuals' responses to certain items on standardized questionnaires.

No study has applied LCA methods to identify patterns of co-occurring internalizing and externalizing symptoms in children and adolescents referred for anxiety disorders. The absence of such research is surprising given research showing that anxiety disorders, depressive disorders, and externalizing disorders have high rates of co-occurrence, or comorbidity, in clinical samples (e.g., Wadsworth, Hudziak, Heath, & Achenbach, 2001; Biederman, Mick, & Faraone, 1998; Achenbach, 1997) and community samples (e.g., Axelson & Birmaher, 2001; Biederman, Faraone, Mick & Lelon, 1995; Cohen, Cohen, Kasen, Velez, Hartmark, Johnson, et al., 1993). A major reason for high comorbidity is the extensive symptom overlap that exists among disorders. Studies estimate that the range of overlapping symptoms is anywhere from 32% (Kovacs, Gatsonis, Paulauska, & Richards, 1989) to 62% (Masi, Mucci, Favilla, Romano, & Poli, 1999), indicating symptom overlap is high (Brown, Chorpita, & Barlow, 1998).

Latent Class Analysis has been applied to identify youths' internalizing symptoms (i.e., anxiety, depression, or both) (i.e., Ferdinand, van Lang, Ormel, & Verhulst, 2006; Ferdinand, de Nijs, van Lier, and Verhulst, 2005; Wadsworth, Hudziak, Heath, & Achenbach, 2001). These studies have varied by type of samples (referred, non-referred), informant source (youth, parent), or both. For example, using the Child Behavior Checklist Anxious/Depressed Scale (CBCL-A/D; Achenbach, 1991) with non-referred (n = 1,987; 4 -18 years) and referred (n = 1,987; 4 -18 years) youth, Wadsworth et al. (2001) found no classes of anxiety or depressive symptoms specifically. Instead, three classes were identified of the *mixed* anxiety and depressive symptom type; all of which differed by symptom severity/frequency (mild, moderate, severe).

In another study, Ferdinand et al. (2005) used the Youth Self-Report (YSR; Achenbach & Edelbrock, 1987) with a group of referred children and adolescents (N= 2032; 11- 18 years) to identify youths' internalizing symptoms (i.e., anxiety, depression, or both). In this study, three anxiety problems and four depressive problems classes were identified. These classes all differed by symptom severity/frequency (not at all, sometimes, often).

Using a non-referred sample (N = 2210; 10 - 12 years), this same investigative team (Ferdinand et al., 2006) used the youth self report questionnaire, the Revised Child Anxiety and Depression Scale (RCADS; Chorpita, Yim, Moffitt, Umemoto, Francis, et al., 2000), to identify youths' anxiety symptoms (depression symptoms were not focused on in this study). Only classes that differed by severity/frequency (never, sometimes, often, always), not type, were found in this study. Specifically, five anxiety classes were found but none of these classes contained the symptoms of a single DSM-IV anxiety disorder only (e.g., not just Separation Anxiety Disorder symptoms).

Overall, past applications of LCA methods to identify internalizing symptoms in children and adolescents have revealed inconsistencies. These inconsistencies include whether the classes revealed differ by, symptom type, symptom severity/frequency, or both. Further, none of the studies have applied LCA methods to a sample of youth referred specifically for anxiety problems.

II. THE PRESENT STUDY

The present study applied LCA methods to identify patterns of co-occurring internalizing *and* externalizing symptoms in children and adolescents referred for anxiety disorders. We used LCA methods to identify the number and types of classes using parent report data obtained from the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001). Once these classes were identified, we used the parent rated Revised Children's Manifest Anxiety Scale (Reynolds & Richmond, 1978), to test convergent validity of the identified classes. In line with prior research demonstrating that parent reports of anxiety symptoms are positively associated with behavioral and emotional problems (Lewinsohn, Klein, & Seeley, 1995), we expected to find significant class differences in anxiety symptom levels. Additional variables relating to youths' daily functioning (social skills, positive/negative friendships as rated by both parent and child), youths' relationship to parents (parental acceptance/control as rated by both parent and child), and clinician rated functional impairments (CGAS) were include as concurrent covariates. We analyzed whether these covariates predicted class membership to further demonstrate the validity of identified classes (Walrath et al., 2004).

Thus, the present study extends past research in several ways. The first is in its application of LCA methods to identify patterns of not only internalizing symptoms, but also internalizing and externalizing symptoms in a sample of youth referred to an anxiety

clinic. The study also extends past research by being the first to use a sample of children and adolescents referred for anxiety disorders. As such, the study represents an effort to begin to discern the extent to which past studies' sampling frames may influence LCA results. A final extension was the study's use of concurrent covariates, described above. These variables were selected as covariates given research showing that each of them is associated with youths' internalizing and externalizing symptoms (Barber, 1996; La Greca & Stone, 1993; Strauss, 1987).

III. METHODOLOGY

Participants

Participants were 224 youth (54% males) and their parents who presented to an anxiety disorders specialty research clinic. The youth were 6 to 16 years of age ($M = 9.90$ years, $SD = 2.32$); 77% were Hispanic/Latino. All youth were referred to the Child Anxiety and Phobia Program at Florida International University by school counselors, psychiatrists, pediatricians, and other mental health professionals because children had difficulties with excessive fear and/or anxiety. Exclusionary criteria were developmental delays (e.g., Asperger's syndrome, mental retardation, autism) or severe psychopathology (e.g., schizophrenia). The initial screening was done using a standard telephone consultation used within the Program.

Measures: Class Indicator

Child Behavior Checklist (CBCL) (Achenbach & Rescorla, 2001). The CBCL was completed by parents to assess for behavioral and emotional problems in their child. The CBCL consists of 118 items to assess specific behavioral and emotional problems. These items are rated on a 3-point scale ($0 = not\ true$; $1 = somewhat\ or\ sometimes\ true$;

2 = *very true or often true*). The CBCL contains narrowband subscales; all of which were used in this study. These scales are: Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problems, Thought Problems, Attention Problems, Rule-Breaking Behavior, and Aggressive Behavior. Each scale's T score was used to determine whether a participant's scores was in the nonclinical range (T score = 64 or lower), borderline or subclinical range (T score = 65-69), or clinical range (T score = 70 or higher) (Achenbach & Rescorla, 2001). For the purpose of this study, a score of 70 or above was considered clinical and a score of 69 or below was considered non-clinical.

Primary Validation Measures

Children's Manifest Anxiety Scale – Revised (parent version; RCMAS/P). The RCMAS/P, revised from Reynolds & Richmond (RCMAS; 1978) is a 28-item self-rating scale to which respondents indicate either *Yes* or *No* to anxious symptoms. The wording of RCMAS items was changed from, "I..." to "My child..." and each item was rated Yes or No and scored 1 or 0. The items are summed to yield a Total Anxiety score. The alpha coefficient in the present sample was 0.63.

Covariate Measures

Parenting Behavior Inventory. (Child Report/Parent Report; Schludermann & Schludermann, 1970). This measure has 3 subscales, Psychological Control, Acceptance, and Firm/Lax Control, each of which contains ten questions. In this study, the Psychological Control and the Acceptance subscales were used. Child and parent ratings on the Parenting Behavior Inventory has been used in samples of children and adolescents referred to youth anxiety disorder specialty clinics and have been found to have satisfactory psychometrics (Siqueland, Kendall, & Steinberg, 1996). Test-retest

reliability for the parent and child subscale versions have been reported as 0.79 and 0.74, respectively (Schluderman & Schluderman, 1988). The alpha coefficient for the youth report was 0.83 and 0.75 for the parent report in the current study.

Social Skills Rating System. The Social Skills Rating System (Child Report/Parent Report; Gresham & Elliott, 1990) provides a comprehensive assessment of the social skills behaviors of youth from several perspectives. The Social Skills Rating System student/youth form consists of 34 questions; the parent form consists of 38 questions. Gresham and Elliot (1990) provide extensive data supporting the scale's validity including content, social, criterion, and construct. The total score of the Social Skills Rating System was used in the current study. The alpha coefficients for the youth and parent versions of the Total scale score in the current sample were 0.86 and 0.89, respectively.

Friendship Questionnaire. The Friendship Questionnaire (Child Report/Parent Report; Bierman & McCauley, 1987) was used to evaluate youth's peer-youth relationships. The Friendship Questionnaire contains 40 items that fall into 3 factors: Positive Interactions, Negative Interactions, and Extensiveness of Peer Network. Although the questionnaire includes eight open-ended questions about youths' friends, enemies, and peer interactions, relevant to the present study are the 32 items to which respondents rate the frequency of positive and negative interactions with peers. The alpha coefficients for the youth and parent versions of the Positive subscale and the negative subscale in the current sample were .85 and .89 (youth rated) and .79 and .88 (parent rated), respectively.

Children's Global Assessment Scale (Clinician Report; CGAS; Bird, Schaffer, Fisher, Gould, & Brasic 1993). The CGAS is a clinician rating scale designed to measure the general functional impairment of youth under age 18 in the critical domains of school, family, peer relationships, and personal distress. CGAS ratings range from 1 to 100 and are divided into increments of 10 that assess for functioning. Scores less than 67 denote placement in the clinical range. Inter-rater reliability of the CGAS has yielded an intra-class coefficient of .66 (Bird et al., 1993).

Procedures

The study's questionnaires were administered by research assistants after parents provided informed consent and youths provided informed assent. All research assistants received training in the proper administration of the questionnaires by doctoral students supervised by the program director. Research assistants underwent thorough training of procedural protocols including familiarizing themselves with the questionnaires and observing others administer the questionnaires to ensure familiarity with protocol. Participants received their own version of questionnaires and the research assistants were trained to read aloud the questionnaires' items and not to observe the youths' responses. The doctoral students provided guidance and ongoing feedback to the research assistant administering the questionnaires throughout the study.

Data Analytic Plan

The Latent Class Analysis was conducted using *Mplus*, version 5.0 (Muthen & Muthen, 2007). The LCA results identify class membership of internalizing and externalizing symptoms based on parents' responses to CBCL narrowband subscales. Multiple statistical indicators were used to determine the best fitting model in terms of

the number of classes (Nylund, 2007). The following indicators were used: the Akaike Information Criterion (AIC; Akaike, 1974), Bayesian Information Criterion (BIC; Schwartz, 1978), the sample size adjusted BIC (SSABIC; Sclove, 1987), and the Bootstrap Likelihood Ratio Test (BLRT). The model that generates the smallest values on the fit indices indicates the best-fitting model (Table 1).

Two types of parameters were used to identify the probabilities: Item probabilities and class probabilities. Item probabilities are parameters that represent a given class and describe the probability a child was rated by his or her parent as being in the clinical range on each subscale. For example, an item probability of 0.90 means a child had a 90% probability of being rated by his or her parent as being in an identified class using a specific the CBCL narrowband subscales. Class probabilities are parameters that represent the probability that a given class characterizes within the total sample. For example, a class probability of 0.30 means an identified class had a 30% probability of being contained within the total sample.

In the first phase of the LCA, we tested the measurement model. The second phase of the LCA focused on validating the measurement model and describing the heterogeneity of the identified latent classes. The primary validation measure and the concurrent covariates, all rated by both youth and their parents, were used for this purpose. As noted, the primary validation measure was the RCMAS/P. The concurrent covariates were: parental acceptance, parental control, youth social skills, youth positive friendships and negative friendships, as well as clinician rated CGAS. All were analyzed using multinomial logistic regression analyses. First, the identified class with the lowest CBCL narrowband subscale scores served as the study's first reference class.

Subsequently, the reference class was replaced by the remaining identified classes so that all classes could be compared with each other.

IV. RESULTS

Latent Class Analysis

A three-class solution fit the data best to identify patterns of co-occurring internalizing and externalizing symptoms in a sample of referred to a youth anxiety disorders specialty research clinic. This was evidenced by the BIC (2764.415), AIC (2653.573), SSABIC (1346.889) and BLRT ($p < 0.000$) (see Table 1). Moving from a three- to four-class solution did not result in a statistically better fitting model. Figure 1 displays the class probabilities and item probabilities of the CBCL narrowband symptom scales. These are best understood by symptom *type* and symptom *severity*.

As Figure 1 illustrates, Class 1 contained youth who were rated highest by their parents on all the CBCL narrowband scales than youth in the other two classes. Class 1 ($n = 36$; 16%), which we refer to as Internalizing-Externalizing, showed *severe* levels of all *types* of symptoms contained on the CBCL subscales. Class 2 contained youth who were rated higher by their parents than the youth in Classes 1 and 3 on the Anxious-Depressed subscale only, not any other CBCL subscale. Class 2 ($n = 94$; 43%), which we refer to as Anxious-Depressed, showed moderate levels of all *types* of symptoms contained on the CBCL subscales, but *severe* levels of anxious/depressed symptoms, contained on the Anxious/Depressed subscale. The final class, Class 3, contained youth who were rated lower by their parents on the CBCL narrowband subscales. This class ($n = 90$; 41%), which we refer to as the Low Severe class, showed low levels of all *types* of symptoms contained on the CBC subscales, but not enough to warrant clinical range.

There were no sex differences among the three classes. Non-significant findings using multinomial logistic regression indicated that the classes did not differ by age.

Class Validation

Parent ratings on the RCMAS were used to offer an independent test of the convergent validity of the three classes (Table 2). As expected, parents of children in Class 1 (Internalizing-Externalizing) rated their children significantly higher in anxiety than parents of children in Class 3 (Low Severe) (OR= 2.273 and CI = 1.120-4.612). Further evidence of convergent validity was the finding that parents of children in Class 3 rated their children lower in anxiety than parents of children in Class 2 (OR = 1.773 and CI = 1.224-2.567).

Concurrent Covariates

To describe the differences between the identified latent classes, the concurrent covariates were regressed on to the classes. Class 3, which contained children with the lowest CBCL narrow-band subscale scores, served as the study's reference class (i.e., Low Severe class or Class 3). Table 2 presents log odds coefficients and odds ratio for the covariates that were found significant: youth positive and clinician rated CGAS scores. Three sets of comparisons were made for each covariate to describe the differences between: (1) Internalizing-Externalizing Class vs. Low Severe Class (2) Anxious-Depressed Class vs. Low Severe Class, and (3) Internalizing-Externalizing Class vs. Anxious-Depressed Class. Using these concurrent covariates to demonstrate item probabilities, these classes were found to differ by symptom severity (i.e., low severe, moderate severity, high severity).

Parent Rated Covariates. Parents of children in the Internalizing-Externalizing class rated their child as having less positive friendships (OR= 0.876 and CI = 0.876-0.876) than parents of children in the Low Severe class. With respect to the Anxious-Depressed class and the Low Severe class, parents of children in the former class rated their children as having less positive friendships (OR= 0.945 and CI = 0.945-0.945) than parents of children in the latter class.

Youth Rated Covariates. None of the youth rated covariate measures differentiated the three classes.

Clinician Rated Covariates. Youth in the Anxious-Depressed class were rated significantly more functionally impaired by clinicians on the CGAS than youth in the Low Severe class (OR = 0.796 and CI = 0.549-1.052). Similarly, youth in the Internalizing-Externalizing class were rated significantly more functionally impaired by clinicians on the CGAS than youth in the Non-Severe class (OR = 0.760 and CI = 0.608-1.042).

V. DISCUSSION

This is the first study to apply LCA methods to identify patterns of co-occurring internalizing *and* externalizing symptoms in children and adolescents referred for anxiety disorders. The findings revealed that these youth can be classified into three distinct class types: Internalizing/Externalizing, Anxious-Depressed, and Low Severe. These three classes differed not just by *type*, but also by *severity/frequency*: Members of the Internalizing/Externalizing class and members of the Anxious-Depressed were more severe in symptomatology than the Low Severe class. Youth members of both the Internalizing-Externalizing class and the Anxious-Depressed class had a significantly higher probability of being in the clinical range on all CBCL narrowband subscales than

the Low Severe class. The youth members of the Low Severe class had a significantly lower probability of being in the clinical range on all the CBCL narrowband subscales.

Similar to past research, the classes found in this study differed by symptom *severity/frequency* (Ferdinand et al., 2005; Ferdinand et al., 2006; Wadsworth et al., 2001). It is interesting that the results revealed that the classes differed by symptom *type* given that all the youth participants were referred to an anxiety disorders specialty clinic.

Given that the participants were referred to an anxiety disorders specialty clinic, 43% were found to be in the Anxious-Depressed class. This class was characterized at low levels of severity across all other symptoms (e.g., somatic, withdrawn, social, attention, thought) except for anxiety and depression. This finding is consistent with past research showing that children referred to an anxiety clinic may not necessarily only be restricted to “pure” classes of anxiety and instead may demonstrate comorbidity with internalizing and/or externalizing problems (Saavedra & Silverman, 2002; Kendall, Brady, & Verduin, 2001; Last, Strauss, & Francis, 1987; Strauss, Last, Hersen, & Kazdin, 1988).

A relatively small percentage (16%) of the sample was assigned to the Internalizing-Externalizing class, characterized by severe levels of all eight CBCL narrowband scales (rule-breaking behavior, anxious-depressed, somatic concerns, withdrawn-depressed, social concerns, attention problems, thought problems, aggressive behavior). Past research reveals high rates of co-occurring symptoms of internalizing and externalizing disorders in youth (e.g., Wadsworth, Hudziak, Heath, & Achenbach, 2001; Biederman, Faraone, Mick & Lelon, 1995). More research is needed to better understand the specific co-occurring *types* of internalizing and externalizing symptoms of children and adolescents.

Lastly, the Low-Severe class consisted of 41% of the youth in our sample; this class was characterized by low to moderate levels of all eight CBCL narrowband scales (rule-breaking behavior, anxious-depressed, somatic concerns, withdrawn-depressed, social concerns, attention problems, thought problems, aggressive behavior). The parents of these children and adolescents did not endorse symptoms from the CBCL narrowband scale severe enough to warrant clinical rating. Future research is needed to better identify the unique characteristics and/or concurrent covariates, if any, that differ this class from the Internalizing-Externalizing class.

Finally, concurrent covariates were used to further differentiate the identified classes. The following covariates displayed differential effects among the three classes: positive friendships (as rated by the parent) and CGAS score. Thus, significant levels of youth with internalizing/externalizing symptoms, as well as internalizing symptoms alone, demonstrated lower positive friendships with peers. This is not a surprising finding given that problematic peer relationships have been found to be associated with moderate to severe negative mental health outcomes in youth (Parker & Asher, 1987). Research indicates that youth who are isolated and rejected by their peers report high rates of internalizing problems such as depression, anxiety, and loneliness (e.g., La Greca & Stone, 1993; Strauss, Lahey, Frick, Frame, & Hynd (1988) and high rates of externalizing behavior problems (Kupersmidt, Coie, & Dodge, 1991; Parker & Asser, 1987). Perhaps future research may aim to specify the direction, if any, of such a relationship.

Significant differences in functional impairment also were evident between the Anxious-Depressed and Low Severe class. Compared to the Low Severe class, members of the Anxious-Depressed class were more likely to receive lower CGAS scores. Likewise, compared to the Low Severe class, members of the Internalizing-Externalizing

class were more likely to receive lower CGAS scores. The CGAS ratings validate the classes because this clinician rated scale has been seen as a helpful measure to rate a child's overall interference (Shaffer, Gould, Brasic, et al., 1983) and a child's overall competence (Green, Shirk, Hanze, Wanstrath, 1994).

Youth rated measures did not differentiate the three classes. Further investigation of the low concordance between the informants in this study is needed. It would be beneficial to use the youth self-report form of the CBCL to assess for relationship, if any, to youth rated concurrent covariates. Perhaps using both the child and parent rated CBCL primary measure, as well as both the child and parent rated concurrent covariates may help obtain more consistency over the results.

Limitations and Future Research Directions

Although the present study made an important contribution by using LCA methods to identify classes of co-occurring internalizing and externalizing symptoms in children and adolescents referred to an anxiety clinic, there are study limitations. First, the generalizability of the study's findings to other types of samples, especially given the large number of Hispanic participants, is unclear and requires further study. Second, the limited sample size may influence the representation of the three classes that were found. Third, the use of additional covariates regressed onto the identified classes may have distinguished the severity of the classes further.

In summary, the present study extends the limited literature regarding co-occurring symptoms of internalizing and externalizing disorders using a sample of youth referred for anxious disorders. Further investigation of these classes across different samples with additional informants will offer an even more comprehensive picture of

child and adolescent internalizing and externalizing disorders. Such work has the potential to advance understanding of the nature of psychopathological conditions in young people.

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Table 1*Fit Indices for Latent Class Model with 2-5 Classes*

Number of classes	df	BIC	AIC	Entropy	SSABIC	BLRT
2	997	2765.14	2692.4	0.751	1368.545	P<0.005
3*	988	2764.415	2653.573	0.791	1346.889	P<0.000
4	978	2789.192	2640.247	0.794	1350.733	P <0.05
5	968	2817.037	2629.99	0.895	1357.266	P > 0.05

Note. df is the degrees of freedom, BIC is the Bayesian Information Criterion (Schwartz, 1978), AIC is the Akaike Information Criterion (Akaike, 1974), SSABIC is the sample size adjusted BIC (Sclove, 1987), and BLRT is the Bootstrap Likelihood Ratio Test.

Table 2*Log Odds Coefficients and Odds Ratio for Three-Class Model with Parent Covariates*

COVARIATES	REFERENCE CLASS	COMPARISON CLASS	95 % CI	LOGIT	P-VALUE	ODDS RATIO
RCMAS (parent rated)	Class 1	Class 3	1.120- 4.612	0.821	P< .05	2.273
CGAS (clinician rated)	Class 1	Class 3	0.549- 1.052	-0.275	P< .05	0.760
POSITIVE FRIENDSHIP (parent rated)	Class 1	Class 3	0.876- 0.876	-0.133	P< .05	0.876
RCMAS (parent rated)	Class 2	Class 3	1.224- 2.567	0.573	P< .05	1.773
CGAS (clinician rated)	Class 2	Class 3	0.608- 1.042	-0.229	P< .05	0.796
POSITIVE FRIENDSHIP (parent rated)	Class 2	Class 3	0.945- 0.945	-0.057	P< .05	0.945

Note. Class 1 is the Internalizing/Externalizing Class, Class 2 is the Anxious/Depressed Class, Class 3 is the Low Severe class, RCMAS is the Children's Manifest Anxiety Scale- Revised, CGAS is the Children's Global Assessment Scale (Bird, Schaffer, Fisher, Gould, & Brasic, 1993).

Figure 1 Item probabilities for the three class solution

