The Pennsylvania State University
The Graduate School
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LATENT CLASS STRUCTURE OF CAREGIVER STRAIN IN PARENTS OF CHILDREN DIAGNOSED WITH ADHD: THE ROLE OF RACE/ETHNICITY, GENDER, EDUCATION, AND INCOME

A Thesis in
Health Policy and Administration

by

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ABSTRACT

Background: Attention-Deficit/Hyperactivity Disorder (ADHD) is the most common neurobehavioral disorder among school-age children. Children diagnosed with disabilities such as ADHD are often associated with disruptions in family functioning and increased levels of caregiver strain. Parenting of children with ADHD varies with gender and race/ethnicity; however, little work has investigated any differential impact that these and other factors can have on the amount of stress reported by parents of children with ADHD.

Methods: Data from the 2003 National Survey of Children’s Health was used to examine caregiver strain among parents of children diagnosed with ADHD. Latent Class Analysis was used to identify risk profiles related to caregiver strain among parents of children with ADHD. LCA is a statistical technique used to identify subgroups of individuals who share a similar pattern of responses to a set of observed items. Latent class analysis with covariates was then used to identify variations in parent associations to each of the latent classes based on race/Ethnicity, child gender, household income and education.

Results: Among the 6,513 children with ADHD, 80.1% were white, 11.5% African-American, and 8.4% Hispanic and 72.1% were boys. The analysis revealed four unique classes of caregiver strain within the population; High Strain (21.5%), Moderate – Relating (43.7%), Moderate – Giving and Caring (18.3 %), and Low Strain (16.5%). White caregivers are more than twice as likely to belong to the Moderate and High Strain classes compared to the black caregivers. Caregivers of boys are more likely to be in one of the Moderate Strain classes, caregivers of girls are slightly more likely to belong to the High Strain class. Caregivers with an education less than high school are more likely to belong to the Low Strain class, and caregivers in households with income less than 300% FPL are more than three times as likely to belong to the High Strain class.

Conclusions: These results identify a significant influence of child gender, race/ethnicity, household education and income on the type of strain reported by caregivers of children diagnosed with ADHD. The results can assist in tailoring interventions based on the proportions of parents in different caregiver strain classes.
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**Introduction**

Attention-Deficit/Hyperactivity Disorder (ADHD) is the most common neurobehavioral disorder among school-age children and is characterized by persistent inattention, hyperactivity and impulsivity (Rowland, Lesesne, & Abramowitz, 2002). As of 2003, ADHD was diagnosed in an estimated 7.8% of school-age children. Prevalence rates are the highest among non-Hispanic insured children, with males significantly more likely to have been diagnosed with ADHD than females (Centers for Disease Control and Prevention, 2005). Studies have investigated ADHD in relation to a variety of factors, including race/ethnicity, gender, and income. However, while these differences have been examined with regard to ADHD prevalence, it is not clear if any significant difference exists in the caregiver strain experienced by these different groups.

**ADHD and Family Functioning**

Caring for children with ADHD is known to have an effect on family functioning. When examining parent-adolescent interactions, groups of adolescents with ADHD have been found to have more angry conflicts at home (Barkley, 1992). Furthermore, adolescents with ADHD and their parents were both found to have more negative behaviors during discussions (Barkley, 1992; Edwards, Barkley, & Laneri, 2001). Johnston and Mash (2001) reviewed the impact of childhood ADHD on family characteristics and found that the presence of ADHD is associated with disrupted relationships, increased parenting stress and reduced parenting efficacy (Johnston & Mash, 2001). A more recent review by Harpin (2005) noted that ADHD is associated
depression in mothers, increased role dissatisfaction by parents, and increased parental alcohol consumption (Harpin, 2005).

Caring for individuals with disabilities has been linked to higher levels of psychological disturbance, such as anxiety and depression, as well as higher levels of physiological issues such as lower self-rated health and cardiovascular functioning (Schulz, O’Brien, & Bookwala, 1995). Specifically, strain among parents of children with disabilities has been associated with both psychological and physiological problems (Daniels, Moos, & Billings, 1987). Additionally, variations in parent stress levels have been associated with different ADHD-associated behaviors and varying degrees of ADHD severity (Podolski & Nigg, 2001).

The Role of Gender, Race/Ethnicity, Education, and Income

Significant gender differences exist for ADHD. Not only are males more likely to be diagnosed, but it is often found that ADHD in males is manifested predominately as hyperactivity and impulsivity and is often comorbid with oppositional behavior (R Bussing, Gary, & Mason, 2003; Maniadaki, Sonuga-Barke, & Kakouros, 2005). Furthermore, the severity of this type of behavior in males elicits the most impact on the self-efficacy of the parent and has been related to levels of parent’s reported psychological stress (Harrison & Sofronoff, 2002; Maniadaki, et al., 2005).

While gender is associated with different manifestations of the disorder, racial/ethnic differences are the most prominent disparities in the perception and management of ADHD. For instance, a study found that Hispanic and black parents of
children diagnosed with ADHD were less likely than their white counterparts to report the presence of a learning disability in the child (Pastor & Reuben, 2005). In another study, when examining ADHD-related symptoms, white parents tended to include more behaviors as attributable to the disorder than black parents of comparably hyperactive children (Hillemeier, Foster, & Heinrichs, 2007).

Race/ethnicity also play a role in the management of ADHD, as significant differences in social networks exist among races/ethnicities, and these differences influence how parents are able to manage their ADHD children. Bussing et al. (2003) found that while blacks and disadvantaged parents would often report smaller network sizes, they would report higher frequencies of contact with network members, as well as higher levels of support from the network (R Bussing, Zima, & Gary, 2003). Furthermore, black parents have been found to respond in smaller increments than white parents in caregiver strain for the same increase in child problems (Kang, Brannan, & Heflinger, 2005). McCabe et al. (2003) also found this same discrepancy in caregiver strain between whites and black. However, they were unable to attribute this difference to the discrepancies in social support, as their findings indicated less support in blacks than in whites (R Bussing, Zima, et al., 2003; McCabe, Yeh, & Lau, 2003).

The relationship between caregiver education and ADHD symptoms is often only studied indirectly as a component of SES. Caregiver education has been found to not be significantly related to the prevalence of pediatric psychiatric disorders in general (Roberts, Roberts, & Xing, 2007). Others have shown maternal education to be positively related to the probability that a child is being treated for ADHD (Currie &
Stabile, 2004). Weckerly et al., (2005) evaluated differences in symptom endorsement among caregivers with varying levels of education and found significantly lower endorsement of inattentive symptoms among caregivers with lower levels of education. This effect was not observed for the hyperactive symptoms, but such relationships raise concerns that socioeconomic factors such as education may result in discrepancies in ADHD assessments and treatments (Weckerly, et al., 2005). Beyond these associations with ADHD prevalence and identification, no work has examined any effect that caregiver education might have on the caregiver’s reported strain.

Numerous studies have investigated the role that income has on ADHD prevalence and treatment. Findings frequently support increased prevalence of ADHD diagnoses and/or symptoms among the poorest families (Froehlich, et al., 2007; Pastor & Reuben, 2005), as well as increased use of medication and mental health services among the families with higher income (Currie & Stabile, 2004; Froehlich, et al., 2007; Garland, et al., 2005; Pastor & Reuben, 2005). It is interesting to note that Currie and Stabile (2004) determined that although treatment increased with income, treatment did not increase with severity of the disorder (based on scores of symptoms) after accounting for differences in income (Currie & Stabile, 2004). That is to say, among poorer families, children with more severe ADHD are not less likely to receive treatment than their wealthier counterparts. Lower incomes were associated with an increased likelihood to be retained in grade (Currie & Stabile, 2004). Little research has evaluated income and caregiver strain together. Among caregivers of children with ADHD, higher income has been associated with reporting fewer child behaviors but not directly with distress.
(Kendall, Leo, Perrin, & Hatton, 2005). While some indirect evidence has shown that low income caregivers of children with special needs are less likely to seek and maintain employment, which may contribute to stress (Litt, 2004).

With a better understanding of how parents of children diagnosed with ADHD of different genders and races/ethnicities experience strain, intervention and assistance programs will be able to better tailor programs for parents. Furthermore, with more precise knowledge about different groups within the population, practitioners should be able to more precisely focus their resources and hopefully have a more significant impact on their target population. Hence, the purposes of this study were to (a) identify distinct typologies of caregiver strain among parents of children diagnosed with ADHD and (b) examine how race/ethnicity, gender, as well as income and education impact the level of caregiver strain reported by caregivers in a nationally representative sample of children.

**Method**

**Participants**

The data used for this study are from the National Survey of Children’s Health (NSCH), conducted by the National Center for Health Statistics (NCSH), Centers for Disease Control and Prevention (CDC). This survey is a module of the State and Local Area Integrated Telephone Survey (SLAITS) program. The NSCH randomly sampled telephone numbers to find households with children aged 0-17 and in cases of multiple children meeting the criteria, randomly selected one to be the focus of the interview. The response rate for the survey was 55.3% with a total of 102,353 respondents (Blumberg, et
al., 2005). The sample for the present study was restricted to children who were identified by their caregiver as either non-Hispanic white, non-Hispanic black or Hispanic and whose caregiver had been told by a doctor or health professional that their child has ADHD. The age of the children with ADHD was limited to children aged 6 to 13 years old. This age range was utilized as it is when the onset of ADHD occurs for most children (Parr, Ward, & Inman, 2003; Rucklidge & Tannock, 2001), and has commonly been used in a variety of studies involving children with ADHD including intervention studies (Biederman, et al., 2006; Brocki & Bohlin, 2006; McGough, et al., 2005; Wilens, et al., 2003).

**Measures**

*Socio-Demographic Variables.* The main socio-demographic variables of interest are race/ethnicity and gender. The race/ethnicity of the child was categorized as either non-Hispanic white, non-Hispanic black or Hispanic. Gender of the child was either male or female. Other demographic variables included household income, caregiver level of education and child age. The statistical procedure used required that all variables be dichotomized into binary categorical variables. Household income was dichotomized to either at or above 300% of the Federal Poverty Level (FPL), or below 300% of the FPL. This benchmark was chosen because 300% FPL is the upper boundary for eligibility among many public assistance programs such as SCHIP and Medicaid expansion programs (Ross & Marks, 2009), and has been used previously as a boundary between high and low incomes (Fulda, Lykens, Bae, & Singh, 2009; Newacheck, Hung, Park,
Brindis, & Irwin, 2003). The highest education attained by an individual within the household was dichotomized to either a high school diploma or less, or more than high school.

**Caregiver Strain Variables.** Five questions from the 2003 NSCH were selected based on the Caregiver Strain Questionnaire developed and validated by Brannan et al. (Brannan, Heflinger, & Bickman, 1997). The five questions selected investigated how close the parent and child are, the coping ability of the parent, how difficult caring for the child is, how much time the parent felt they were giving up, and how often the parent is angry with the child (see Table 1). These five items together represent each of the three domains of caregiver strain identified by the Caregiver Strain Questionnaire: 1) Objective Strain, negative occurrences resulting from caring for the child; 2) Internalized Subjective Strain, feelings internalized by the caregiver associated with caring for the child; 3) Externalized Subjective Strain, negative feelings directed towards the child (Brannan, et al., 1997). Because the distribution of the responses to each question was bimodal, each question was collapsed into a 2-point Likert scale from the original 5-point scales. In the resulting responses, category 1 responses are considered more favorable than category 2 responses (see Table 1).

**Statistical Analyses**

While combining the responses to the selected caregiver strain variables into an overall caregiver strain score is a possible way of describing the caregiver strain reported by the caregivers, it would not adequately account for variation in responses to each
separate caregiver strain variable. To examine the heterogeneity of different aspects of caregiver strain among parents of children with ADHD, latent class analysis was utilized. Latent class analysis (LCA) is a group-based statistical technique that has been used previously in the social and health sciences to identify underlying classes of behaviors such as social phobias (Kessler, Stein, & Berglund, 1998), motivations for teen drinking (Coffman, Patrick, Palen, Rhoades, & Ventura, 2007), disordered eating (Bulik, Sullivan, F.R.A.N.Z.C.P., & Kendler, 2000), and also subtypes of ADHD (Neuman, et al., 1999; Volk, Todorov, Hay, & Todd, 2009).

Latent class analysis utilizes the variations in the responses to multiple categorical variables to construct latent classes or subgroups of individuals. The model assumes that at least two mutually exclusive and exhaustive latent classes exist in the population based on their responses to multiple categorical variables (Goodman, 1974). In this case, the latent classes were constructed based on the caregivers’ responses to the caregiver strain variables in order to identify and describe different groups of caregivers as well as the influence of the child’s race/ethnicity, the child’s gender, household income, and caregiver education.

The LCA model was used to (a) identify the optimal number of latent classes of caregivers that best represented the variations in the responses to the caregiver strain variables, (b) describe the sizes and characteristics of each latent class, and (c) evaluate how race/ethnicity, gender, income, and education influenced the propensity for a caregiver to be associated with one of the identified latent classes. All analyses were conducted using SAS version 9.2 © and Proc LCA version 1.1.5 (Lanza & Collins, 2008;
Maximum likelihood estimation procedures were used to derive two sets of parameter estimates: latent class membership probabilities, and item-response probabilities for each latent class. The latent class membership probabilities represent the likelihood that an individual in the population will belong to a given latent class. The item-response probabilities represent the likelihood of a certain response category to a variable given membership to a particular latent class. In this case, this is the probability of a caregiver’s response being either a category 1 or 2 response to one of the caregiver strain variables in a particular class of caregiver strain profiles. These parameters, which are described for each class and each variable, are the basis for interpreting the size and characteristics of each latent class discovered. Thus, the result from the LCA presents groups of caregivers who provided similar responses to each of the caregiver strain variables, which reflects the overall caregiver strain expressed by the caregiver.

Selecting the optimal LCA model for analysis was conducted by using a combination of the $G^2$ statistic, degrees of freedom, the Akaike Information Criteria (AIC), the Bayesian Information Criterion (BIC), and interpretation of the models. First, multiple models were run with each forced to fit a different numbers of latent classes. The resulting BIC were evaluated with lower BIC representing a more optimal balance between fitting the data and parsimony. Models were then evaluated for whether or not the latent classes identified were both of significant size and distinct from one another, and whether or not the item-response probabilities for each latent class were interpretable (Lanza, Collins, & Schafer, 2005; Lanza, Flagherty, & Collins, 2003). Once a
meaningful model was identified, each latent class was labeled to reflect the corresponding item-response probabilities for that class where larger item-response values indicate an increased probability of a certain category response, whether it be favorable or unfavorable. The parameter estimate procedure was performed again using different starting values to ensure reproducibility of the estimates, with the final model being chosen only after the model estimates were reproduced using these different starting values.

The LCA model was further utilized to examine the influence of the socio-demographic variables on latent class parameter estimates. The latent class model finally chosen was used as a dependent variable for multinomial logistic regression models of latent class membership based on the child’s race/ethnicity (white, black, or Hispanic), household income (above or below 300% FPL), caregiver education (high school diploma or less, or more than high school) and child’s gender. Child age was controlled for in all regression models by inclusion as a covariate.

**Results**

**Sample**

The mean age of the children diagnosed with ADHD is 10.2 years old (s.d. = 2.1). The distribution of the race/ethnicity of the children diagnosed with ADHD is 80.1% white, 11.5% black, and 8.4% Hispanic. A majority of the children are boys (72.1%). Fifty-nine percent of the households surveyed have an income of below 300% FPL and as of 2009, 300% of the FPL would equate to an annual income of $66,150 for a family of
A majority of the caregivers reported someone in the household having more than a high school diploma (70.6%).

**Latent Classes of Caregiver Strain**

LCA identified that four distinct latent classes exist among the caregivers with regards to their reported caregiver strain (See Table 2): 1) Low Strain class: Characterized by individuals with the highest probabilities for favorable responses to all of the caregiver strain variables; 16.5% of the caregiver population is expected to be in this class; 2) Moderate – Caring and Giving class: Characterized by individuals who do not report problems with the amount of time or difficulty that was needed to care for their child, but do report difficulties coping with their child; 18.3% of the ADHD caregiver population is expected to belong to this class; 3) Moderate – Relating class: Characterized by individuals who report being able to successfully relate to their child, however, these individuals do report difficulties with the remaining four caregiver strain variables; 43.7% of the caregivers are expected to be a part of this class; 4) High Strain class: Individuals with the highest probabilities for unfavorable responses to all of the caregiver strain variables, especially coping with the child, being able to care for the child, and feelings of giving up time for the child; 21.5% of the caregiver population is expected to be in this class. The fit statistics for this four-class model are: $G^2 = 8.6$, AIC = 54.6, BIC = 195.4, DF = 8. The SAS LCA outputs can be found in the appendix.

Table 2 describes the membership probabilities for each of the four latent classes within the different race/ethnicity, gender, education and income groups.
Relation between Gender, Race/Ethnicity, Education, Income and Caregiver Strain

The results from the multinomial logistic regressions used to assess the relation between the covariates and caregiver strain are displayed in Table 3. The Low Strain class was selected as the reference class, with the other classes representing increases in strain among the different dimensions of caregiver strain. Each of the odds ratios represents a change in the odds of membership in a particular class relative to membership in the Low Strain class for each of the covariates. Hence, an odds ratio greater than 1.0 indicates an increased likelihood of membership in that particular class relative to the Low Strain class while an odds ratio of less than 1.0 indicates a decreased likelihood of membership in that particular class relative to the Low Strain class. The $P$ value associated with each of the covariates indicates the significance of the relation between the covariate and the latent class membership described.

Significant variation exists between the white and black caregiver populations when accounting for variations in child gender, household income, and education. White caregivers of children diagnosed with ADHD are almost six times as likely to be in the Moderate – Giving & Caring class ($OR = 5.85$) compared to the Low Strain class, and are also more than twice as likely to be in the Moderate – Relating class ($OR = 2.30$) or High Strain class ($OR = 2.31$) compared to the Low Strain class. Black caregivers of children with ADHD are much more likely to be in the Low Strain group compared to either the High Strain ($OR = 0.51$), Moderate – Relating ($OR = 0.51$) or Moderate – Giving & Caring classes ($OR = 0.13$). The results for the Hispanic caregiver population are not
significant; however, the odds ratios identified are similar to those described for the black caregivers.

Differences also exist between the odds of class membership for caregivers of boys and girls with ADHD when controlling for race/ethnicity, child age, household income, and education. Although caregivers of boys are more likely to belong to the Moderate – Giving & Caring class and the Moderate – Relating class (OR = 1.29, OR = 1.45), caregivers of girls are slightly more likely to be in the High Strain class relative to the Low Strain class (OR = 1.12).

The highest level of education attained by someone in the household was seen to be a significant predictor of latent class membership. Compared to caregivers reporting a high school diploma or less, those with more than a high school education were more likely to belong to the Moderate – Giving & Caring (OR = 2.17), Moderate – Relating (OR = 1.64), and High Strain Classes (OR = 1.47). Household income was also a significant predictor of latent class membership. Caregivers in households making below 300% FPL are more likely to belong to the Moderate and High Strain classes compared to caregivers in households making above 300% FPL, including being more than 3.5 times likely to belong to the High strain class. All SAS LCA outputs are located in the appendix.

**Discussion**

Latent class analysis was used in order to identify and classify different groups of caregiver strain that exist among caregivers of children with ADHD. Additionally, socio-
demographic variables including race/ethnicity, gender, and income were considered as factors that may be associated with the identified latent classes. Previous studies have investigated the influence of children’s mental health disorders on caregiver strain; however, none have approached this relationship with the group-based approach that is possible through LCA. Similar to other studies, these results suggest a relation between caregiver strain and race/ethnicity, child gender, and income. The findings further explore these relationships by identifying four distinct latent classes of strain that exist among caregivers of children with ADHD: Low Strain, Moderate – Giving & Caring, Moderate – Relating, and High Strain.

Results from this study indicate that there is a significant difference in the types of caregiver strain experienced among caregivers of children with ADHD. While caregivers of boys are more likely to be in one of the Moderate strain classes, caregivers of girls are slightly more likely to belong to the High strain class. These findings display complicated interaction between child gender and strain levels of parents that has been observed in previous studies. Some studies examining this relationship have cited parents of boys with ADHD as reporting higher levels of caregiver strain (R Bussing, Gary, et al., 2003; R Bussing, Zima, et al., 2003), and that boys diagnosed with ADHD most often display symptoms that are closely related to higher levels of reported caregiver strain (Harrison & Sofronoff, 2002; Maniadaki, et al., 2005). However, while some studies have reported negligible differences between boys and girls with ADHD and the corresponding levels of caregiver strain they are associated with (Breen & Barkley, 1988; Silverthorn, Frick, Kuper, & Ott, 1996), others have found contradictory
results that girls diagnosed with ADHD are in fact more debilitated than their male counterparts (Brown, Madan-Swain, & Baldwin, 1991; Gordon & Mettelman, 1994; James & Taylor, 1990) with more self-reported impairments in anxiety, depression and distress that were also confirmed by both teacher and parent reports (Rucklidge & Tannock, 2001). The results from this study would support this concept, as caregivers of boys were more likely to belong to the Moderate strain classes while caregivers of the more impaired girls were more likely to belong to the High Strain class.

Findings from this study provide support for significant differences in the type and amount of caregiver strain reported by caregivers of different race/ethnicity. White caregivers are more than twice as likely to belong to the Moderate and High Strain classes compared to the black caregivers. Although the results for the Hispanic caregivers are not statistically significant, they do exhibit the same trend as the black caregivers. Previous studies investigating this relationship between race/ethnicity, ADHD symptoms and strain suggest that differences do exist; however, studies seem to indicate that the variations observed are due to differences in the perceptions of ADHD symptomatology by the caregivers rather than differences in the symptoms displayed. Studies investigating manifestations of ADHD among different race/ethnicity groups have often suggested that black children display more severe symptoms of ADHD (DuPaul, et al., 1997; Reid, et al., 1998; Reid, et al., 2000); however, it remains unclear whether these variations are due to actual differences in behavior or reporter bias (Reid, et al., 2000), which has been seen to be influenced by ethnicity (Sonuga-Barke, Minocha, Taylor, & Sandberg, 1993). While the variations in symptoms displayed by different
races/ethnicities remains unclear, studies have shown that significant differences exist when it comes to parent/caregiver perceptions of ADHD and ADHD-like symptoms. One study found that white parents were more likely to attribute inattentive and hyperactive characteristics to ADHD compared to black parents (R. Bussing, Schoenberg, Rogers, Zima, & Angus, 1998). Bussing et al.’s (2003) study showed that white parents reported having larger social support networks, but with much less frequent contact, which in turn was associated with higher levels of reported caregiver strain (R Bussing, Zima, et al., 2003). These findings support the results from the LCA, which indicates that white parents experience higher levels of caregiver strain.

Variations in caregiver education were also seen to have a significant effect on the type of strain reported by the ADHD caregivers. Caregivers in households reporting an education of more than a high school diploma were more likely to belong to the Moderate – Relating and High Strain classes, and more than twice as likely to belong to the Moderate – Giving & Caring class. The small amount of work investigating this caregiver education and ADHD has shown that increases in education are related to increases in symptom endorsement (Weckerly, et al., 2005) and treatment (Currie & Stabile, 2004). It has been suggested that certain symptoms, namely inattentiveness, of ADHD may be more difficult to detect (Weckerly, et al., 2005), so this relationship may be a result of less educated caregivers being less aware and effected by certain symptoms of their children.

Household income was another significant predictor of latent class membership. Caregivers reporting incomes less than 300% FPL were more likely to belong to the
Moderate and High Strain classes including being more than 3.5 times as likely to belong to the High Strain class compared to their wealthier counterparts. These higher levels of strain support previous findings of wealthier families reporting fewer child behavior problems among children with ADHD and in turn lower levels of family conflict (Kendall, et al., 2005). Barkley (1998) has also suggested this relationship between lower income and increased stress where the difficulties associated with lower SES may exacerbate ADHD symptoms which lead to increased child behavior problems and family strain (Barkley, 1998). Furthermore, with medication and mental health service use rates significantly related to income (Currie & Stabile, 2004; Froehlich, et al., 2007; Garland, et al., 2005; Pastor & Reuben, 2005), this increase in strain among lower income families may arise from complex interactions among a multitude of SES-related difficulties such as barriers to treatment.

Limitations and Future Directions

This study has several limitations. The data utilized in this study from the NSCH are cross-sectional data, hence any interpretations of causation in the relationships described is limited. Additionally, the five self-report measures of caregiver strain are limited in their scope and specificity. While the measures reflect those on the well-validated self-report measure the CGSQ, they are only five items and they do not incorporate the entire range of factors that have been shown to constitute caregiver strain (Brannan, et al., 1997). Also, the study does not control for some potentially important aspects of ADHD including the severity of the disorder, comorbidities, as well as
treatment status. Although severity and treatment patterns are known to vary across many socio-demographic variables (Olfson, Gameroff, Marcus, & Jensen, 2003; Pastor & Reuben, 2005; Stevens, Harman, & Kelleher, 2005), and ADHD is most frequently comorbid with other childhood disorders (Biederman, Newcorn, & Sprich, 1991), it is exceedingly difficult to separate out “pure” ADHD cases and the severity and treatment patterns associated with the cases.

The findings from this study identify unique classes of strain among caregivers of children with ADHD and demonstrate how these classes can vary across different groups of individuals. Particularly, race/ethnicity and child gender were shown to influence class membership. Latent class analysis can be utilized to further examine potential covariates related to caregiver strain such as SES or other qualities such as neighborhood characteristics or social networks.
**Tables**

**Table 1. Questions from the NSCH used as caregiver strain variables**

<table>
<thead>
<tr>
<th>Item from NSCH</th>
<th>Item Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>During the past month, how often have you felt your child is much harder to</td>
<td>Never&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>care for than most children their age?</td>
<td>Sometimes&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Usually&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Always&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>During the past month, how often have you felt you are giving up more of</td>
<td>Never&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>your life to meet your child’s needs than you ever expected?</td>
<td>Sometimes&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Usually&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Always&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>In general, how well do you feel you are coping with the day-to-day demands</td>
<td>Very</td>
</tr>
<tr>
<td>of parenthood?</td>
<td>Well&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Somewhat</td>
</tr>
<tr>
<td></td>
<td>Well&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Not Very</td>
</tr>
<tr>
<td></td>
<td>Well&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Not Well</td>
</tr>
<tr>
<td></td>
<td>At All&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Is your relationship with your child very close, somewhat close, not very</td>
<td>Very</td>
</tr>
<tr>
<td>close, not close at all?</td>
<td>Close&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Somewhat</td>
</tr>
<tr>
<td></td>
<td>Close&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Not Very</td>
</tr>
<tr>
<td></td>
<td>Close&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Not Close</td>
</tr>
<tr>
<td></td>
<td>At All&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>During the past month, how often have you felt angry with your child?</td>
<td>Never&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Sometimes&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Usually&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Always&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>Category 1 Response; <sup>2</sup>Category 2 Response

**Table 2. Latent class membership probabilities: Percent of each group expected to belong to each latent class**

<table>
<thead>
<tr>
<th></th>
<th>Low Strain</th>
<th>Giving &amp; Caring</th>
<th>Relating</th>
<th>High Strain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total ADHD Population</td>
<td>16.5</td>
<td>18.3</td>
<td>43.7</td>
<td>21.5</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>13.8</td>
<td>24.9</td>
<td>48.2</td>
<td>13.1</td>
</tr>
<tr>
<td>Black</td>
<td>10.6</td>
<td>32.5</td>
<td>28.0</td>
<td>28.9</td>
</tr>
<tr>
<td>Hispanic</td>
<td>17.4</td>
<td>13.7</td>
<td>52.2</td>
<td>16.7</td>
</tr>
<tr>
<td><strong>Child Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>16.0</td>
<td>24.5</td>
<td>53.7</td>
<td>5.8</td>
</tr>
<tr>
<td>Girl</td>
<td>17.3</td>
<td>25.7</td>
<td>48.3</td>
<td>8.7</td>
</tr>
<tr>
<td><strong>Household Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above 300% FPL</td>
<td>21.1</td>
<td>37.1</td>
<td>32.2</td>
<td>9.7</td>
</tr>
<tr>
<td>Below 300% FPL</td>
<td>27.3</td>
<td>32.1</td>
<td>20.9</td>
<td>19.6</td>
</tr>
<tr>
<td><strong>Caregiver Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than High School</td>
<td>30.5</td>
<td>7.8</td>
<td>37.8</td>
<td>24.0</td>
</tr>
<tr>
<td>High School diploma or</td>
<td>21.4</td>
<td>13.7</td>
<td>39.6</td>
<td>25.3</td>
</tr>
</tbody>
</table>
Table 3. Odds ratios reflecting increased odds of membership in a particular class relative to the Low Strain class

<table>
<thead>
<tr>
<th></th>
<th>Low Strain</th>
<th>Giving &amp; Caring</th>
<th>Relating</th>
<th>High Strain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White $P&lt;.0001$</td>
<td>-</td>
<td>5.85</td>
<td>2.30</td>
<td>2.31</td>
</tr>
<tr>
<td>Black $P&lt;.0001$</td>
<td>-</td>
<td>0.13</td>
<td>0.51</td>
<td>0.51</td>
</tr>
<tr>
<td>Hispanic n.s.</td>
<td>-</td>
<td>0.33</td>
<td>0.53</td>
<td>0.54</td>
</tr>
<tr>
<td><strong>Child Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy $P&lt;.05$</td>
<td>-</td>
<td>1.29</td>
<td>1.45</td>
<td>0.89</td>
</tr>
<tr>
<td>Girl $P&lt;.05$</td>
<td>-</td>
<td>0.78</td>
<td>0.69</td>
<td>1.12</td>
</tr>
<tr>
<td><strong>Household Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above 300% FPL $P&lt;.0001$</td>
<td>-</td>
<td>0.68</td>
<td>0.85</td>
<td>0.28</td>
</tr>
<tr>
<td>Below 300% FPL $P&lt;.0001$</td>
<td>-</td>
<td>1.52</td>
<td>1.18</td>
<td>3.52</td>
</tr>
<tr>
<td><strong>Caregiver Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than High School $P&lt;.05$</td>
<td>-</td>
<td>2.17</td>
<td>1.64</td>
<td>1.47</td>
</tr>
<tr>
<td>High School diploma or less $P&lt;0.5$</td>
<td>-</td>
<td>0.46</td>
<td>0.61</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Note: “-“ in Low Strain indicates reference class for odds ratios interpretations
Note: $P$ value associated with each of the covariates indicates the significance of the relation between the covariate and the latent class membership described
References


Centers for Disease Control and Prevention (2005). Mental health in the United States. Prevalence of diagnosis and medication treatment for attention-


Appendix

Data Summary, Model Information, and Fit Statistics (EM Algorithm)

Number of subjects: 3363
Number of measurement items: 5
Response categories per item: 2 2 2 2
Number of groups in the data: 1
Number of latent classes: 4
Rho starting values were randomly generated (seed = 325991).

No parameter restrictions were specified (freely estimated).

The model converged in 2093 iterations.

Maximum number of iterations: 5000
Convergence method: maximum absolute deviation (MAD)
Convergence criterion: 0.0000010000

-----------------------------------------------

Fit statistics:
-----------------------------------------------

Log-likelihood: -8944.76
G-squared: 8.58
AIC: 54.58
BIC: 195.35
Degrees of freedom: 8

Test for MCAR
Log-likelihood: -8940.47
G-squared: 55.06
Degrees of freedom: 80

-----------------------------------------------

Parameter Estimates

Gamma estimates (class membership probabilities):
Class: 1 2 3 4
0.4373 0.2147 0.1650 0.1831

Rho estimates (item response probabilities):
Response category 1:
Class: 1 2 3 4
relate : 0.9065 0.5808 1.0000 0.8505
cope : 0.4183 0.0564 0.8645 0.4991
care : 0.2203 0.0935 0.8757 0.7380
give : 0.3511 0.1135 0.7969 1.0000
angry : 0.0772 0.0087 0.3487 0.1196

Response category 2:
Class: 1 2 3 4
relate : 0.0935 0.4192 0.0000 0.1495
cope : 0.5817 0.9436 0.1355 0.5809
care : 0.7797 0.9065 0.1243 0.2620
give : 0.6489 0.8865 0.2031 0.0000
angry : 0.9228 0.9913 0.6513 0.8804
Number of subjects: 3363
Number of measurement items: 5
Response categories per item: 2 2 2 2 2
Number of groups in the data: 3
Number of latent classes: 4
Rho starting values were randomly generated (seed = 325991).

Rho (measurement) parameters were constrained to be equal across groups.
The model converged in 907 iterations.

Maximum number of iterations: 5000
Convergence method: maximum absolute deviation (MAD)
Convergence criterion: 0.0000010000

Fit statistics:

Log-likelihood: -8914.48
G-squared: 73.40
AIC: 131.40
BIC: 308.89
Degrees of freedom: 66

Test for MCAR
Log-likelihood: -8877.78
G-squared: 84.20
Degrees of freedom: 177

Parameter Estimates

Gamma estimates (class membership probabilities):
Class: 1 2 3 4
Group 1: 0.3592 0.4028 0.1090 0.1379
Group 2: 0.0862 0.4048 0.2414 0.2677
Group 3: 0.1949 0.4021 0.1996 0.2034

Rho estimates (item response probabilities):
(All groups)
Response category 1:
Class: 1 2 3 4
relate : 0.8983 0.7311 0.8936 0.9863
cope : 0.4666 0.0365 0.9986 0.8813
care : 0.5623 0.1428 0.1098 0.9566
give : 0.9230 0.1445 0.2331 0.7598
angry : 0.1174 0.0350 0.0923 0.3332

Response category 2:
Class: 1 2 3 4
relate : 0.1097 0.2689 0.1064 0.0137
cope : 0.5334 0.9635 0.0014 0.1187
care : 0.4377 0.8572 0.8902 0.0434
give : 0.0770 0.8555 0.7669 0.2402
angry : 0.8826 0.9650 0.9077 0.6668
Data Summary, Model Information, and Fit Statistics (EM Algorithm)

Number of subjects: 3363
Number of measurement items: 5
Response categories per item: 2 2 2 2 2
Number of groups in the data: 2
Number of latent classes: 4
Rho starting values were randomly generated (seed = 325901).
Rho (measurement) parameters were constrained to be equal across groups.

The model converged in 4140 iterations.

Maximum number of iterations: 5000
Convergence method: maximum absolute deviation (MAD)
Convergence criterion: 0.0000010000

Fit statistics:

Log-likelihood: -8942.64
G-squared: 52.50
AIC: 104.50
BIC: 263.64
Degrees of freedom: 37

Test for MCAR
Log-likelihood: -8916.39
G-squared: 79.55
Degrees of freedom: 132

Parameter Estimates

Gamma estimates (class membership probabilities):

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.4832</td>
<td>0.0866</td>
<td>0.1728</td>
<td>0.2573</td>
</tr>
<tr>
<td>Group</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5370</td>
<td>0.0581</td>
<td>0.1595</td>
<td>0.2454</td>
</tr>
</tbody>
</table>

Rho estimates (item response probabilities):

<table>
<thead>
<tr>
<th>Response category</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>All groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response category 1:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relate</td>
<td>0.8831</td>
<td>0.0077</td>
<td>1.0000</td>
<td>0.8728</td>
</tr>
<tr>
<td>cope</td>
<td>0.2932</td>
<td>0.0284</td>
<td>0.8874</td>
<td>0.5196</td>
</tr>
<tr>
<td>care</td>
<td>0.1772</td>
<td>0.0568</td>
<td>0.8328</td>
<td>0.6586</td>
</tr>
<tr>
<td>give</td>
<td>0.2187</td>
<td>0.1200</td>
<td>0.7454</td>
<td>1.0000</td>
</tr>
<tr>
<td>angry</td>
<td>0.0588</td>
<td>0.0030</td>
<td>0.3566</td>
<td>0.1213</td>
</tr>
<tr>
<td>Response category 2:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relate</td>
<td>0.1169</td>
<td>0.9923</td>
<td>0.0000</td>
<td>0.1272</td>
</tr>
<tr>
<td>cope</td>
<td>0.7068</td>
<td>0.9716</td>
<td>0.1126</td>
<td>0.4804</td>
</tr>
<tr>
<td>care</td>
<td>0.8228</td>
<td>0.9432</td>
<td>0.1672</td>
<td>0.3414</td>
</tr>
<tr>
<td>give</td>
<td>0.7813</td>
<td>0.8800</td>
<td>0.2546</td>
<td>0.0000</td>
</tr>
<tr>
<td>angry</td>
<td>0.9492</td>
<td>0.9970</td>
<td>0.6434</td>
<td>0.8787</td>
</tr>
</tbody>
</table>
Data Summary, Model Information, and Fit Statistics (EM Algorithm)

Number of subjects: 3150
Number of measurement items: 5
Response categories per item: 2 2 2 2 2
Number of groups in the data: 2
Number of latent classes: 4
Rho starting values were randomly generated (seed = 325991).

Rho (measurement) parameters were constrained to be equal across groups.

The model converged in 458 iterations.

Maximum number of iterations: 5000
Convergence method: maximum absolute deviation (MAD)
Convergence criterion: 0.0001

Fit statistics:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Log-likelihood</td>
<td>-8370.27</td>
</tr>
<tr>
<td>G-squared</td>
<td>59.42</td>
</tr>
<tr>
<td>AIC</td>
<td>111.42</td>
</tr>
<tr>
<td>BIC</td>
<td>268.86</td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>37</td>
</tr>
</tbody>
</table>

Test for MCAR

Log-likelihood: -8340.56
G-squared: 67.66
Degrees of freedom: 134

Parameter Estimates

Gamma estimates (class membership probabilities):

<table>
<thead>
<tr>
<th>Class:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1:</td>
<td>0.3223</td>
<td>0.0966</td>
<td>0.2106</td>
<td>0.3705</td>
</tr>
<tr>
<td>Group 2:</td>
<td>0.2094</td>
<td>0.1960</td>
<td>0.2731</td>
<td>0.3214</td>
</tr>
</tbody>
</table>

Rho estimates (item response probabilities):

(All groups)

Response category 1:

<table>
<thead>
<tr>
<th>Class:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>relate</td>
<td>0.9912</td>
<td>0.2694</td>
<td>0.9268</td>
<td>0.9273</td>
</tr>
<tr>
<td>cope</td>
<td>0.1561</td>
<td>0.0986</td>
<td>0.5918</td>
<td>0.6633</td>
</tr>
<tr>
<td>care</td>
<td>0.1740</td>
<td>0.1087</td>
<td>0.0152</td>
<td>0.9744</td>
</tr>
<tr>
<td>give</td>
<td>0.2186</td>
<td>0.1865</td>
<td>0.5217</td>
<td>0.8095</td>
</tr>
<tr>
<td>angry</td>
<td>0.0112</td>
<td>0.0185</td>
<td>0.1325</td>
<td>0.2178</td>
</tr>
</tbody>
</table>

Response category 2:

<table>
<thead>
<tr>
<th>Class:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>relate</td>
<td>0.0088</td>
<td>0.7306</td>
<td>0.0732</td>
<td>0.0727</td>
</tr>
<tr>
<td>cope</td>
<td>0.8439</td>
<td>0.9014</td>
<td>0.4082</td>
<td>0.3367</td>
</tr>
<tr>
<td>care</td>
<td>0.8260</td>
<td>0.8913</td>
<td>0.9848</td>
<td>0.0256</td>
</tr>
<tr>
<td>give</td>
<td>0.7814</td>
<td>0.8135</td>
<td>0.4783</td>
<td>0.1905</td>
</tr>
<tr>
<td>angry</td>
<td>0.9888</td>
<td>0.9815</td>
<td>0.8675</td>
<td>0.7822</td>
</tr>
</tbody>
</table>
Number of subjects: 3352
Number of measurement items: 5
Response categories per item: 2 2 2 2 2
Number of groups in the data: 2
Number of latent classes: 4
Rho starting values were randomly generated (seed = 325991).
Rho (measurement) parameters were constrained to be equal across groups.
The model converged in 1276 iterations.
Maximum number of iterations: 5000
Convergence method: maximum absolute deviation (MAD)
Convergence criterion: 0.0000010000

Fit statistics:

Log-likelihood: -8911.71
G-squared: 34.12
AIC: 86.12
BIC: 245.17
Degrees of freedom: 37

Test for MCAR

Log-likelihood: -8894.65
G-squared: 77.98
Degrees of freedom: 125

Parameter Estimates

Gamma estimates (class membership probabilities):
Class: 1 2 3 4
Group 1: 0.3780 0.2398 0.3046 0.0776
Group 2: 0.3960 0.2532 0.2139 0.1370

Rho estimates (item response probabilities):
(All groups)
Response category 1:
Class: 1 2 3 4
relate: 0.9230 0.5950 0.8933 1.0000
cope: 0.4320 0.0756 0.5501 0.9618
care: 0.2465 0.0952 0.6768 0.9549
give: 0.2819 0.1468 1.0000 0.7562
angry: 0.0860 0.0100 0.1405 0.4312

Response category 2:
Class: 1 2 3 4
relate: 0.0770 0.4850 0.1067 0.0000
cope: 0.5680 0.9244 0.4499 0.0382
care: 0.7535 0.9848 0.3232 0.0451
give: 0.7181 0.8540 0.0000 0.2438
angry: 0.9140 0.9900 0.8595 0.5688
Data and Model Summary and Fit Statistics (EM Algorithm with Logistic Regression)

Number of subjects: 3145
Number of measurement items: 5
Response categories per item: 2 2 2 2 2
Number of groups in the data: 1
Number of latent classes: 4
Logistic model: multinomial
Number of covariates used: 5
Reference class: 3
Rho starting values were randomly generated (seed = 234527).
No parameter restrictions were specified (freely estimated).
The model converged in 901 iterations.

Maximum number of iterations: 5000
Convergence method: maximum absolute deviation (MAD)
Convergence criterion: 0.000100000

------------------------------------------
Fit statistics:
------------------------------------------
Log-likelihood: -8296.09

Parameter Estimates

Gamma estimates (class membership probabilities):
Class: 1 2 3 4
       0.2805 0.1007 0.1362 0.4825

Rho estimates (item response probabilities):
Response category 1:
Class: 1 2 3 4
relate : 0.8950 0.0000 1.0000 0.9417
cope : 0.5497 0.1175 0.9174 0.2846
care : 0.6675 0.1000 0.8357 0.1788
give : 0.9999 0.1784 0.6784 0.2078
angry : 0.1377 0.0247 0.3654 0.0460

Response category 2:
Class: 1 2 3 4
relate : 0.1050 1.0000 0.0000 0.0583
cope : 0.4503 0.8825 0.0826 0.7154
care : 0.3325 0.8920 0.1643 0.8212
give : 0.0001 0.8216 0.3216 0.7922
angry : 0.8623 0.3753 0.6346 0.9540
Beta estimates:

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.5554</td>
<td>-4.2643</td>
<td>Reference</td>
<td>1.0293</td>
</tr>
<tr>
<td>white</td>
<td>1.7660</td>
<td>0.8386</td>
<td>0.8324</td>
<td></td>
</tr>
<tr>
<td>boy</td>
<td>0.2529</td>
<td>-0.1140</td>
<td>0.3696</td>
<td></td>
</tr>
<tr>
<td>income</td>
<td>0.4232</td>
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<td>-0.1548</td>
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</tbody>
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Odds Ratio estimates:

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
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<td>0.0141</td>
<td>Reference</td>
<td>2.7991</td>
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<td>2.3132</td>
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<tr>
<td>boy</td>
<td>1.2877</td>
<td>0.8922</td>
<td>1.4472</td>
<td></td>
</tr>
<tr>
<td>income</td>
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<td>1.2814</td>
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Significance Tests

Beta parameter test (Type III): (based on 2*log-likelihood)

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Exclusion LL</th>
<th>Change in 2*LL</th>
<th>deg freedom</th>
<th>p-Value</th>
</tr>
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<tbody>
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</tr>
</tbody>
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Data and Model Summary and Fit Statistics (EM Algorithm with Logistic Regression)

Number of subjects: 3145
Number of measurement items: 5
Response categories per item: 2 2 2 2 2
Number of groups in the data: 1
Number of latent classes: 4

Logistic model: multinomial
Number of covariates used: 5
Reference class: 3
Rho starting values were randomly generated (seed = 234527).
No parameter restrictions were specified (freely estimated).
The model converged in 945 iterations.

Maximum number of iterations: 5000
Convergence method: maximum absolute deviation (MAE)
Convergence criterion: 0.0000010000

Fit statistics:

Log-likelihood: -8300.33

Parameter Estimates

Gamma estimates (class membership probabilities):
Class:
1 2 3 4
0.2736 0.0992 0.1528 0.4745

Rho estimates (item response probabilities):
Response category 1:
Class:
relate : 0.8894 0.0000 1.0000 0.9391
cope : 0.5246 0.1148 0.8915 0.2892
care : 0.6274 0.1092 0.8660 0.1760
give : 1.0000 0.1768 0.7193 0.1900
angry : 0.1258 0.0245 0.3516 0.0475

Response category 2:
Class:
relate : 0.1106 1.0000 0.0000 0.0609
cope : 0.4754 0.8852 0.1085 0.7108
care : 0.3726 0.8908 0.1340 0.8240
give : 0.0000 0.8232 0.2807 0.8100
angry : 0.8742 0.9755 0.6484 0.9525
### Beta estimates:

<table>
<thead>
<tr>
<th>Class:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
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### Odds Ratio estimates:

<table>
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<tr>
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<th>4</th>
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<tbody>
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### Significance Tests

**Beta parameter test (Type III): (based on 2*log-likelihood)**

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Exclusion LL</th>
<th>Change in 2*LL</th>
<th>deg freedom</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
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<td>55.01353287</td>
<td>3</td>
<td>0.000000000</td>
</tr>
</tbody>
</table>
Number of subjects: 3145
Number of measurement items: 5
Response categories per item: 2 2 2 2 2
Number of groups in the data: 1
Number of latent classes: 4

Logistic model: multinomial
Number of covariates used: 5
Reference class: 3
Rho starting values were randomly generated (seed = 234527).
No parameter restrictions were specified (freely estimated).
The model converged in 2691 iterations.

Maximum number of iterations: 5000
Convergence method: maximum absolute deviation (MAD)
Convergence criterion: 0.0000010000

Fit statistics:

Log-likelihood: -8311.02

Parameter Estimates

Gamma estimates (class membership probabilities):
Class: 1 2 3 4
0.2692 0.1036 0.1241 0.5081

Rho estimates (item response probabilities):
Response category 1:
Class: 1 2 3 4
relate: 0.8938 0.0000 1.0000 0.9481
cope: 0.5797 0.1188 0.9128 0.2916
care: 0.7123 0.1074 0.8367 0.1819
give: 0.9998 0.1775 0.6642 0.2408
angry: 0.1475 0.0251 0.3824 0.0463

Response category 2:
Class: 1 2 3 4
relate: 0.1062 1.0000 0.0000 0.0519
cope: 0.4203 0.8812 0.0872 0.7084
care: 0.2877 0.8926 0.1633 0.8181
give: 0.0002 0.8225 0.3358 0.7592
angry: 0.8525 0.9749 0.6176 0.9537
### Beta estimates:

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
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<td>-0.1672</td>
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</tbody>
</table>

### Odds Ratio estimates:

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
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<td>0.8460</td>
</tr>
</tbody>
</table>

*all 4 class*

17:48 Sunday, June 28, 2009

### Significance Tests

#### Beta parameter test (Type III): (based on 2*log-likelihood)

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Exclusion LL</th>
<th>Change in 2*LL</th>
<th>deg freedom</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.000000000</td>
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