Structural Equation Modeling & Theory Testing:

An Overview & Application to the Study of Culture and Parenting for Latino Immigrant Families

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Overview of Presentation

I. Structural Equation Models or SEM (Covariance structure models, Latent variable models)

II. Application of SEM to research on Latino families & youth
Best source for SEM in-depth....
Some number freaks are well endowed in other abilities, but some of them are other. Thurstone

Knowing how to logically design a research study and properly analyze the gathered data are two of the most critical knowledge tools a student can acquire during his or her training. The Institute for Measurement, Methodology, Analysis, and Policy at Texas Tech University are dedicated to the complementary mission of (a) training students at both the Undergraduate and Graduate levels in state-of-the-art methodology and data analysis, and (b) providing best-practice support to students, staff, and faculty in the conduct of their research. These
Visual Language of SEM

- Latent variables, factors, constructs
- Observed variables, measures, indicators, manifest variables
- Direction of influence, relationship from one variable to another
- Non-directional associations – covariance or variance estimates
Several Unique Advantages of SEM
Advantage #1

- Theories of human behavior and health involve complex patterns of relationships or differences involving many variables, conditions, groups – Can test entirety of these patterns at same time

…Tests of Theoretical Models…

…Process Evaluation…

…Comparing Intervention Groups…
Advantage #2

- Increased confidence in validity of constructs measured by several indicators

- Results account for variations in the relevance of each item to the latent construct

- Can determine extent to which constructs represented by same items across groups – excellent for cross cultural research
Advantage #3

- Address Shared Method Variance

“Cheap measure” (youth report)…100% of sample

“Expensive measure” (youth & parent report) – 30% of sample
Advantage #4

- Results not biased by unreliability of measures because measurement error estimated and removed from structural paths
Advantage #5

- Most efficient way of testing significance of multiple mediators and identifying directionality in associations
Advantage #6

Software advances easily allow:

1) Multi-level data
2) Handling Intentional & Unintentional Missing data
3) Multiple group
4) Longitudinal:
   • Growth Curve Models
   • Growth Mixture Models
Disadvantages of SEM

Odds Ratio for Suicidal Ideation

**Major depression**

6.4* (4.6, 8.7)

Goodwin, Kroenke, Hoven & Spitzer, 2003
Disadvantage #1

- Computationally intensive & need to understand the language of SEM

Although complex, we are at a place where software-wise it’s much less difficult
Disadvantage #2

- Sample size requirements considerable (but not such a problem for most public health research)
Disadvantage #3

- No single test of model fit or explained variance
Common Misuses of SEM

- Cannot overcome limitations of poor data collection
- Overstating causality
- Lack of transparency in what was done
Useful Applications of SEM
Process Evaluation (multiple mediation)

- Parent time spent reading to child
  - Reduced Parent Stress
  - Parental Warmth
  - Cognitive
  - Emotional
  - Behavioral

- Early Head Start
  - 0 = no
  - 1 = yes

- Program participation
- Parenting factors
- School readiness
Intervention Impact

Cognitive

Emotional

Behavioral

Home Visiting Intervention

Time 0  Time 1  Time 2
Identify Directionality

Cognitive

Emotional

Behavioral

Home Visiting Intervention

Time 0

Time 1

Time 2
Testing a Theoretical Model

Late Childhood Through Early Adolescence
Basics of Structural Equation Models:

An application to the study of Parenting, Adolescents, and Latino Families
Cultural Orientations, Parental Beliefs and Practices, and Latino Adolescents’ Autonomy and Independence

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We are grateful to Todd D. Little and Sharon R. Ghazarian for their statistical consulting on structural equation modeling used in this study.
Study Background

Behavioral autonomy & independence hallmark feature of adolescence

Not always clear how much and what kind of freedoms parents should allow their children to have during adolescence to promote positive health

Particularly relevant to consider “ambiguously personal” forms of youth independence...activities adolescents perceive as involving youth’s own personal choices and decisions but that parents may view as under parental authority and control

Steinberg, 1999; Smetana & Daddis, 2002
Study Background

When considering Latino families, parents’ granting of behavioral independence to adolescent children particularly unclear due to cultural values on youth autonomy versus family obligation

Fuligni and Yoshikawa 2003; Greenfield et al. 2006;
Study Background

Yet, “Latino” families in U.S. are culturally heterogeneous, with implications for parenting & adolescent behavior.

Bicultural ↔ U.S. monocultural ↔ Latino monocultural

Heterogeneity

Language, beliefs, behaviors, friends – comprise multidimensional aspects of cultural orientation with unique implications for behavior.

Berry 1990; Guo et al. 2012
Parents’ cultural beliefs and values largely determine the goals that parents have for their children and, in turn, the childrearing practices used to ensure youth’s successful development.

Research Objectives

1) Identify cultural orientation subgroups among pan-Latino sample of parents in Houston, TX
   - Expect U.S. / Latino / Bicultural patterns

2) Identify how parental beliefs may explain associations between cultural orientation & parenting
   - Expect beliefs emphasizing youth autonomy/independence will act as intervening variable for associations between US cultural orientation and less parental behavioral control

3) Examine gender differences in pathways linking cultural orientation to parenting beliefs
   - Expect gender differences to be magnified for Latino oriented parents
Analytic Framework to Address Study Objectives

How is cultural orientation directly and indirectly, through parental beliefs, associated with parental behavioral control?
Analytic Steps Taken In SEM

**Specification:** Develop model want to test; convert that information into syntax specifying relationships

**Estimation:** Obtain parameter estimates for model

**Evaluation:** Interpret model fit

------ Sometimes iterative process entailing modifying the model ------
Analytic Framework

Cultural orientation (ref: Latino)

Age Expectation: Youth Autonomy

Legitimacy of Parental Authority

Parental supervision, MR

Parental supervision, YR

Rules, MR

Parental Decision-making, MR

Parental Decision-making, YR
If we did NOT use SEM

Age Expectation = $\beta_1$ Cultural orientation + $\varepsilon_1$

Legitimacy Parental Authority = $\beta_1$ Cultural orientation + $\varepsilon_1$

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MR supervision = $\beta_2$ Age Expectation + $\beta_4$ Legitimacy + $\varepsilon_1$

YR supervision = $\beta_2$ Age Expectation + $\beta_4$ Legitimacy + $\varepsilon_1$

MR rules = $\beta_2$ Age Expectation + $\beta_4$ Legitimacy + $\varepsilon_1$

MR decision-making = $\beta_2$ Age Expectation + $\beta_4$ Legitimacy + $\varepsilon_1$

YR decision-making = $\beta_2$ Age Expectation + $\beta_4$ Legitimacy + $\varepsilon_1$

7 Equations: 8 variables; 7 have one-way arrows pointing to them

Saveli & Bentler, 2006
Why regression not best approach

1. Each construct measured by several items. In creating scales, items are not equally relevant to given construct.

2. Newly created scales might or might not be reliable. Even though we report Cronbach’s α, regression equations presume items are a good estimate of relationship of interest.

3. Fitting separate regression equations to different parts of our model does not allow assessment of overall model fit (addressing theory and/or process evaluation) or identify most important intervening variables.
Study Design & Participants

Variations in Parenting Study (VIPS), cross-sectional study affiliated with Healthy Passages (HP), multi-site, community-based study of a representative sample of public school students and parent/primary caregiver

HP followed 5th to 7th to 10th grade

In Houston, TX, 86% of HP 10th graders participated in VIPS (n = 684 Latino-origin)

Diverse origins:
Mexican (71%), Central/South American (11%), “Other” (15%) Cuban or P. Rican (3%)
1st generation (23%) 2nd generation (49%) 3rd generation (27%)
Independent Variable

Parents’ Cultural Orientation

Latent Profile Analysis: Person-centered approach to identify parent groups with distinct cultural orientations

- 4 language use items & 12 behavior/belief items (Pan Acculturation Scale, Soriano, 2013).

“My accent sounds like people from” “The words I use are from” “Foods I eat are from” “Traditions I follow are from” “Culture that influences that way I think and see things is”

6 Variables submitted to LPA
### Independent Variable

#### Parents’ Cultural Orientation – Latent Profiles

<table>
<thead>
<tr>
<th>Latino</th>
<th>n = 291 (43%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spanish-speaking bicultural</td>
<td>n = 141 (21%)</td>
</tr>
<tr>
<td>Bilingual bicultural</td>
<td>n = 108 (16%)</td>
</tr>
<tr>
<td>English-speaking bicultural</td>
<td>n = 100 (15%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>n = 44 (6%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Profiles</th>
<th>Log-likelihood</th>
<th>AIC</th>
<th>BIC</th>
<th>Lo-Mendell-Rubin</th>
<th>Vuong-Lo-Mendell-Rubin</th>
<th>Entropy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-17475.17</td>
<td>34998.35</td>
<td>35107.02</td>
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<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>-16424.84</td>
<td>32923.68</td>
<td>33091.21</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
<td>.98</td>
</tr>
<tr>
<td>3</td>
<td>-15723.32</td>
<td>31546.64</td>
<td>31773.03</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
<td>.97</td>
</tr>
<tr>
<td>4</td>
<td>-15384.86</td>
<td>30895.72</td>
<td>31180.99</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
<td>.98</td>
</tr>
<tr>
<td>5</td>
<td>-15144.07</td>
<td>30440.14</td>
<td>30784.26</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
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<td>6</td>
<td>-14941.61</td>
<td>30061.22</td>
<td>30464.21</td>
<td>p &lt; .05</td>
<td>p &lt; .05</td>
<td>.92</td>
</tr>
<tr>
<td>7</td>
<td>-14806.44</td>
<td>29816.88</td>
<td>30278.73</td>
<td>p = .12</td>
<td>p = .12</td>
<td>.93</td>
</tr>
</tbody>
</table>
Intervening Variables

Age expectations for youth’s behavioral autonomy
6 items, $\alpha = .72$; Teen Timetable Scale (Feldman & Rosenthal, 1990)

“At what age is it OK for a girl or boy be able to…”
(1 = “Before age 12,” 2 = “12–14 years,” 3 = “15–17 years,” 4 = “18 or older,”
and 5 = “never”)

choose clothes to buy even if the parent disapproves; go on a
date; choose his or her hairstyle even if the parent
disapproves; do things with friends rather than the family;
attend boy/girl parties at night; watch as much TV as s/he
wants.

Parent Cultural Orientation  Beliefs about youth autonomy  Parenting practices
Intervening Variables

Legitimacy of parental authority
5 items, α = .75; Smetana, 1995

“Is it OK or not OK for a parent to make a rule about…”
(0 = no; 1 = yes)
clothes kids wear, child having to clean his/her room, eating junk food, watching TV; a girl wearing heavy makeup/boy wearing an earring
Dependent Variables

Rules
(5 items, $\alpha = .73$; Laird et al. 2009)

How much is there a rule for your child...

0 = no rule exists, 1 = a rule exists but is not followed, 2 = a rule exists and is sometimes followed, 3 = a rule exists and is always followed

Answering door when no adult; using certain things when adult not present; following after-school routines; chores; how far away from home can play.

Parent Cultural Orientation → Beliefs about youth autonomy → Parenting practices
Dependent Variables

Supervision: Youth Report & Mother Report
(5 items, \( \alpha = .73 \); 4 items, \( \alpha = .73 \) Stattin & Kerr 2000)

Does your child need [your parent require] …
0 = no, never to 5 = yes, always
ask permission prior to staying out late weekday evening; ask before deciding what s/he will do on a Saturday evening when going out with friends; tell you what s/he did and whom if out very late at night; tell you where they are, whom they are with, and what they do with others at night

Diagram:
- Parent Cultural Orientation
- Beliefs about youth autonomy
- Parenting practices
Dependent Variables

Parental decision-making: Youth Report & Mother Report
(3 items, $\alpha = .68$; Dornbush et al. 1984; Smetana et al. 1995)

Do you or your parent [child] decide...
1 = Mother or father decides alone, 2 = I ask my child’s opinion but I have the final say, 3 = We decide together, and 4 = My child decides without discussing with either parent

how late the child stays out, what the child does with friends, and the child being at a friend’s house unsupervised

Parent Cultural Orientation

Beliefs about youth autonomy

Parenting practices
Background Variables

Youth age
National origin
Gender
Parent’s Use of English language
Parent education
Depressive symptoms
Parental Acculturation stress
Measurement Model: Relationship between Latent & Observed Variables

Parental decision-making, YR

How late can stay out (X1)

What can do w/ friends (X2)

Can be at friend home no adult (X3)

δ₁ δ₂ δ₃

Decision-making “causes” the observed correlation b/w three items below.
## Measurement Model: Results

<table>
<thead>
<tr>
<th>Scale</th>
<th>Items</th>
<th>parcels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Young Age Expectation for Autonomy</strong> (6 items)</td>
<td>Parcel 1: choose clothes to buy even if parents disapprove + go on date</td>
<td>.75</td>
</tr>
<tr>
<td></td>
<td>Parcel 2: choose hairstyle, even if parents disapprove + doing things with friends than family</td>
<td>.71</td>
</tr>
<tr>
<td></td>
<td>Parcel 3: watch as much TV as want + attend girl-boy parties at night</td>
<td>.79</td>
</tr>
<tr>
<td><strong>Legitimacy of Parental Authority</strong> (6 items)</td>
<td>Parcel 1: choosing own clothes + girl wearing heavy makeup</td>
<td>.75</td>
</tr>
<tr>
<td></td>
<td>Parcel 2: eating junk food + boy wearing earring</td>
<td>.78</td>
</tr>
<tr>
<td></td>
<td>Parcel 3: watching TV + cleaning one’s room</td>
<td>.69</td>
</tr>
<tr>
<td><strong>Rules</strong> (5 items)</td>
<td>Parcel 1: how far away from home can play + answering the door</td>
<td>.68</td>
</tr>
<tr>
<td></td>
<td>Parcel 2: doing chores + using certain things when an adult is not present</td>
<td>.84</td>
</tr>
<tr>
<td></td>
<td>Following after school routine</td>
<td>.65</td>
</tr>
<tr>
<td><strong>Supervision, Youth Report</strong> (5 items)</td>
<td>Parcel 1: need permission to stay out late on weekday + ask parents before decide what will do with friends on a Saturday night</td>
<td>.80</td>
</tr>
<tr>
<td></td>
<td>Parcel 2: if out late, explain what did + tell where, what, who if out at night</td>
<td>.85</td>
</tr>
<tr>
<td></td>
<td>Parcel 3: Tell where going and with whom if going out on Saturday night</td>
<td>.85</td>
</tr>
</tbody>
</table>
Measurement Model: Results

<table>
<thead>
<tr>
<th></th>
<th>( \beta )</th>
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</thead>
<tbody>
<tr>
<td><strong>Supervision, Parent Report (4 items)</strong></td>
<td></td>
</tr>
<tr>
<td>( \rightarrow ) require permission to stay out late on weekday</td>
<td>.55</td>
</tr>
<tr>
<td>( \rightarrow ) must ask before can decide what will do on a Saturday night</td>
<td>.66</td>
</tr>
<tr>
<td>( \rightarrow ) must explain what did and with whom if out very late on Saturday night</td>
<td>.82</td>
</tr>
<tr>
<td>( \rightarrow ) inquire about where child goes at night, with whom and what does</td>
<td>.78</td>
</tr>
<tr>
<td><strong>Youth Autonomy in Decision-making, Youth Report (3 items)</strong></td>
<td></td>
</tr>
<tr>
<td>( \rightarrow ) whether can go to a friend’s house when no one is there</td>
<td>.85</td>
</tr>
<tr>
<td>( \rightarrow ) what can and cannot do with friends</td>
<td>.76</td>
</tr>
<tr>
<td>( \rightarrow ) how late can stay out</td>
<td>.65</td>
</tr>
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<td>( \rightarrow ) whether can go to a friend’s house when no one is there</td>
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<td>.67</td>
</tr>
<tr>
<td>( \rightarrow ) how late can stay out</td>
<td>.55</td>
</tr>
</tbody>
</table>

Fit statistics: \( \chi^2 = 355.38, df = 188, p < .001; CFI = .988; RMSEA = .036, 90\% C.I: .030, .042. \) All parameter estimates significant at \( p < .001. \)
General or Structural Model: Relationship between Latent & Measurement Model

Cultural orientation (ref: Latino)

Age Expectation: Youth Autonomy

Legitimacy of Parental Authority

Parental supervision, MR
Parental supervision, YR
Rules, MR
Parental Decision-making, MR
Parental Decision-making, YR

Parent's cultural orientation → Parenting beliefs → Parental behavioral control
Close up: Relationship between Latent Variables + Measurement Model
Structural Model Results
Figure 1. Structural Pathways from Latent Profiles of Maternal Cultural Orientation to Maternal Beliefs and Expectations to Parenting Practices Granting Youth Autonomy, $N = 684$

Notes: Standardized coefficients shown. a. Reference group: Latino cultural orientation. Models control for correlations among intervening, among dependent variables, and between both intervening and dependent variables and the following: youth national origin, gender, and use of English language; parent education; and, maternal acculturation stress. Model fit statistics: $\chi^2 (338) = 586.74$; CFI = .95; RMSEA = .033 (90% CI: .028, .037).

* $p < .05$  ** $p < .01$  *** $p < .001$
Summary of Findings

Vast majority Latino parents retain some Latino cultural identification

- Houston – longstanding immigrant area
- Selective acculturation theory
Summary of Findings

Support for parental ethnotheories (Harkness & Super) and Ogbu’s “native theory of success”

Parents with US cultural orientations and, to some extent, bicultural orientations, might view youth’s success in more individualistic terms than is the case for Latino oriented parents.

No evidence for gender differences
- Domain of autonomy measured
Summary of Findings

Understanding cultural orientation:

• Language use has orthogonal relationship with behaviors and beliefs

• Language especially salient to parenting – social networks influential in this regard – child or parent driven possibilities
Next steps

- Longitudinal pathways
- Extend to examining adolescent health-related behaviors, mental health
- New immigrant destination areas
What was possible with SEM

Establishing direct & indirect effects

Providing results that removed bias of measurement error in constructs from beta coefficients

Testing overall model with multiple dependent variables

Ensuring constructs valid for boys & girls
Practical utility of having used SEM

Gain a valid, culturally informed, and specific understanding of an important social determinant – parental behavioral control - of adolescent health for Latino families in the U.S.
An Extra Thank You to...

Sharon Ghazarian, PhD

Director, Biostatistics, Epidemiology & Data Management (BEAD) Core

Johns Hopkins School of Medicine