Categorical Data Analysis and Meta-Analysis

Download:
- ***GenderDepr*.sav**
- ***Fitzpatrick* et al.**
- ***Hill* & *Lent***

20 Nov 2009
CPSY501
Dr. Sean Ho
Trinity Western University

TRINITY WESTERN UNIVERSITY

Outline for today

- Categorical Data Analysis
  - Entering frequency data
  - Chi-squared test and effect sizes
  - SPSS example
  - Log-linear analysis example: Fitzpatrick 01
  - Interactions
- Meta-Analysis
  - Combining effect sizes
  - Example: Hill & Lent (2006)

Contingency Tables

- When comparing two categorical variables, all observations can be partitioned into cells of the contingency table
  - e.g., two dichotomous variables: 2x2 table
  - Gender vs. clinically depressed:

	Depressed	Not Depressed
Female	**126**	**154**
Male	**98**	**122**

  - RQ: is there a significant relationship between gender and depression?

SPSS: Frequency Data

- Usually, each row in the Data View represents one participant
  - In this case, we'd have 500 rows
- For our example, each row will represent one cell of the contingency table, and we will specify the frequency for each cell
- Open: GenderDepr.sav
- Data → Weight Cases: Weight Cases by
  - Select "Frequency" as Frequency Variable

2 Categorical Vars: χ^2 and φ

- Chi-squared (χ^2) test: Two categorical variables
  - Asks: is there a significant relationship?
  - Requires no cells have expected count ≤ 1, and $<20\%$ of cells have expected count < 5, otherwise must resort to Fisher's exact test
- Effect size:
  - φ is akin to correlation: definition: $\varphi^2 = \chi^2 / n$
  - Cramer's V extends φ for more than 2 levels
  - Odds ratio: #yes / #no

SPSS: χ^2 and φ

- Analyze → Descriptives → Crosstabs:
  - One var goes in Row(s), one in Column(s)
  - Cells: Counts: Observed, Expected, and Residuals: Standardized, may also want Percentages: Row, Column, and Total
  - Statistics: Chi-square, Phi and Cramer's V
  - Exact: (runs Fisher's exact test; computationally intensive)
- If χ^2 is significant, use standardized residuals (z-scores) to follow-up which categories differ

Reporting χ^2 Results

- As in ANOVA, IVs with several categories require follow-up analysis to determine which categories show the effect
  - The equivalent of a pairwise comparison is a 2x2 contingency table!
- Report:
  "There was a significant association between gender and depression, $\chi^2(1) =$ ___, $p < .001$. Females were twice as likely to have depression as males."
  - Odds ratio: (#F w/depr) / (#M w/depr)

Log-Linear Analysis

- Relationship among many categorical variables
  - Need not have IV/DV distinction
- Application of the General Linear Model (ANOVA, Regression) for several categorical variables
  - [For dichotomous (0/1) variables, use log of probability of getting a "1"]
- Look for moderation / interactions:
  - e.g., Employment * Gender * Depression

Goodness of Fit

- Two χ^2 metrics measure how well our model (expected counts) fits the data (observed):
  - Pearson χ^2 and likelihood ratio (G) (likelihood ratio is preferred for small n)
- Significance test looks for deviation of observed counts from expected (model)
  - So if our model fits the data well, then the Pearson and likelihood ratio should be small, and the test should be non-significant
- SPSS tries removing various effects to find the simplest model that still fits the data well

Hierarchical Backward Select'n

- By default, SPSS log-linear regression uses automatic hierarchical “backward” selection:
- Starts with all main effects and all interactions
  - For a “saturated” categorical model, all cells in contingency table are modelled, so the “full-factorial” model fits the data perfectly: likelihood ratio is 0 and p-value = 1.0.
- Then removes effects one at a time, starting with higher-order interactions first:
  - Does it have a significant effect on fit?
  - How much does fit worsen? (ΔG)

Example: Fitzpatrick et al.

- Fitzpatrick, M., Stalikas, A., Iwakabe, S. (2001). Examining Counselor Interventions and Client Progress in the Context of the Therapeutic Alliance. *Psychotherapy, 38(2), 160-170.*

- Exploratory design with 3 categorical variables, coded from session recordings / transcripts:
  - Counsellor interventions (VRM)
  - Client good moments (GM)
  - Strength of working alliance (WAI)
- Therapy: 21 sessions, male & female clients & therapists, expert therapists, diverse models.

Fitzpatrick: Research Question

- RQ: For expert therapists, what associations exist amongst VRM, GM, and WAI?
- Therapist Verbal Response Modes:
  - 8 categories: encouragement, reflection, self-disclosure, guidance, etc.
- Client Good Moments:
  - Significant (I)nformation, (E)xploratory, or (A)ffective-Expressive
- Working Alliance Inventory
  - Observer rates: low, moderate, high

Fitzpatrick: Abstract

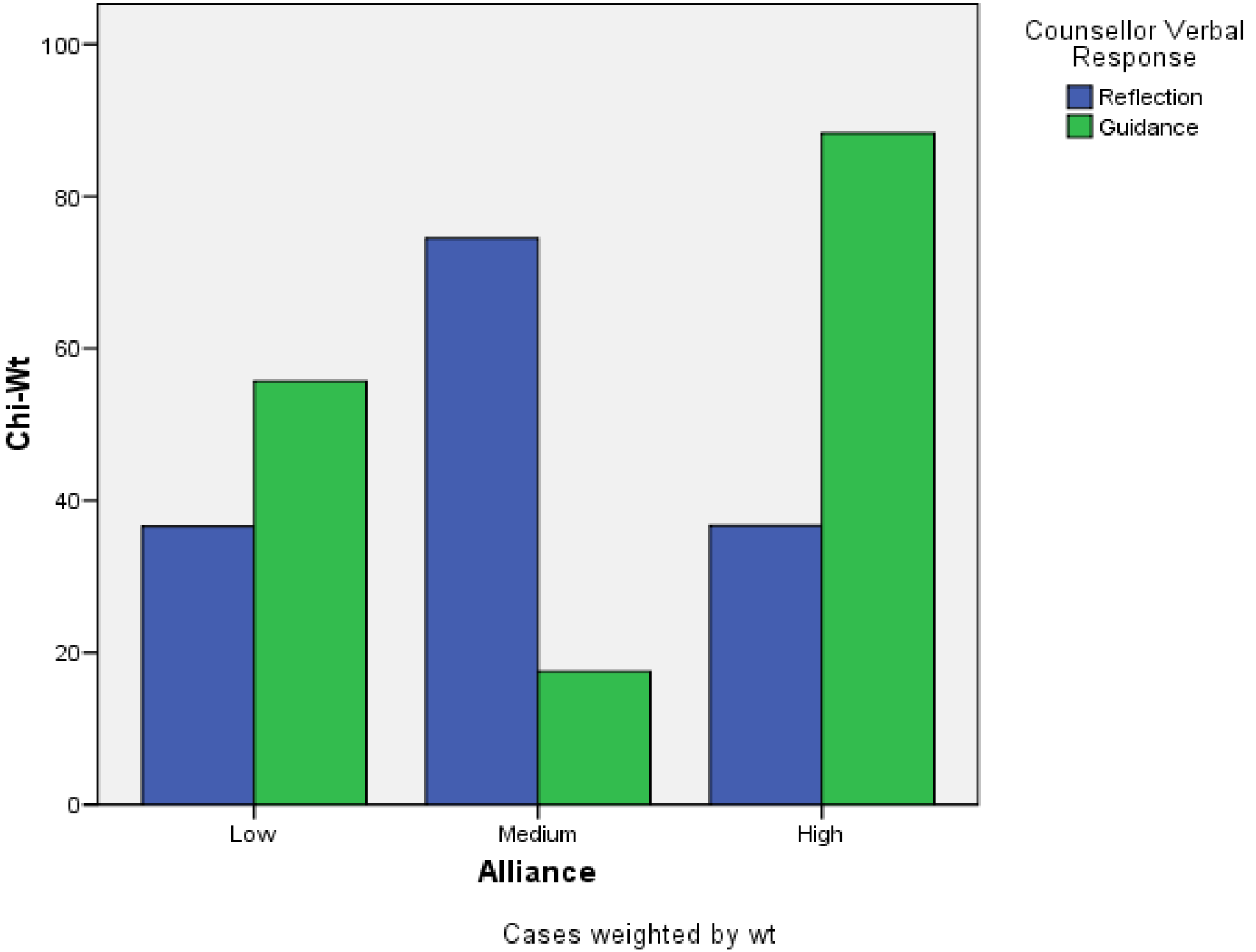
- Client "good moments" did not necessarily increase with Alliance
- Different interventions fit with good moments of client information (GM-I) at different Alliance levels.
- "Qualitatively different therapeutic processes are in operation at different Alliance levels."
- Explain each statement and how it summarizes the results.

Top-down Analysis: Interaction

- As in ANOVA and Regression, Loglinear analysis starts with the most complex interaction ("highest order") and tests whether it adds incrementally to the overall model fit
  - Compare with ΔR^2 in regression analysis
- Interpretation focuses on:
  - 3-way interaction: VRM * GM * WAI
  - Then the 2-way interactions: GM * WAI, etc.
- Fitzpatrick did separate analyses for each of the three kinds of good moments: GM-I, GM-E, GM-A

Results: Interactions

- 2-way CGM-E x WAI interaction:
  - Exploratory Good Moments tended to occur more frequently in High Alliance sessions
- 2-way WAI x VRM interaction:
  - Structured interventions (guidance) take place in Hi or Lo Alliance sessions, while
  - Unstructured interventions (reflection) are higher in Moderate Alliance sessions
  - Describes shared features of “working through” and “working with” clients, different functions of safety & guidance.


Counsellor Verbal Response
Reflection
Guidance
100
80
60
40
20
0
Chi-Wt
Low
Medium
High
Alliance
Cases weighted by wt

Meta-Analysis

- The APA journal has basic standards for literature review in many areas
- Meta-Analysis (MA) is a tool for combining results of quantitative studies in a systematic, quantitative way.
- Example Meta-Analysis journal article:
  - Hill, C. E., & Lent, R. W. (2006). A narrative and meta-analytic review of helping skills training: Time to revive a dormant area of inquiry. *Psychotherapy: Theory, Research, Practice, Training*, 43(2), 154–172.

MA Focuses on Effect Sizes

- Choose groups of studies and subgroups of studies to combine and compare
- g : difference between the means divided by the pooled standard deviation
- d : unbiased estimates of the population effect size as reported by each study

Combining Effect Sizes: ex.

- Example: two correlation studies, with
  - $r_1 = .22$ and $r_2 = .34$
  - $N_1 = 125$ and $N_2 = 43$
- Combine studies to estimate r
- Unweighted average: (.22 + .34) / 2 = .28
- Weighted average by sample size:
  [.22(125) + .34(43)] / (125 + 43) = .25
- The larger sample has a smaller effect size!

Persuasiveness of MA

- Quality of studies (design, etc.)
- Comparability of studies (variables, measures, participants, etc.)
  - Especially moderating factors!
- RQ: Differences among types of training? (instruction, modeling, feedback)
- Do we know the "amount" of training time examined in each study?
- What impact might these factors have on the interpretation of the meta-analysis?

Hill & Lent (2006)

- p.159: Summary of strategy and symbols used
- p.160: List of studies being summarized (k = 14), including outcome measures, etc.
- Multiple measures were aggregated within each study by calculating a mean effect size and standard error
- Use Cohen's (1988) criteria for effect size: d=0.20 (small), d=0.50 (med), d=0.80 (large)

Global analysis: outlier

- Hill & Lent chose to exclude one entire study as an outlier: p.161:
- "Given its potential to disproportionately influence effect sizes, especially in a relatively small set of studies, the outlier study was omitted in our subsequent analyses."
- Now only 13 studies left …
- Pros & cons of this omission?

Questions... pre-assignment

- Note: The same group of studies is used in all sections of Hill & Lent...
- How do the different research questions shape the MA calculations?
- How do confidence intervals help us interpret effect sizes (ES)?
- How do we integrate the results of different research questions?

Formatting Tables in MS-Word

- Use the “insert table” and “table properties” functions of Word to build your tables; don’t do it manually.
- General guidelines for table formatting can be found on pages 147-176 of the APA manual.
- Additional tips and examples: see NCFR site: http://oregonstate.edu/~acock/tables/
- In particular, pay attention to the column alignment article, for how to get your numbers to align according to the decimal point.