

Detection of Neuropsychiatric States of Interest in Text

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Adaptation of Existing Method

- Gottschalk-Gleser content analysis method
- Manual process – human scorers
- Documented beginning in 1950s
- Focus on research over multiple subjects – not one-on-one interaction

Measuring Psychological States

- Directly observable speech behavior
- Processed and analyzed using empirically derived scales
- Provides a numerical approximation of complex neuropsychobiological states

Defined Scales

- Anxiety (6 subscales)
- Hostility Outward (2 subscales)
- Hostility Inward
- Ambivalent Hostility
- Social Alienation / Personal Disorganization
- Cognitive Impairment
- Hope
- Depression
- Health / Sickness
- Achievement Strivings
- Human Relations
- Dependency Strivings
- Quality of Life

Scale Development

- All scale development is empirical
- Hypothesize state/trait to measure, validate construct
- Collect examples of text, identify candidate markers
- Confirm/deny presence of markers in further examples
- No specific theoretical model of speech production

Extensive Research Background

- Reliability and validity studies
- Application over many areas
 - Drug development
 - Alcohol studies
 - Therapy studies
 - Others
- Cross-cultural and cross-language studies

Standard Procedure

- Five-minute verbal sample in response to a standard prompt
- Sample transcribed to written form
- Clause boundaries are identified
- Scores assigned to each clause in accordance with scale definitions
- Clause scores aggregated over entire sample (scale score)
- Scale score compared with norms

Standard Neutral Prompt

"This is a study of speaking and conversational habits. I have a microphone here, and I would like you to talk for five minutes about any dramatic or personal life experiences you have ever had. While you are talking I would prefer not to reply to any questions you have until the five minutes is over. Do you have any questions now? If not, you may start talking now."

Sample Scale Definition

- Cognitive Impairment Scale
- Derived from Social Alienation / Personal Disorganization Scale
- Used in a variety of studies
 - Presidential debates (Reagan, Carter, Mondale)
 - Substance abusers (for NIDA)
 - Chemotherapy recipients (internal UCI)

Cognitive Impairment Scale (Part 1 of 3)

I. Interpersonal References

- B. To unfriendly, hostile, destructive thoughts, feelings, or actions
 1. **Self unfriendly to others (-1/2)**
- C. To congenial and constructive thoughts, feelings, or actions
 1. **Others helping, being friendly toward others (-1/2)**
 2. **Self helping, being friendly toward others (-1/2)**
 3. **Others helping, being friendly toward self (-1/2)**

Cognitive Impairment Scale (Part 2 of 3)

II. Interpersonal References

- A. To disorientation-orientation, past, present, or future (+3)
- B. To self
 - 1. Injured, ailing, deprived, malfunctioning, getting worse, bad, dangerous, low value or worth, strange (-1/2)
 - 3. Intact, satisfied, healthy, well (+1/4)
 - 5. To being controlled, feeling controlled, wanting control, asking for control or permission, being obliged or having to do, think, or experience something (+1)
- C. Denial of feelings, attitudes, or mental state of the self (+1)
- D. To food
 - 2. Good or neutral (-1)

Cognitive Impairment Scale (Part 3 of 3)

III. Miscellaneous

- A. Signs of disorganization
 - 2. Incomplete sentence, clauses, phrases; blocking (+1)
- B. Repetition of ideas in sequence
 - 2. Phrases, clauses (separated only by a phrase or clause) (+1)

IV. References to Interviewer

- A. Questions directed to the interviewer (+1/2)

Manual Processing a Problem

- Scorer training is time-consuming
- Inter-scorer reliability varies, requiring re-training
- Scorers require compensation, making the procedure expensive
- Manual scoring is not especially quick

Response – Computerize Scoring

- Initial efforts in early 1970s focused on Hostility Scales, mainframe computers
- Small-scale effort gave positive results
- Introduction of personal computers motivated renewed efforts
- Many years of refinement – adding scales, new features

Computer Scoring

- Automate method
- Speed processing, increase consistency
- Correlates highly with trained human scoring (correction factors available)
- Produces a range of outputs for different uses

Computer Scoring Process

- Dictionary based
 - Part-of-speech and other syntactic information
 - Scale-specific scoring information
 - Categorization for nouns (self, other, inanimate)
 - Entries for words and phrases (idioms)

Computer Scoring Process (cont.)

- Input is parsed for clause structure
 - Uses syntactic information from dictionary
 - Identifies clause boundaries, agents, recipients
 - Parsing result is an input to score determination
- Scale-specific scoring information taken from dictionary for words and phrases found in input

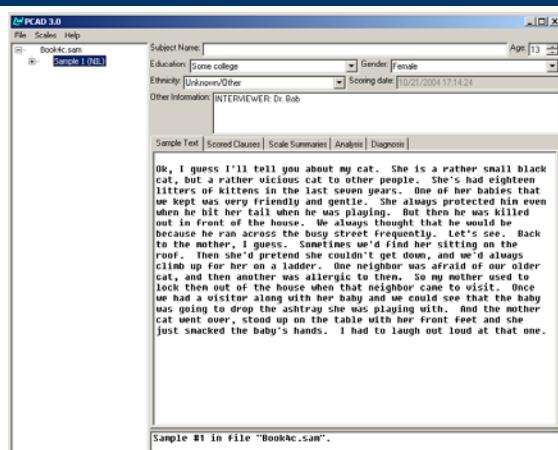
Computer Scoring Process (cont.)

- Scale-dependent procedures combine parse-based information with scoring information to validate/reject possible clause scores
- Individual clause scores are aggregated over the sample
- Sample scores are calculated
- Scores are compared to norms
- Norm comparisons used to generate analyses and suggested diagnoses

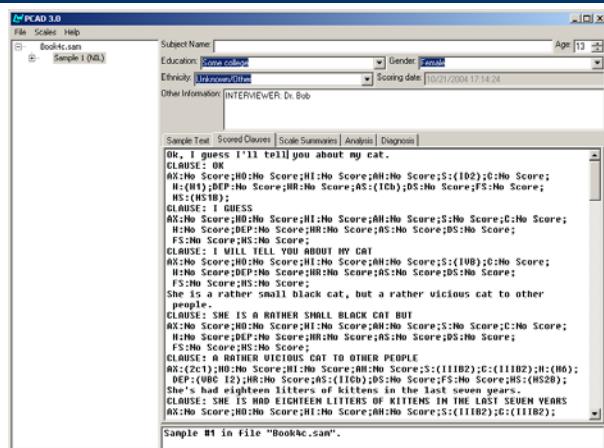
Computer Scoring Outputs

- Clause-by-clause scoring
- Summary scoring for sample on each scale
- Textual analysis of sample result based on deviations from norms
- Suggested DSM-IV diagnoses (also based on deviations from norms)

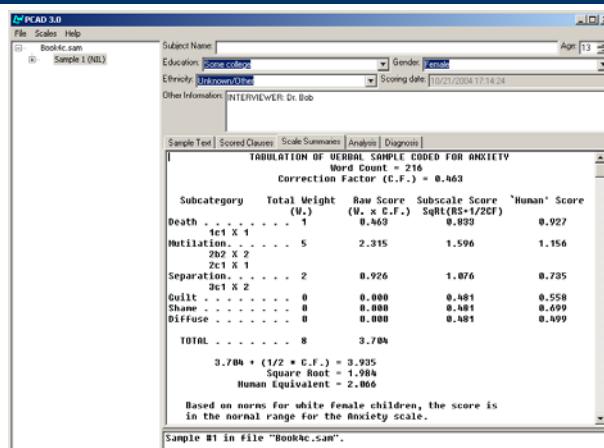
Input Text



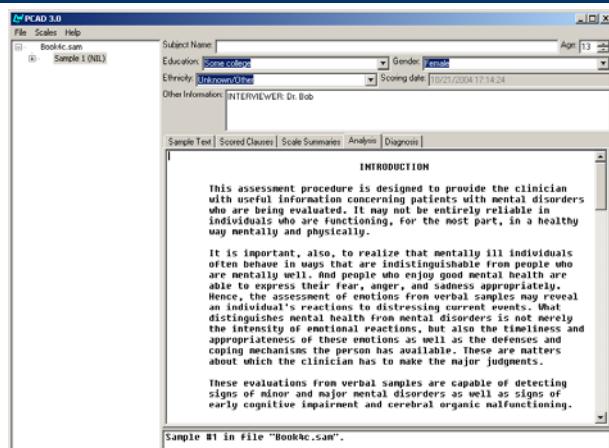
Clause-by-Clause Scoring



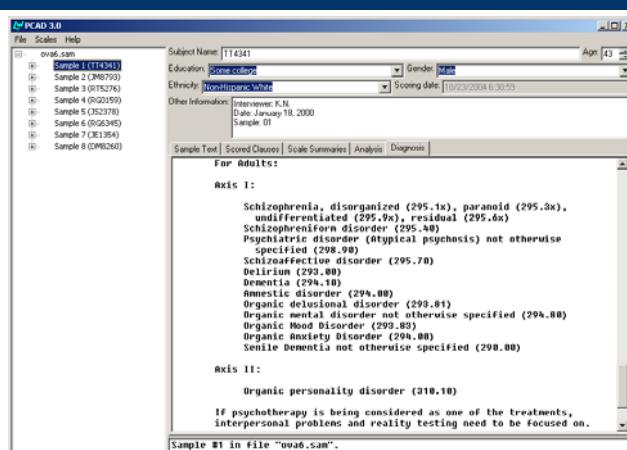
Scale-by-Scale Summaries



Analysis of Results



Potential Diagnoses



Computer Scoring Enables

- Larger studies
- Composite scales – Depression, Quality of Life
- Widespread use of the technique, since scorer training is not required

Issues for Direct Interaction

- Speech recognition not up to the task
 - In one study, only 57% of words appeared in both human- and computer-transcriptions (paper in press)
 - Fortunately, studies indicate that scales are valid for written input
- Scoring on short (<80 word) samples not reliable
 - Aggregation appears to be viable
 - Subscale detection still potentially useful
- Sample-level aggregation loses specific topics
 - E.g., all entities classed as self, other, inanimate
 - Individuals (other than self) not distinguished

Experimental Prototype

- Basic subject data collection via form fill
 - Age, education, gender, drugs
- Adaptation of neutral prompt to elicit typed user input
- Score constellation selects system response

Data Collection

The screenshot shows a Windows application window titled "THERAPIST". The window contains several input fields: "Your name:" (Jill Green), "Your education:" (Some grade school), "Your ethnicity:" (Non-Hispanic White), "Your gender:" (Female), and "Your age:" (25). There is also a "Session date:" field. Below these fields is a "THERAPIST remark:" section with a text area and a "Session transcript:" scrollable text area at the bottom.

Please provide some information about yourself by filling in the material above, such as name, age, etc. The session date will be filled in automatically. When you have finished filling in the basic personal information, type in personal interesting or dramatic life experiences you have ever had by typing in the area below marked 'Your input...'. Click on the OK button to signal that you are done typing.

Your input:

Session transcript:

Subject Input

Re: Help

Your name: Louise Farmer Your age: 13
Your education: Finished grade school Your gender: Female
Your ethnic background: Non-Hispanic White Session date:

THERAPIST remark:

Please provide some information about yourself by filling in the material above, such as name, age, etc. The session date will be filled in automatically. When you have finished filling in those blanks, please describe any personal interesting or dramatic life experiences you have ever had by typing in the area below marked 'Your input'. Click on the OK button to signal that you are done typing.

Your input:

ladder... One neighbor was afraid of our older cat, and then another was allergic to them. So my mother used to lock them out of the house when that neighbor came to visit. Once we had a visitor along with her baby and we could see that the baby was going to drop the ashtray she was playing with. And the mother cat went over, stood up on the table with her front feet and she just smacked the baby's hands. I had to laugh out loud at that one!

OK | Clear | Post

Session transcript:

System Response

Re: Help

Your name: Louise Farmer Your age: 13
Your education: Finished grade school Your gender: Female
Your ethnic background: Non-Hispanic White Session date:

THERAPIST remark:

These are matters we need to talk about more. There must have been a number of stressors in your life to bring on emotional strain. I believe you should consider communicating regularly with a weekly trip up to appear before the therapist you have gone through. I believe that communicating with someone else about these events will help relieve the inner pressures you are experiencing. Also, I wonder whether your family doctor is prescribing some medications for you that might relieve some of your symptoms.

Your input:

THERAPIST said:

Please provide some information about yourself by filling in the material above, such as name, age, etc. The session date will be filled in automatically. When you have finished filling in those blanks, please describe any personal interesting or dramatic life experiences you have ever had by typing in the area below marked 'Your input'. Click on the OK button to signal that you are done typing.

You said:

OK. I guess I'll tell you about my cat. She is a rather small black cat, but a rather vicious cat to other people. She's had eighteen litters of kittens in the last seven years. One of her babies that we kept was very friendly and gentle. She always protected him even when he was being picked on by other cats. But he would kill out the kitten of the house. We always thought that he would be because he ran across the busy street frequently. Let's see. Back to the mother, I guess. Sometimes we'd find her sitting on the roof. Then she'd pretend she couldn't get down, and we'd always climb up for her on a ladder. One neighbor was afraid of our older cat, and then another was allergic to them.

Status and Plans

- System very preliminary
- Need finer discrimination among analyses
 - Interaction among scales
 - Use of specific score items
- Entity tracking is high priority
 - Determining coreferences
 - Associating affect with specific entities
- Move away from “canned” responses

“Generic” Dialogue Issues

- Conversational goals
- User modeling
 - Models of therapy – model both user and interaction process
- Tactical utterance generation
 - Moving beyond template responses