

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

The screenshot displays the PCAD 3.0 software interface. The window title is "PCAD 3.0" and the file name is "Book4c.sam". The interface includes a menu bar (File, Scores, Help) and several input fields: "Subject Name:" (empty), "Age:" (13), "Education:" (Some college), "Gender:" (female), "Ethnicity:" (Hispanic/Other), and "Scoring date:" (10/20/2004 17:14:24). Below these fields is a tabbed area with "Other Information:" containing the text "INTERVIEWER: Dr. Bob". The main text area is titled "Sample Text" and contains a paragraph of text: "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 bit her tail when he was playing. But then he was killed out in front 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. 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 ash-tray she was playing with. And the mother cat went over, stood up on the table with her front feet and she just snacked the baby's hands. I had to laugh out loud at that one."

Sample #1 in file "Book4c.sam".

Clause-by-Clause Scoring

Subject Name: _____ Age: 13

Education: Some college Gender: Female

Ethnicity: Unknown/Other Scoring date: 10/23/2004 17:14:24

Other Information: INTERVIEWER: Dr. Bob

Sample Text | Scored Clauses | Scale Summaries | Analysis | Diagnosis

OK, I guess I'll tell you about my cat.

CLAUSE: OK
 AX:No Score;NO:No Score;HI:No Score;AH:No Score;S:(102);O:No Score;
 N:(H1);DEP:No Score;HR:No Score;AS:(10B);OS:No Score;FS:No Score;
 NS:(NS1B);

CLAUSE: I GUESS
 AX:No Score;NO:No Score;HI:No Score;AH:No Score;S:No Score;O:No Score;
 N:No Score;DEP:No Score;HR:No Score;AS:No Score;OS:No Score;
 FS:No Score;NS:No Score;

CLAUSE: I WILL TELL YOU ABOUT MY CAT
 AX:No Score;NO:No Score;HI:No Score;AH:No Score;S:(10B);O:No Score;
 N:No Score;DEP:No Score;HR:No Score;AS:No Score;OS:No Score;
 FS:No Score;NS:No Score;

She is a rather small black cat, but a rather vicious cat to other people.

CLAUSE: SHE IS A RATHER SMALL BLACK CAT BUT
 AX:No Score;NO:No Score;HI:No Score;AH:No Score;S:No Score;O:No Score;
 N:No Score;DEP:No Score;HR:No Score;AS:No Score;OS:No Score;
 FS:No Score;NS:No Score;

CLAUSE: A RATHER VICIOUS CAT TO OTHER PEOPLE
 AX:(2C1);NO:No Score;HI:No Score;AH:No Score;S:(11B2);O:(11B2);N:(H6);
 DEP:(W6 I2);HR:No Score;AS:(11C);OS:No Score;FS:No Score;NS:(NS2B);
 She's had eighteen litters of kittens in the last seven years.

CLAUSE: SHE IS AND EIGHTEEN LITTERS OF KITTENS IN THE LAST SEVEN YEARS
 AX:No Score;NO:No Score;HI:No Score;AH:No Score;S:(11B2);O:(11B2);

Sample #1 in file "BookAc.sam".

Scale-by-Scale Summaries

Subject Name: _____ Age: 13

Education: Some college Gender: Female

Ethnicity: Unknown/Other Scoring date: 10/23/2004 17:14:24

Other Information: INTERVIEWER: Dr. Bob

Sample Text | Scored Clauses | Scale Summaries | Analysis | Diagnosis

TABULATION OF VERBAL SAMPLE CODED FOR ANXIETY

Word Count = 216
 Correction Factor (C.F.) = 0.463

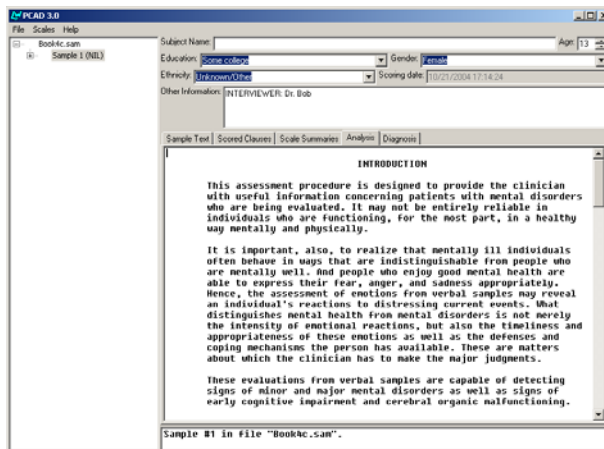
Subcategory	Total Weight (W.)	Raw Score	Subscale Score	'Human' Score
		(W. x C.F.)	Sqrt((RS*1/2CF)	
Death	1	0.463	0.839	0.927
1c1 X 1				
Mutilation	5	2.315	1.596	1.156
2b2 X 2				
2c1 X 1				
Separation	2	0.926	1.076	0.735
3c1 X 2				
Guilt	0	0.000	0.481	0.558
Shame	0	0.000	0.481	0.699
Diffuse	0	0.000	0.481	0.409
TOTAL	8	3.704		

3.704 * (1/2 * C.F.) = 3.935
 Square Root = 1.984
 Human Equivalent = 2.466

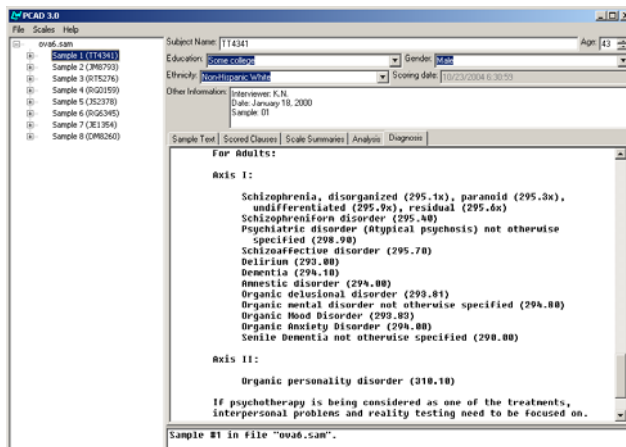
Based on norms for white female children, the score is in the normal range for the anxiety scale.

Sample #1 in file "BookAc.sam".

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

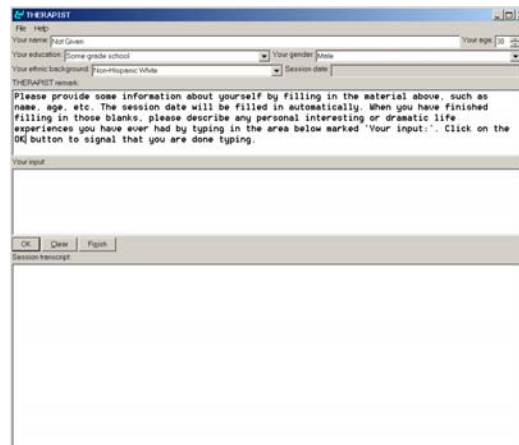
Issues for Direct Interaction

- 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 window titled "THERAPIST" with a menu bar (File, Help) and several input fields: "Your name" (text), "Your age" (spin box), "Your education" (dropdown menu), "Your gender" (dropdown menu), "Your ethnic background" (dropdown menu), and "Session date" (text). Below these fields is a text area with the following text: "THERAPIST notes: 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." Below the text area is a large text input field labeled "Your input:". At the bottom of the window are three buttons: "OK", "Clear", and "Finish". Below the buttons is a text area labeled "Session transcript:".

Subject Input

THERAPIST

File 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 other cat went over, stood up on the table with her front feet and she just secked the baby's hands. I had to laugh out loud at that one.

OK Clear Finish

Session transcript:

System Response

THERAPIST

File 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 such mental strain. I believe we should consider communicating regularly maybe daily or weekly to help us appreciate the tough times 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:

OK Clear Finish

Session transcript:

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 bit her tail when he was playing. But then he was killed out in front 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