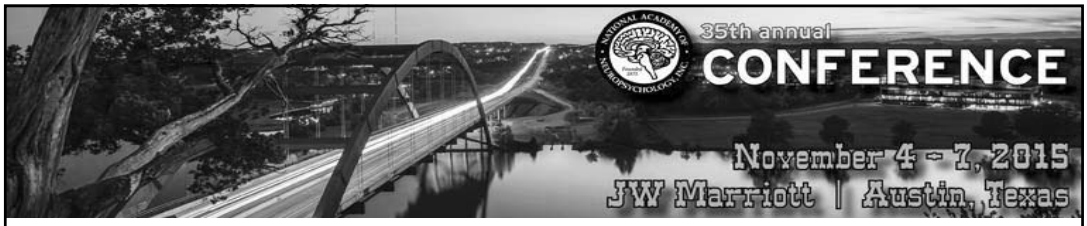
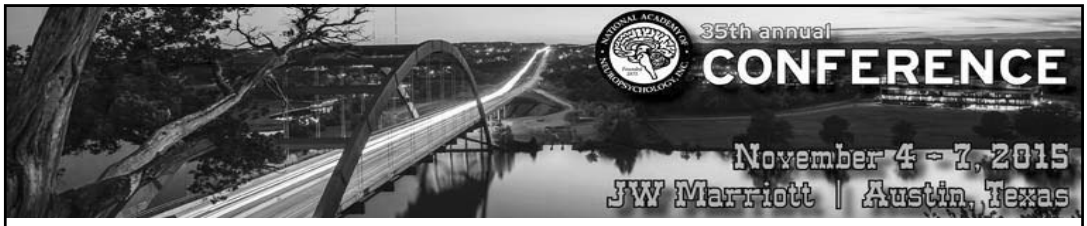


Moving Neuropsychology from the Backdoor to the Front Door: Embracing Outcomes in Research and Practice

Gordon J. Chelune, Ph.D.
Professor, Department of Neurology
University of Utah School of Medicine



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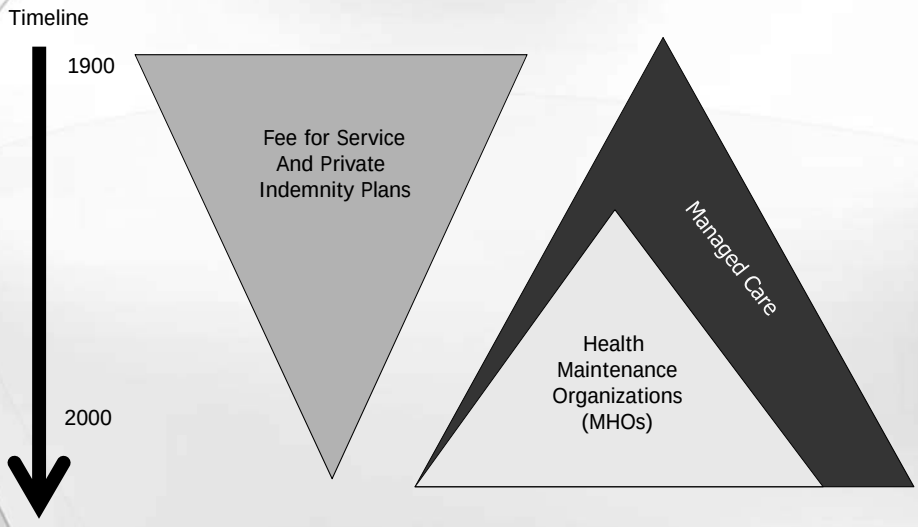
"A Talk"

Moving Neuropsychology from the Backdoor to the Front Door: Embracing Outcomes in Research and Practice

Evidence Based Medicine and "The Outcomes Movement"

The Changing Face of Health Care



Evidence Based Medicine

An Alternative but Complimentary Approach to Administrative Managed Care

Clinical Practice and Evidence-Based Medicine:

Toward a value-driven, evidence-based health care system

"Evidence-based medicine, or the 'outcomes movement,' accepts as axiomatic that a substantial portion of health care expenditure in the United States is wasted on unproven or ineffective tests and treatments. As a result, this movement figures prominently in health care reforms and in medical education."

Horwitz, 1996

A value-driven, evidence-based health care system

Based on Outcomes Management not Administrative Management

As originally conceived, procedures and treatments have value (are reimbursable) if they can be objectively demonstrated to positively affect (change) a patient's condition in a cost effective manner.

Outcomes Management

A value-driven, evidence-based health care system

Outcomes accountability and following the outcomes of patients and managing them on the basis of epidemiologic information is critical to medicine and the HMO movement.

Paul Ellwood, M.D.

Note: Emphasis is not on "how much" but on "how many"

What is a Clinical Outcome?

In a broad sense, clinical outcomes are discrete measurable events, marked by a change in status, performance, or other objectively defined endpoint, that can be tracked both in the aggregate on a group level but also, importantly, at the level of the specific patient.

Chelune, 2002, 2010

Neuropsychological Evaluations Involve Inferences about CHANGE

- Single-Point Assessment – Does the observed test score represent a meaningful difference from an inferred premorbid?
- Serial Assessment – Does the observed retest score represent a meaningful or reliable change/difference from baseline?

Do these changes – "Outcomes" -- have relevancy for diagnosis or treatment?

From Description to Outcomes

Every Patient Evaluation

- Represents a Clinical Outcome
- Every Test Score is part of the Outcome
- Can/Should be interpreted within context of Evidence-based Research

Evidence-Based Practice: General Components

- Integration of “best research”
- Clinical expertise
- Patient/Referral Source values

Who is the Evidence-Based Clinical Neuropsychological Practitioner?

A Clinical Neuropsychologist who uses …

A value-driven pattern of clinical practice that attempts to integrate “best research” derived from the study of populations to inform clinical decisions about individuals within the context of his/her expertise and individual patient values with the goal of maximizing clinical outcomes and quality of life for the patient in a cost-effective manner while addressing the concerns and needs of the provider’s referral sources.

Adapted from Chelune, 2010

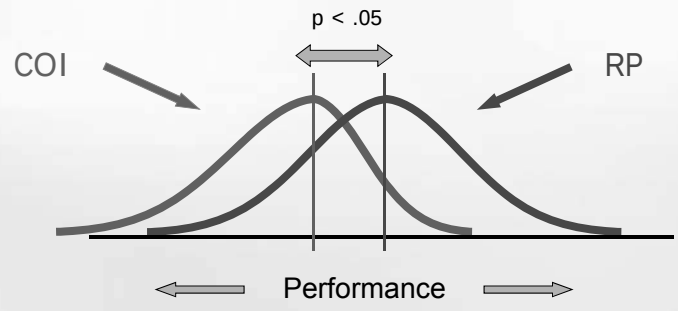
Clinical Significance of Tests

Patients "deserve decisions and recommendations that are founded increasingly upon empirical validation. The instruments chosen to produce data to resolve questions in a valid fashion should be selected for their power to reduce uncertainty with respect to those questions..."

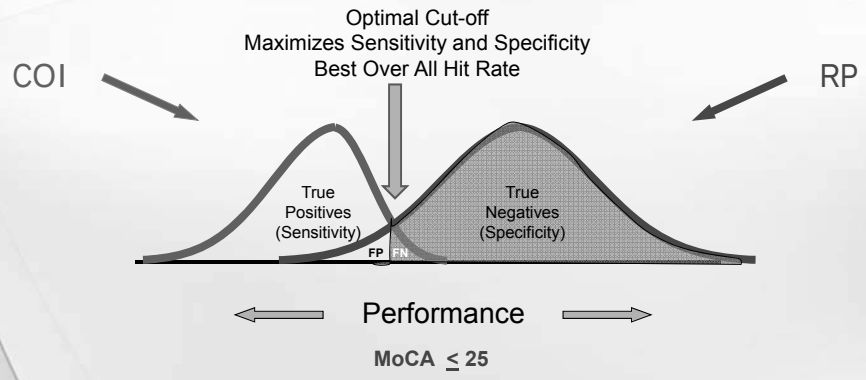
Costa, JCN, 1983, p. 7.

Our ability "to reduce uncertainty" provides value to patient care

Is the difference between groups statistically reliable?



Clinical Significance

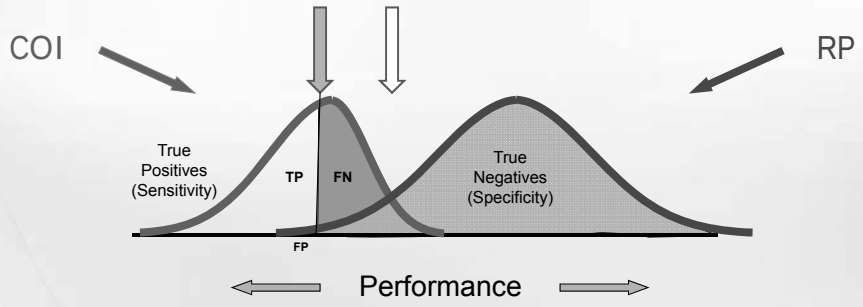


MoCA ≤ 25

Diagnostic vs Screening Tests

Its All About the Cutoff

SpPin: High Specificity + Positive Result = Rules the COI **IN**

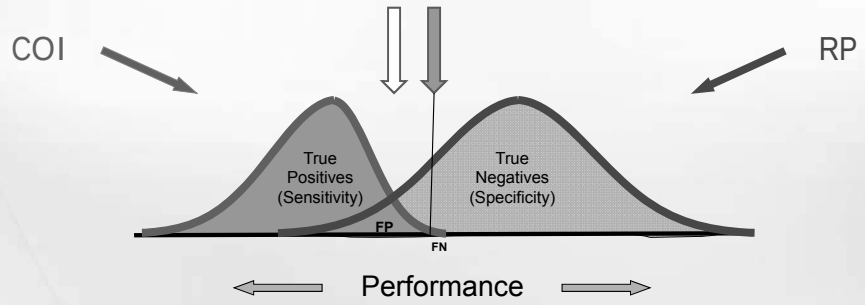


Diagnostic vs Screening Tests

Its All About the Cutoff

TOC: Test Operating Characteristics

SnNout: High Sensitivity + Negative Result = Rules the COI **OUT**

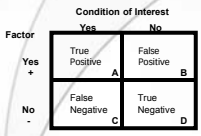


The Basic 2x2 Table

Condition of Interest

Factor (event)	**Yes**	**No**
Yes +	True Positive **A**	False Positive **B**
No -	False Negative **C**	True Negative **D**

Bayesian Test Operating Characteristics	
% Prevalence	Odds
% Overall Correct Hit Rate	Odds Ratio
Sensitivity	Relative Risk Ratio
Specificity	Likelihood Ratio
Positive Predictive Power	Pre – Post Test Odds
Negative Predictive Power	Pre – Post Test Probabilities



TOC Characteristics of a Diagnostic Test

Likelihood Ratio: **A measure of how reliably a diagnostic test actually detects the COI. It represents the likelihood that a test result would be expected in patients with the COI divided by the likelihood that the same result would be expected in patients without the COI. It compares the proportion of TP to proportion of FP**

LR+: Likelihood of COI if Test is Positive = Sensitivity/(1-Specificity)
LR-: Likelihood of COI if Test is Negative = (1-Sensitivity)/Specificity

Interpretation of LR+: ***If a test result is positive in a patient, the patient is X-times more likely to have the COI than not to have it.***

- **More stable than PPP and NPP**
- **Does not vary with prevalence**
- **Can be calculated for several levels of a test result.**

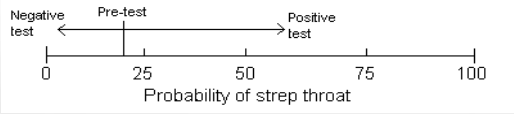
Bayesian approach: Analyses of Changes in Base Rates

Bayes' Theorem: What we know after giving a test in equal to what we knew before doing the test times a modifier (based on the test results). Test results are used to adjust a *prior distribution* to form a new *posterior distribution* of scores.

Value Driven Pattern of Practice

Michigan State University: Evidence-based Medicine Course
http://omerad.msu.edu/ebm/Diagnosis/Diagnosis4.html

In the language of clinical epidemiology, we take our initial assessment of the likelihood of disease ("pre-test probability"), do a test to help us shift our suspicion one way or the other, and then determine a final assessment of the likelihood of disease ("post-test probability").



The Test Result guides the Rx (the "Front Door")

From the Backdoor to the Front Door

From Description to Prediction

From Dependent Variable to Independent Variable

An Application:

International Neuropsychological Society
Dublin, Ireland,2005

Risk of Processing Speed Deficits among Patients with Relapsing Remitting and Secondary Multiple Sclerosis

GJ Chelune & L Stone
Cleveland Clinic

Referral Question:

My patient with RMSS is complaining of increased cognitive problems; physical exam is relatively stable. Has the patient's course become Secondary Progressive?

Literature Review (Best Evidence):

- Background: What are the best measures to differentiate SPMS from RRMS?
- Foreground: In patients with

Patient: SPMS
Intervention: what neuropsychological tests
Comparison: compared RRMS
Outcome: are sensitive?

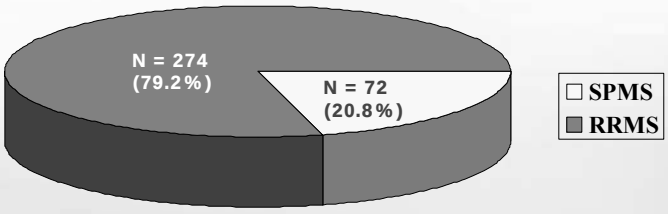
Research Question (Case Controlled Study) :

Can patients' performances on measures of processing speed (e.g., WAIS-III PSI, Trails B, and PASAT) help me identify those who are likely to have SPMS vs. RRMS? If so, what is the likelihood that this patient has SPMS?

CCF MS Patient Registry

N = 346

(Patients with WAIS-III PSI, Trails B, and PASAT)



Logistic Regression Using PSI-Tc, Trails B and PASAT as Predictor Variables

Classification

Observed	Predicted SPMS	Predicted RRMS	Percent Correct
SPMS	24	48	33.3%
RRMS	6	268	97.8%
Overall Percentage	8.7%	91.3%	84.4%

Demographically Corrected PSI (Tc-PSI) for RRMS and SPMS

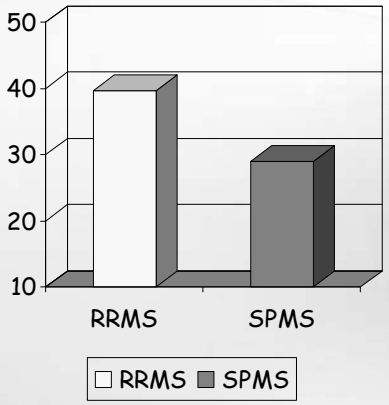
	RRMS		SPMS	
	M	*SD*	*M*	*SD*
Tc-PSI	39.7	*10.8*	29.0	*9.5*

$F(1,344) = 58.96$, $p < .0001$

$\eta^2 = .146$

Cohen's $d = 1.02$

OL% = .46



But what about my patient?

With a PSI-Tc score < 40, how likely is s/he to have SPMS than when the score is ≥ 40?

Classification of Cases

Factor PSI Tc	Condition of Interest: SPMS	Condition of Interest: RRMS	
< Tc 40	62 (A)	141 (B)	203
≥ Tc 40	10 (C)	133 (D)	143
	72	274	346

Diagnostic Information:

Prevalence of SPMS (+ Case):
(A+C)/N: (62+10)/346 = **20.8%**

Overall Hit Rate:
(A+D)/N: (62+133)/346 = **56.4%**

Sensitivity: A/(A+C): 62/72 = **86.1%**

Specificity: D/(B+D): 133/274 = **48.5%**

Positive Predictive Power (PPP):
A/(A+B): 62/(62+141) = **30.5%**
Given that the patient has a PSI Tc ≤ 40, the probability that they have SPMS is 30.5%

Negative Predictive Power (NPP):
D/(C+D): 133/(10+133) = **93.0%**
Given that the patient has a PSI TC >40, the probability that that they do not have SPMS is 93.0%

2x2 Table Classification Table

Factor PSI Tc	Condition of Interest: SPMS	Condition of Interest: RRMS	
< Tc 40	62 (A)	141 (B)	203
≥ Tc 40	10 (C)	133 (D)	143
	72	274	346

Diagnostic Information:

Odds Ratio: (A*D)/(B*C)
(62*133)/(141*10) = **5.85**
Among patients with SPMS the odds of having a PSI Tc < 40 is 5.85 times higher than PSI Tc ≥ 40.

Likelihood Ratio: Sensitivity/(1-Specificity)
.861/(1 - .485) = **1.67**
If a patient has PSI Tc < 40, the patient is 1.67 times more likely to have SPMS than not to have it.

Can patients' performances on measures of processing speed (i.e., WAIS-III PSI) help me identify those who are likely to have SPMS?

Test Operating Characteristics	
% **Prevalence** (**Baserate**) of COI	20.81
% Overall Correct Hit Rate	56.36
Sensitivity (% True Positives)	0.8611
Specificity (% True Negatives)	0.4854
Positive Predictive Power	0.305
Negative Predictive Power	0.930
Odds Ratio	5.8482
Risk Ratio (cohort studies)	4.3675
Likelihood Ratio (LR+)	1.6734
Pre-Test Odds	0.2628
Post-Test Odds	0.4397
Pre-test Probability	0.2081
Post-Test Probability	0.3054

Journal of the International Neuropsychological Society (2009), **15**, 769–776.

doi:10.1017/S1355617709990373

The diagnostic utility of multiple-level likelihood ratios

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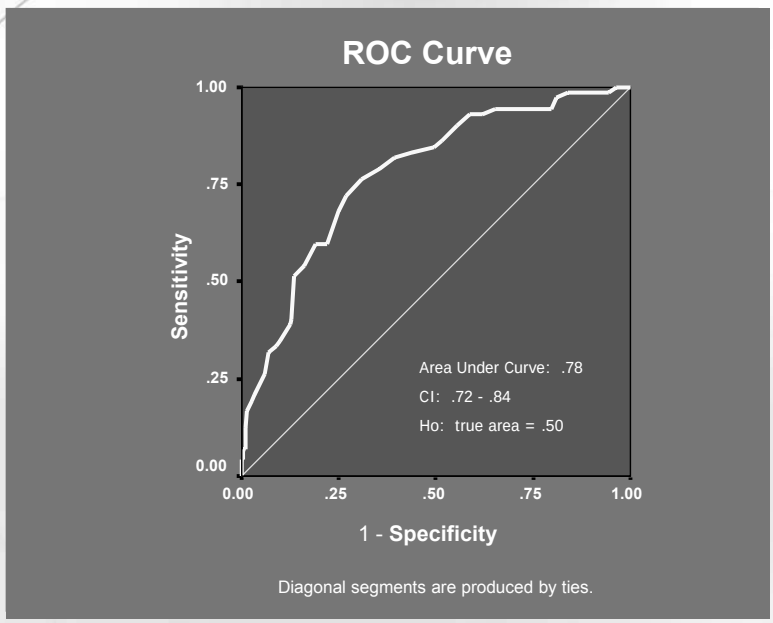
(RECEIVED September 12, 2008; FINAL REVISION June 2, 2009; ACCEPTED June 11, 2009)

Abstract

Clinicians are accustomed to interpreting diagnostic test scores in terms of sensitivity and specificity. Many clinicians also appreciate that sensitivity and specificity need to be interpreted in terms of local base rates (i.e., pretest probability). However, most neuropsychological tests contain a wide range of scores. Important diagnostic information may be sacrificed when valid test scores are reduced to the simple dichotomy of "positive" or "negative" diagnosis that underlies sensitivity and specificity analysis. The purpose of this study is to provide an introduction to multiple-level likelihood ratios, a method for preserving the information in a wider range of scores. These statistics are first described using a hypothetical example of dementia screening, then with patient data from an epilepsy surgery sample. Multiple-level likelihood ratios have several advantages over sensitivity and specificity analysis because they are applied across a wider range of diagnostic scores, and generalize to settings with different base rates. We suggest that the diagnostic validity of many psychological tests may be underestimated by relying solely on traditional dichotomous sensitivity and specificity analysis. (*JINS*, 2009, *15*, 769–776.)



Positive if Less Than or Equal To	Sensitivity	1-Specificity		Positive if Less Than or Equal To	Sensitivity	1-Specificity	
10.00	.000	.000		39.50	.861	.515	LR 1.7
11.50	.028	.000		40.50	.903	.555	
12.50	.042	.000		41.50	.931	.588	
13.50	.042	.004		42.50	.931	.620	
14.50	.069	.004		43.50	.944	.653	
15.50	.069	.011		44.50	.944	.693	
16.50	.083	.011		45.50	.944	.737	
17.50	.097	.011		46.50	.944	.759	
18.50	.125	.011		47.50	.944	.777	
19.50	.167	.015		48.50	.944	.796	
20.50	.194	.026	LR 11.1	49.50	.972	.810	
21.50	.208	.033		50.50	.986	.839	
22.50	.264	.058		51.50	.986	.861	
23.50	.319	.069		52.50	.986	.880	
24.50	.333	.088		53.50	.986	.901	
25.50	.347	.099		54.50	.986	.909	
26.50	.389	.124		55.50	.986	.927	
27.50	.403	.128		56.50	.986	.931	
28.50	.514	.135		57.50	.986	.945	
29.50	.542	.161	LR 3.4	58.50	1.000	.964	
30.50	.597	.190		60.00	1.000	.971	
31.50	.597	.219		61.50	1.000	.974	
32.50	.681	.248		63.00	1.000	.982	
33.50	.722	.270		65.50	1.000	.985	
34.50	.764	.307		68.50	1.000	.989	
35.50	.792	.354		72.50	1.000	.993	
36.50	.819	.394		76.00	1.000	.996	
37.50	.833	.438		78.00	1.000	1.000	
38.50	.847	.496					

3.00 SD → (20.50)

2.00 SD → (29.50)

1.00 SD → (39.50)

Likelihood Ratio as a Clinical Tool

How likely is my patient to have a SPMS Course (the COI) compared to RRMS based on his/her specific PSI discrepancy from demographic expectations (Tc = 50)?

PSI Tc <	SD	(SS)	LR
40	1.0	(85)	1.7
38	1.2	(82)	1.9
36	1.4	(79)	2.2
34	1.6	(76)	2.7
32	1.8	(73)	2.7
30	2.0	(70)	3.4

My Patient has a PSI T-score of 32

Reference Group			COI Group		
Enter Mean, SD and Target Score			Enter Mean, SD and Target Score		
Mean	39.7		Mean	29	
SD	10.8		SD	9.5	
Target Score	32.99	←	Target Score	32.99	←
z-score	-0.6213		z-score	0.42	
Percentile Above	0.73		Percentile Above	0.34	
Percentile Below	0.27		Percentile Below	0.66	
Enter N for Ref Group		274	Enter N for COI Group		72
Est. N Above Target score		201	Est. N Above Target score		24
Est N Below Target score		73	Est. N Below Target score		48

TOC Characteristics of PSI Tc ≤ 32

Fill In the Number of Subjects in Each Cell:			Estimated Test Operating Characteristics		
	A:	48	% Prevalence of COI	20.81 %	
	B:	73	% Overall Correct	71.82 %	
	C:	24	Sensitivity	0.6628	
	D:	201	Specificity	0.7328	
			PPP	0.395	
Enter Confidence Level (1-α)	0.95		NPP	0.892	
Z-score of Interval ($Z_{1-\alpha/2}$)	1.960		Odds Ratio	5.390	←
Standard Error of OR	0.2842		*Odds Ratio Lower CI*	3.088	
			Odds Ratio Upper CI	9.408	
	COI		Likelihood Ratio (LR+)	2.480	←
	SPMS	RRMS	Likelihood Ratio (LR-)	0.4602	
Tc ≤ 32	48	73	Pre-Test Odds	0.2628	
Test Result	A	B	Post-Test Odds	0.6518	
Tc ≥ 33	24	201	Pre-Test Probabality	0.2081	
	C	D	Post-Test Probability	0.3946	
			Risk Ratio*	3.6575	* For cohort studies

Evidence-based Clinical Statements

Within the context of this study comparing patients with SPMS to RRMS, demographically corrected Processing Speed Tc-scores of 32 have an OR of 5.39 and a +LR of 2.48.

Clinical translation:

- Among patients with SPMS, the odds of having PSI Tc-scores a ≤ 32 are 5.39 times higher than having PSI Tc-scores ≥ 33.
- Patients obtaining scores ≤ 32 are 2.48 more likely to have SPMS than RMSS.

Valued-added by knowing this patient's PSI score --

Pre-Test Probabality	0.2081
Post-Test Probability	0.3946

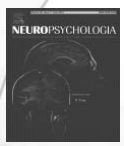
An Example of Being at the "Front Door"

I work in a Memory Disorders Clinic and am often faced with the question of differentiating AD from Frontotemporal Dementia (FTD). Our neurologists would like to get PET scans as a biomarker but Nuclear Medicine will not do them until neuropsychological testing is done and documents "appropriateness." What tests or test signs might help me in making this differentiation?

I have read that differences between phonemic and semantic fluency can differentiate the two disorders (Levy & Chelune, J Geriatr Psychiatry & Neurol, 2007, 20, 227-38).

I frame my question in the EBM PICO format and go to PubMed and do an advanced search under Clinical Queries to explore the Sensitivity and Specificity of Fluency Tests in differentiating AD from FTD

Meta Analysis



Neuropsychologia 42 (2004) 1212–1222

Verbal fluency performance in dementia of the Alzheimer's type: a meta-analysis

Julie D. Henry*, John R. Crawford, Louise H. Phillips

Abstract

A meta-analysis of 153 studies with 15,990 participants was conducted to compare the magnitude of deficits upon tests of phonemic and semantic fluency for patients with dementia of the Alzheimer's type (DAT) relative to healthy controls. As has been found for patients with focal temporal cortical lesions (but not for patients with focal frontal cortical lesions), DAT patients were significantly more impaired on tests of semantic relative to phonemic fluency ($r = 0.73$ and 0.57, respectively). Thus, since phonemic and semantic fluency are considered to impose comparable demands upon executive control processes such as effortful retrieval, but the latter is relatively more dependent upon the integrity of semantic memory, these results suggest that the semantic memory deficit in DAT reflects a degradation of the semantic store. Also supporting this conclusion, confrontation naming, a measure of semantic memory that imposes only minimal demands upon effortful retrieval, was significantly more impaired than phonemic fluency ($r = 0.60$ versus 0.55, respectively). However, since semantic fluency was also significantly more impaired than confrontation naming ($r = 0.73$ versus 0.61), deficits in semantic memory and effortful retrieval may be additive. Semantic, but not phonemic fluency, was significantly more impaired than measures of verbal intelligence and psychomotor speed. Thus, the semantic memory deficit in DAT qualifies as a differential deficit, but executive dysfunction as indexed by phonemic fluency does not constitute an additional isolated feature of the disorder. Dementia severity was not significantly related to the *relative* magnitude of deficits upon phonemic and semantic fluency.

Neuropsychology
2007, Vol. 21, No. 1, 20–30

Disparate Letter and Semantic Category Fluency Deficits in Autopsy-Confirmed Frontotemporal Dementia and Alzheimer's Disease

Katya Rascovsky, David P. Salmon, and Lawrence A. Hansen
University of California, San Diego

Leon J. Thal and Douglas Galasko
University of California, San Diego, and San Diego Veterans Affairs Medical Center

Patients with autopsy-confirmed frontotemporal dementia (FTD; $n = 16$) and Alzheimer's disease (AD; $n = 32$) were compared on first-letter and semantic category fluency tasks. Despite being matched on age, education, and dementia severity, FTD patients performed worse overall and showed similar impairment in letter and semantic category fluency, whereas AD patients showed greater impairment in semantic category than letter fluency. A measure of the disparity between letter and semantic category fluency (the semantic index) was effective in differentiating FTD from AD patients, and this disparity increased with increasing severity of dementia. These unique patterns of letter and semantic category fluency deficits may be indicative of differences in the relative contribution of frontal-lobe-mediated retrieval deficits and temporal-lobe-mediated semantic deficits in FTD and AD.

Variable	FTD (n = 16)	AD (n = 32)
Age		
M (*SD*), years	63.31 (8.2)	66.56 (5.4)
Range	48–76	53–77
Education		
M (*SD*), years	13.62 (4.2)	13.94 (2.6)
Range	3–19	11–20
MMSE score		
M (*SD*)	21.12 (5.6)	21.09 (5.6)
Range	9–29	8–30
FAQ percentage score		
M (*SD*)	63.07 (26.2)[a]	57.37 (27.9)[b]
Range	12–95	0–100
Estimated duration		
M (*SD*), years	4.31 (3.7)	4.16 (3.0)
Range	1–16	1–15

$$\text{Semantic index} = \frac{\text{semantic fluency}}{(\text{semantic fluency} + \text{letter fluency})}.$$

p.24

fluency performance independent of defective retrieval. As expected, the semantic index was significantly lower in AD patients (M = 0.43, SD = 0.12) compared with FTD patients (M = 0.62, SD = 0.21), $t(46) = -4.16$, $p < .05$, d = 1.28, even though

On the basis of this analysis, an optimal semantic index (SI) cutoff score of .524 (SI < .524 = AD; SI ≥ .524 = FTD) correctly classified 26 of 32 (81.3%) AD patients and 12 of 16 (75.0%) FTD patients, for an overall correct discrimination of 79.2%. Compar-

FTD

Condition of Interest

	FTD	AD	*Totals*
SI ≥ .524	**12** (A)	**6** (B)	*18*
SI Cutoff			
SI < .524	**4** (C)	**26** (D)	*30*
Totals	*16*	*32*	*48*

Test Operating Characteristics for FTD	
% **Prevalence** (**Baserate**) of COI	33.33
% Positive Test Result	37.50
% Negative Test Result	62.50
% Overall Correct Hit Rate	79.17
Sensitivity (% True Positives)	0.7500
Specificity (% True Negatives)	0.8125
Positive Predictive Power	0.667
Negative Predictive Power	0.867
Odds having COI w. Pos. Test	2.000
Odds having COI w. Neg. Test	0.154
Odds Ratio	13.0000
Likelihood Ratio (LR+)	4.0000
Pre-Test Odds	0.5000
Post-Test Odds	2.0000
Pre-test Probability	0.3333
Post-Test Probability	0.6667
Risk Ratio (cohort studies)	5.0000

AD

Condition of Interest

	AD	FTD	*Totals*
SI < .524	**26** (A)	**4** (B)	*30*
SI Cutoff			
SI ≥ .524	**6** (C)	**12** (D)	*18*
Totals	*32*	*16*	*48*

Test Operating Characteristics for AD	
% **Prevalence** (**Baserate**) of COI	66.67
% Positive Test Result	62.50
% Negative Test Result	37.50
% Overall Correct Hit Rate	79.17
Sensitivity (% True Positives)	0.8125
Specificity (% True Negatives)	0.7500
Positive Predictive Power	0.867
Negative Predictive Power	0.667
Odds having COI w. Pos. Test	6.500
Odds having COI w. Neg. Test	0.500
Odds Ratio	13.0000
Likelihood Ratio (LR+)	3.2500
Pre-Test Odds	2.0000
Post-Test Odds	6.5000
Pre-test Probability	0.6667
Post-Test Probability	0.8667
Risk Ratio (cohort studies)	2.6000

My Patient's SI Score is 0.65

How likely is my patient FTD?

My Patient's SI Score is .45

How likely is my patient FTD?

If you know the sample characteristics of the groups in question, you can estimate the TOC characteristics of your patient's specific score

	AD	FTD
N	32	16
Mean	0.43	0.62
SD	0.12	0.21

Estimating Contingency Table Cell Sizes Derived from the Means and Standard Deviations of a Reference Group and a COI Group

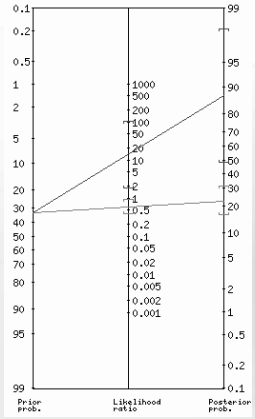
****IMPORTANT**** Calculations assume normal distribution of scores
Use only within the scope of this assumption

Reference Group		COI Group	
Enter Mean, SD and Target Score		Enter Mean, SD and Target Score	
Mean	0.43	Mean	0.62
SD	0.12	SD	0.21
Target Score	0.65	Target Score	0.65
z-score	1.83333	z-score	0.14286
Percentile Above	0.03	Percentile Above	0.44
Percentile Below	0.97	Percentile Below	0.56
Enter N for Ref Group	32	Enter N for COI Group	16
Est. N Above Target score	1	Est. N Above Target score	7
Est N Below Target score	31	Est. N Below Target score	9

My Patient's SI Score is 0.65
How likely is my patient FTD?

FTD ≥ .65
AD < .65

Fill In the Number of Subjects in Each Cell:			Estimated Test Operating Character		
	A:	7	% Prevalence of COI	33.33	%
	B:	1	% Overall Correct	79.17	%
	C:	9	Sensitivity	0.4375	
	D:	31	Specificity	0.9688	
			PPP	0.875	
Enter Confidence Level (1-α)	0.95		NPP	0.775	
Z-score of Interval ($Z_{1-\alpha/2}$)	1.960		Odds Ratio	24.111	
Standard Error of OR	1.1341		*Odds Ratio Lower CI*	2.611	
			Odds Ratio Upper CI	222.629	
	COI		Likelihood Ratio (LR+)	14.000	⇐
	Present	Absent	Likelihood Ratio (LR-)	0.58065	⇐
Positive	7	1	Pre-Test Odds	0.5000	
Test Result	A	B	Post-Test Odds	7.0000	
Negative	9	31	Pre-Test Probability	0.33333	
	C	D	Post-Test Probability	0.875	
			Risk Ratio*	3.88889	* For cohort st



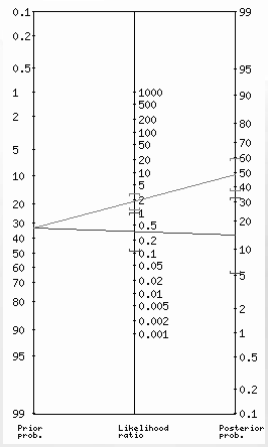
http://araw.mede.uic.edu/cgi-bin/testcalc.pl

My Patient's SI Score is .45

How likely is my patient FTD?

FTD ≥ .45
AD < .45

Fill In the Number of Subjects in Each Cell:			Estimated Test Operating Chara		
	A:	3	% Prevalence of COI	33.33	%
	B:	18	% Overall Correct	35.42	%
	C:	13	Sensitivity	0.1875	
	D:	14	Specificity	0.4375	
			PPP	0.143	
Enter Confidence Level (1-α)	0.95		NPP	0.519	
Z-score of Interval ($Z_{1-\alpha/2}$)	1.960		Odds Ratio	0.179	
Standard Error of OR	0.7330		*Odds Ratio Lower CI*	0.043	
			Odds Ratio Upper CI	0.755	
	COI		Likelihood Ratio (LR+)	0.333	⇐
	Present	Absent	Likelihood Ratio (LR-)	1.85714	⇐
Positive	3	18	Pre-Test Odds	0.5000	
Test Result	A	B	Post-Test Odds	0.1667	
Negative	13	14	Pre-Test Probabality	0.33333	
	C	D	Post-Test Probability	0.14286	
			Risk Ratio*	0.2967	* For cc



http://araw.mede.uic.edu/cgi-bin/testcalc.pl

Neuropsychology at the Front Door

1. Neuropsychological scores represent discrete "outcomes."
2. As evidence based practitioners, we can and should interpret our patient's scores within the context of published research evidence.
3. By examining the test operating characteristics (TOC) of our patient's performances with regard to the questions posed to us, we can assess our ability to reduce uncertainty and provide "value" to the patient's care.
4. If we can indeed empirically demonstrate our "value" in patient care, we can help guide health care decisions – from the front door.