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# Cognitive Profile of Neurotoxicity

# Neurotoxicity

- Adverse effects on the structure or function of the central and/or peripheral nervous system caused by exposure to a toxic chemical.
- Symptoms include muscle weakness, loss of sensation and motor control, tremors, ***cognitive alterations***, and autonomic nervous system dysfunction.

# Context...

- Drug use (alcohol, psycho-active inhalant drugs ["sniffing drugs"])
- Medical treatment (chemotherapy)
- ***Occupational Exposure***
  - Acute
  - ***Chronic***
    - ***Solvents***
    - Other (lead, mercury, dioxin...)

# Occupations...

- Painters, Panel Beaters, Industrial Plant Workers who use solvents, Manufacturers or occupational users of benzene or benzene products, Chemical Lab Workers, Rubber Industry Workers, Pesticide Manufacturing and Spraying, Printing, Paper Manufacturing, Chemical and Petrochemical Plants, Beauty Therapists, etc.

# Occupational Chronic Solvent Toxicity

- Personal Injury
- ACC Claim
- Focus on Entitlement

# Neuropsychological Assessments

- Complex testing procedures are undertaken with clients in the context of toxicity claims to find out:
  - whether or not / to which degree cognitive functions are affected
  - whether or not cognitive changes are consistent with neuro-toxic brain damage
- These assessments are:
  - Based on norm-based cognitive tests<sup>2,3</sup>
  - Called ***Neuropsychological Assessments***.

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1) Spreen, O., & Strauss, E. (1998). A Compendium of Neuropsychological Tests (2 ed.). New York: Oxford University Press.

2) Lezak, M., Howieson, D. B., & Loring, D. W. (2004). Neuropsychological Assessment (4th ed.). New York: Oxford University Press.

# Main Cognitive Functions investigated

- Attention / Concentration
- Short-term Memory
  - Learning
  - Information retention
- Intelligence
  - verbal and operational comprehension
- Processing speed
- Executive functions

# Neuro-cognitive Profiles = Diagnostic Fingerprints

- Solvent toxicity
- Traumatic Brain Injury
- Alzheimer's Dementia
- Depression
- Malingering
- [You name it...]

# Complicating factors for establishing a Cognitive Profile of Toxic Brain Injury

## ■ Exposure Variables

- Substance(s)
- Dosage
- Duration of exposure

## ■ Client Variables

- Age, gender
- Previous Brain Injuries
- Co-morbidity
- Genotype
- Treatment /Recovery

## ■ Assessment Variables

- Time after exposure
- Sensitivity of cognitive tests

# Cognitive Profile of Toxic Brain Injury

## Cognitive testing chronic and acute solvent exposure

### Significant decline for :

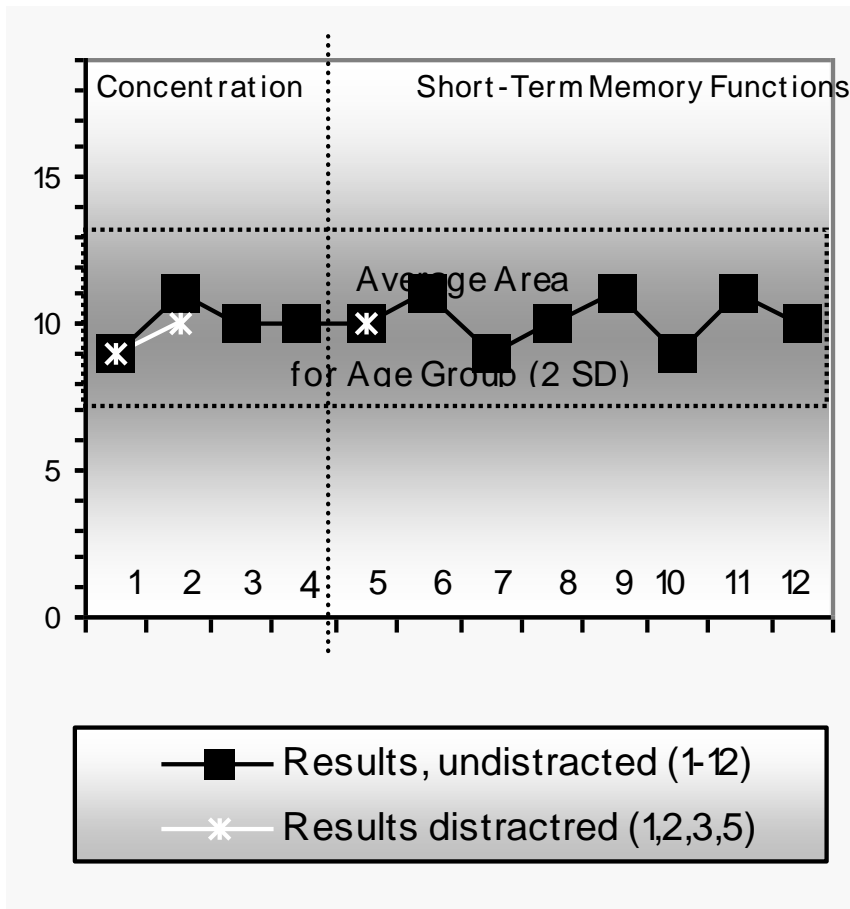
- Concentration (complex attention, sustained attention)
- Memory (new learning and retention)
- Frontal lobe/executive functions (planning, abstract thinking, flexibility, initiation, mood regulation)

### Unaffected:

- Intelligence,
- Processing speed
- Simple Concentration

3. Morrow L A, Steinhauer S S, Condray R, Hodgson M, Neuropsychological Performance of journeymen painters under acute solvent exposure and exposure-free conditions. *J Int Neuropsychological Soc* (1997) 3, 269-275
4. Wood R, Liossi Ch: Long-term neuropsychological impact of brief occupational exposure to organic solvents. *Arch. Of Clinical Neuropsychology* .2005, 20, 5, 655-665
5. Haut M, Leach S, Kuwabara H, Whyte S, Callahan Ty, Ducatman A, Lombardo L, Gupta N.: Verbal Working memory and solvent exposure: A positron emission tomography study. *Neuropsychology* 2000, 14 (4) 551-558

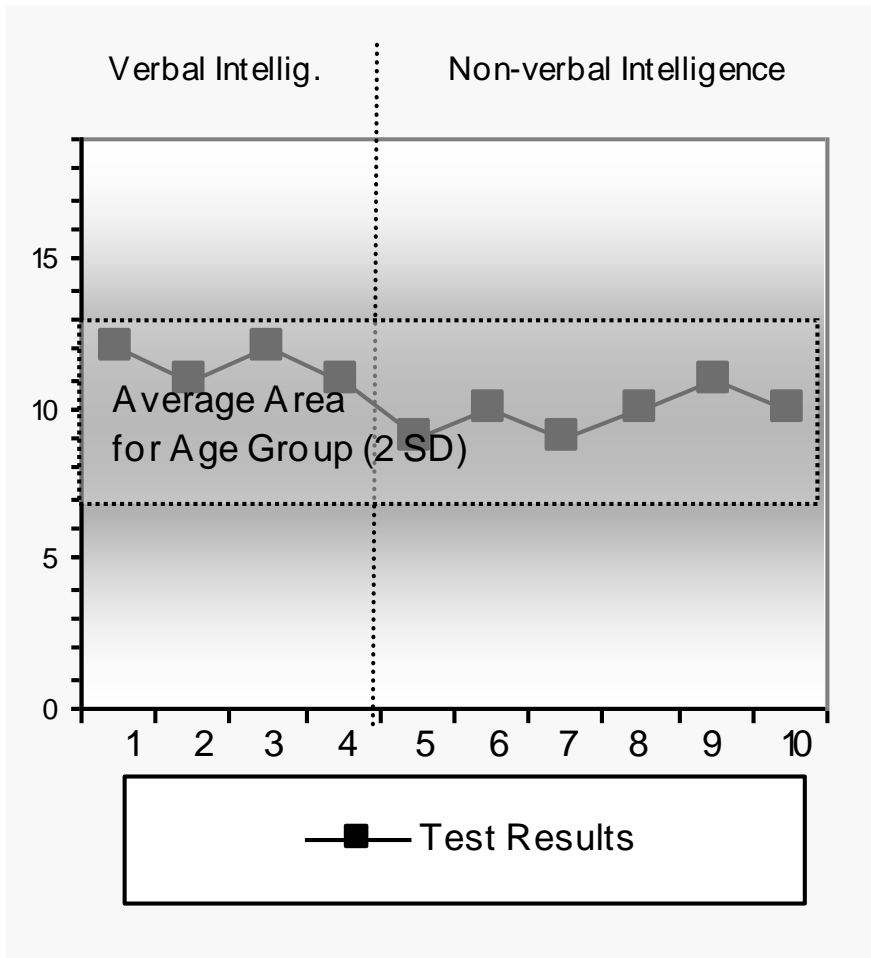
# Results of Psychometric Testing Normal Study (1)



- **Attention/Concentration**
- 1= One-dimensional concentration
- 2 & 3= Complex concentration
- 4 = Arithmetic
- **Verbal Memory**
- Immediate Recall:
  - 5= Logical Memory I
  - 6= Abstract Learning I
  - 7= List learning I
- Delayed recall:
  - 8= Logical Memory II
  - 9= Abstract Learning II
  - 10= List learning II
- **Visual Memory**
- 11= Spatial Span
- 12= Visual Reproduction

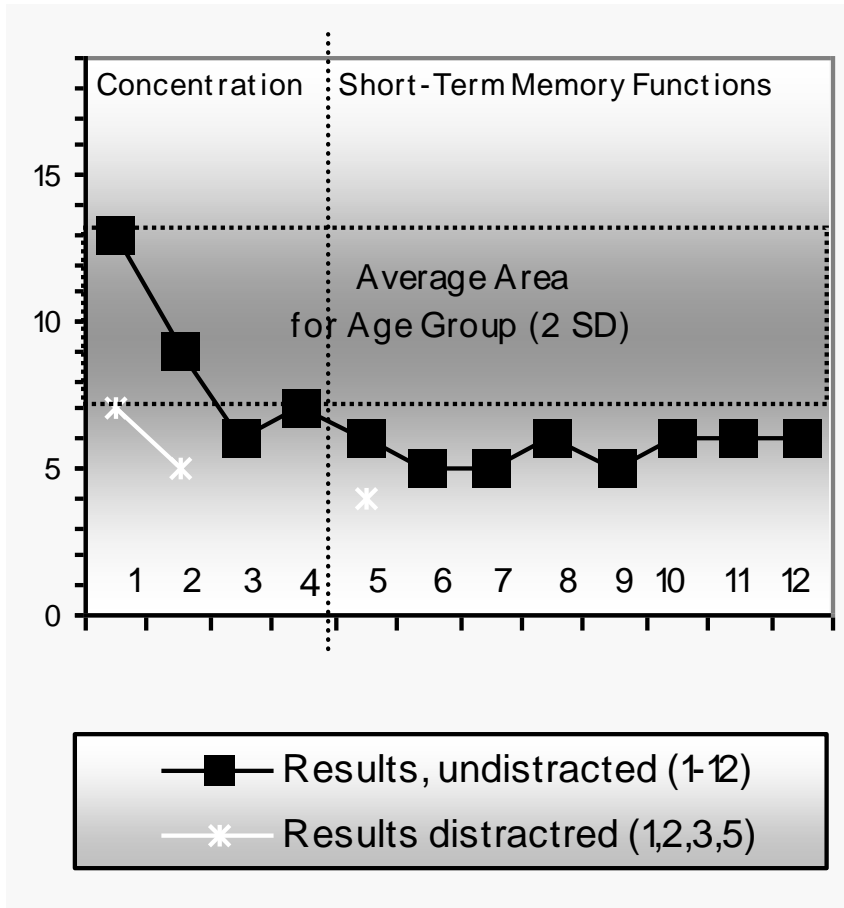
# Results of Psychometric Testing

## Normal Study (2)



- Verbal Intelligence
  - 1 = Verbal comprehension
  - 2 = Abstract conceptualisation
  - 3 = Vocabulary
  - 4 = General knowledge
- Non-verbal perceptual Intelligence
  - 5 = Visual comprehension
  - 6 = Logical sequencing
  - 7 = Construction
  - 8 = Quantitative logic
  - 9,10 = Psychomotor speed

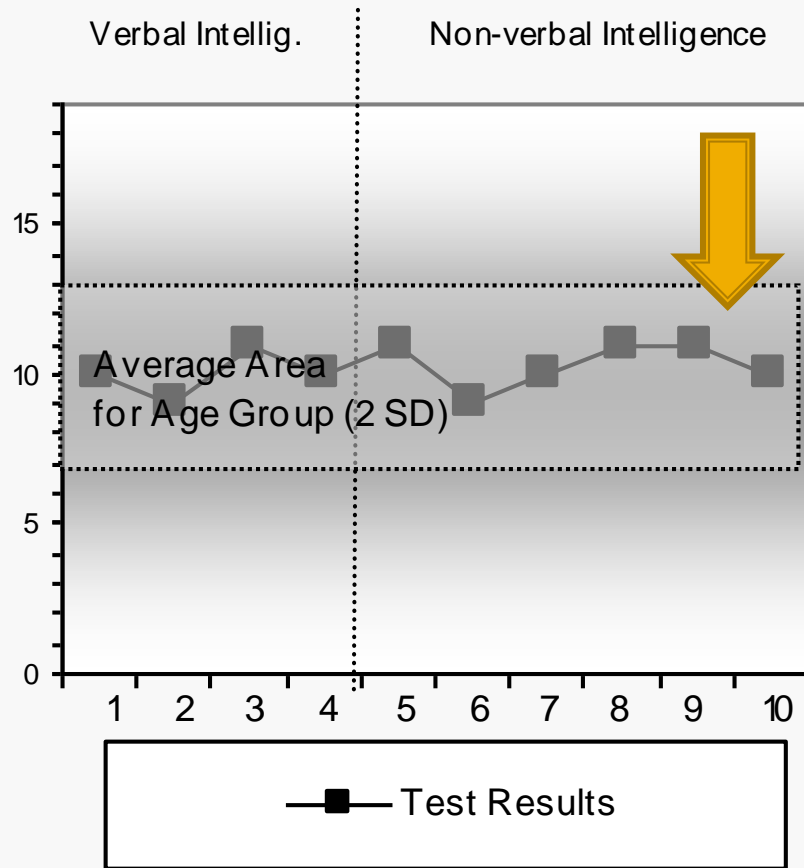
# Results of Psychometric Testing Chronic Solvent Toxic Profile (1)



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6) Schnabel, R: *Effects of Controlled Environmental Distraction on Neuro-cognitive Functioning - Innovative Procedures for Improving Test Validity and Differential Diagnosis*; PhD project, currently undertaken at the Department of Psychological Medicine, University of Auckland, supervised by Professor Rob Kydd and Professor Des Gorman

# Results of Psychometric Testing Chronic Solvent Toxic Profile (2)



- Verbal Intelligence

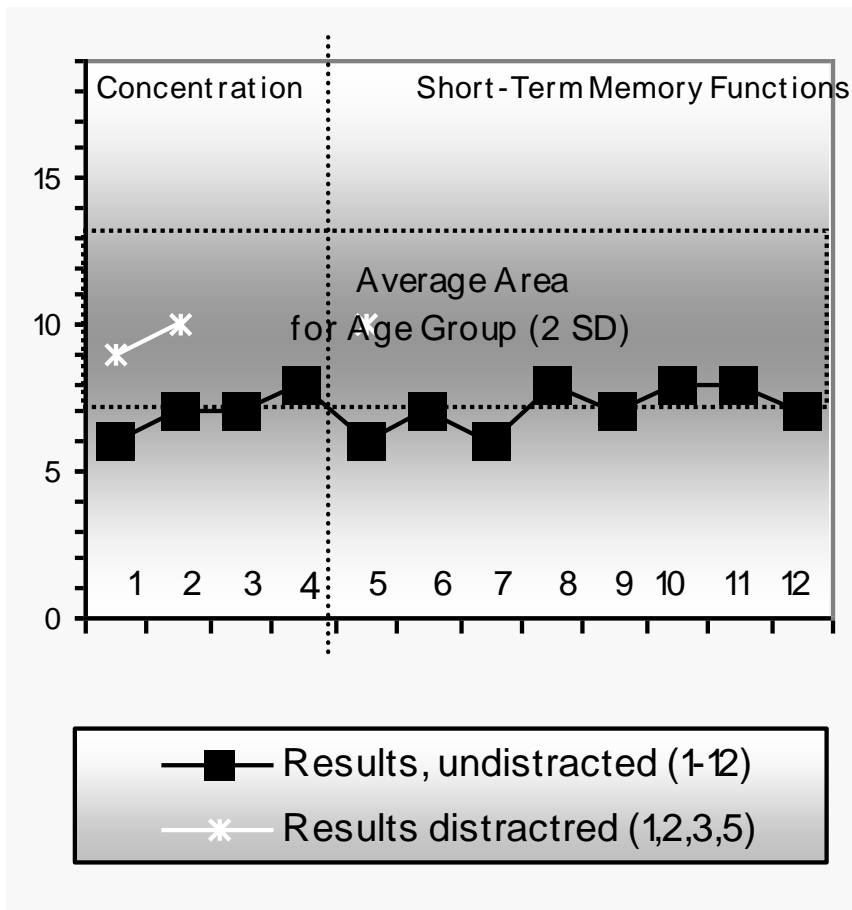
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# Results of Psychometric Testing

## MDE Study (1)

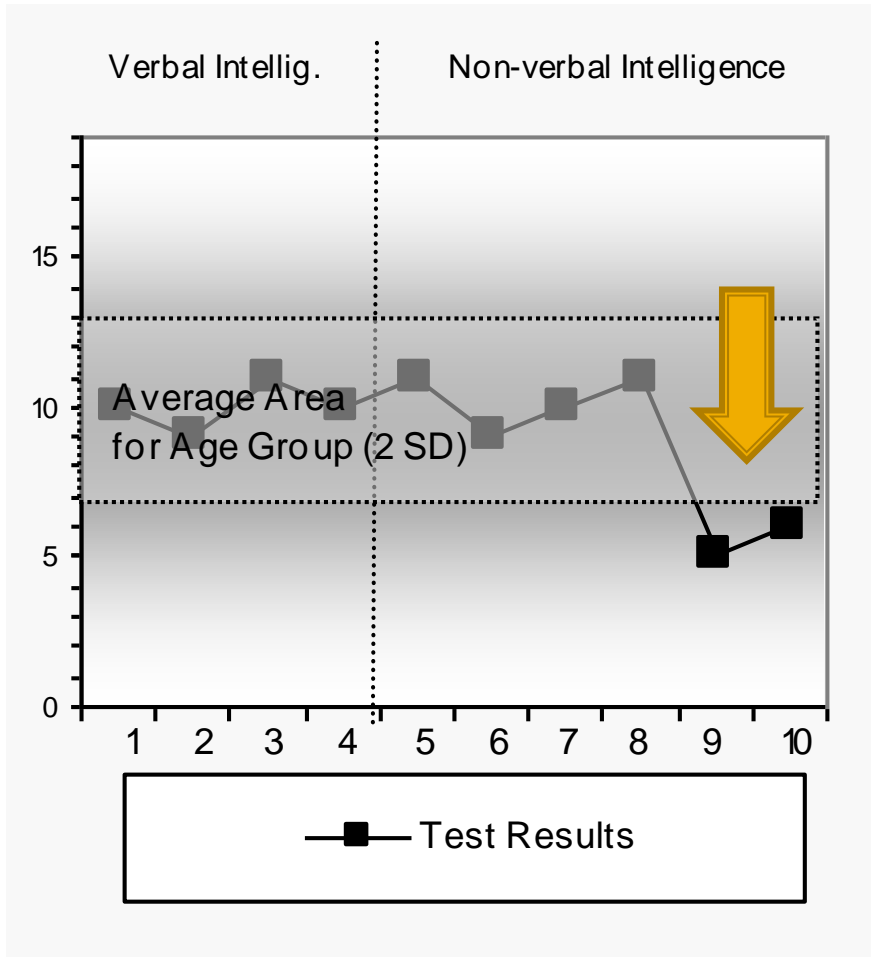


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# Results of Psychometric Testing

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# Main Confounding Factors in the Cognitive Assessment of Neurotoxicity Claims

- Motivational factors (malingering, factitious disorder)
- Depression, Anxiety Disorder
- Alcohol Disorder
- Neurophysical or somatoform features (nausea, headaches, fatigue, “chemical sensitivity”) at the time of the assessment
- Test-learning effects (practice effects on re-testing)
- Historic claims

# Summary

- Neuropsychological Assessments can assist with differential diagnosis in Chronic Solvent Toxicity Claims.
- Not a stand-alone procedure; multi-disciplinary approach recommended (exposure data, medical data, confounding factors) for controlling risks of “false positive”/“false negative” judgements.