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A method for exploring compensatory cognitive mechanisms

In the recovery of brain function literature, a change in the means of accomplishing a task is referred to as functional adaptation or compensation. Compensation has been proposed as a recovery mechanism following central nervous system damage in general, and specifically, in response to alcohol intake effects. Brain compromise, from direct or indirect neurotoxic effects, may force functional systems to reorganize so that weakened components are not heavily relied upon. The possibility of compensation opens the door to studying the effects of neurotoxins not only in terms of performance decrements, which may not be evident, but also in terms of the functional systems that underlie performance. We use the results of two studies to demonstrate how the functional organization of cognitive abilities in control groups may be compared to that of groups hypothesized to show a compensatory reorganization of abilities: children of alcoholics and heavy social drinkers. The cognitive data were provided by subsets of the 1380 subjects involved in the Rutgers Health and Human Development Project, a longitudinal study of adolescents and young adults. Specifically, we show how LISREL analyses can be used to partition cognitive skills into latent factors representing functional systems and how tests of full and partial invariance of measurement and structural parameters may be conducted. It is suggested that this method is potentially more sensitive and less confounded than traditional performance measures of cognitive status, especially for exploring neurotoxic effects in young aged samples. The advantages of this methodology for the early detection of deficits are discussed.

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BRAIN ORGANIZATION UNDERLYING DISSOCIATIONS BETWEEN LANGUAGE AND COGNITION FUNCTIONS

Our long term goal is to understand the biological basis of language and other cognitive functions. We present a new line of investigation which forges links between a specific metabolic disorder, an unusual neuropsychological profile, and abnormal brain organization. We investigate a rare metabolic disorder known as Williams Syndrome, in which we are finding a unique fractionation of higher cortical functions; e.g., linguistic functioning appears to be selectively preserved in the face of severe general cognitive deficit. A psychophysical results of this metabolic disorder is an unusual sensitivity to classes of sounds, not characteristic of other syndromes. Our neurobehavioral studies of adolescent Williams children indicate that there is a marked discontinuity between linguistic and other cognitive functions -- with language as an island of spared capacities in the face of general mental retardation. The study of Williams Syndrome promises to provide new insights into the relationships between cognitive domains and their underlying neural substrate.

Several lines of evidence will be presented suggested that the cerebral hemispheres are not organized in normal fashion in Williams syndrome. Results of Magnetic Resonance Imaging scans will be report, indicating abnormalities in specific brain structures which relate to the unusual neurobehavioral profile. Studies of brain function, including electrophysiological measures, also implicate abnormal brain organization underlying the disorder. We investigate a hypothesis which related CNS dysfunction and abnormalities of calcium and calcitonin metabolism in children with Williams syndrome. We hypothesize that these children may have a single underlying genetic disturbance which results in the abnormal production of a specific neurotransmitter. This hypothesis will be linked to the unusual neurobehavioral profile found across domains.