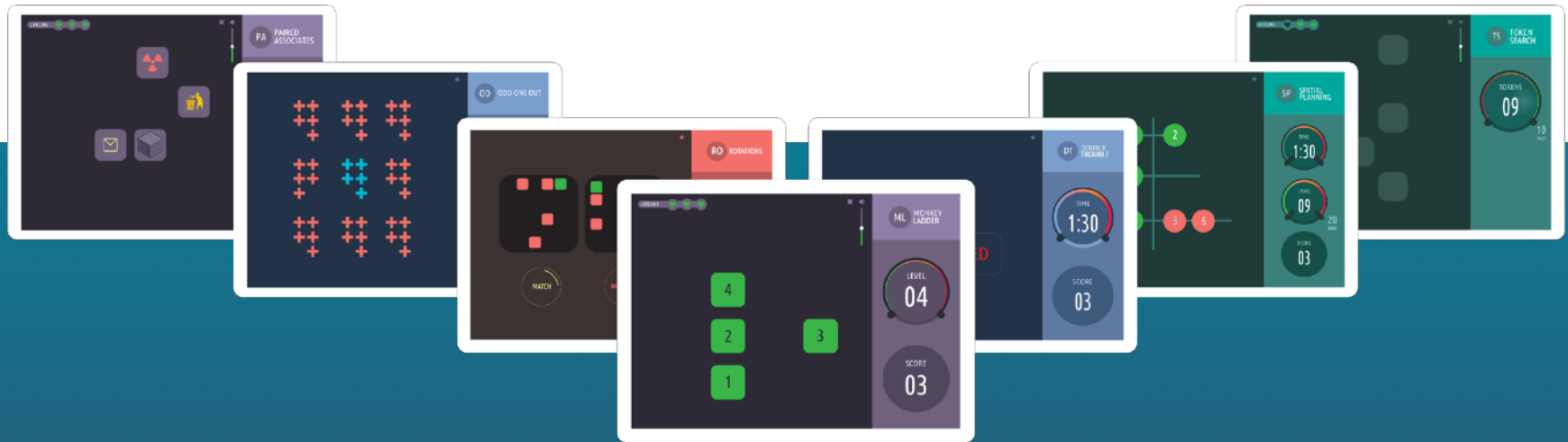


# Task Selection Guide

Create customized batteries to meet your specific assessment needs.



Note: The table below is meant to be an indicative guide. Creyos (formerly Cambridge Brain Sciences) does not guarantee that any of the tasks within each row will be appropriate for your specific needs.

- ✓ Green checkmarks indicate that an academic study was published showing that the cognitive function assessed by the task was significantly different in people with that disorder.
- ✓ Blue checkmarks indicate additional tasks recommended by Creyos to assess individuals with the disorders outlined below based on the characteristics and historical use of these tasks.

	CORE COGNITIVE AREA	MEMORY				REASONING				VERBAL ABILITY		CONCENTRATION	
	OUTCOME MEASURE	Visuospatial Working Memory	Spatial Short-Term Memory	Working Memory	Episodic Memory	Mental Rotation	Visuospatial Processing	Deductive Reasoning	Planning	Verbal Reasoning	Verbal Short-Term Memory	Attention	Response Inhibition
	TASK	Monkey Ladder	Spatial Span	Token Search	Paired Associates	Rotations	Polygons	Odd One Out	Spatial Planning	Grammatical Reasoning	Digit Span	Feature Match	Double Trouble

Disorder													
Autism			✓		✓		✓	✓		✓			✓
Early Alzheimer's	✓	✓		✓		✓					✓	✓	✓
Asperger Syndrome			✓		✓		✓	✓	✓		✓		
Non-Alzheimer's Dementia	✓	✓		✓		✓		✓		✓	✓		
Epilepsy							✓		✓				✓
Parkinson's		✓	✓	✓		✓		✓	✓		✓	✓	✓
Age-Related Decline	✓	✓		✓		✓	✓		✓	✓			✓
ADHD	✓		✓						✓	✓	✓	✓	✓
PTSD			✓				✓		✓	✓			✓
Schizophrenia		✓	✓				✓	✓		✓			✓
Dyslexia							✓		✓	✓			✓
Stroke	✓		✓	✓		✓			✓				✓
Concussion	✓	✓	✓	✓			✓	✓			✓	✓	✓
Huntington's Disease		✓	✓					✓			✓		✓
Frontal Lobe		✓	✓	✓			✓	✓	✓				✓
Temporal Lobe			✓	✓									
Depression			✓				✓	✓	✓				✓

The table below provides a definition of each task and outcome measure, as well as related example activities.

MEMORY			
Task	Outcome Measure	Definition	Related Example Activities
Monkey Ladder	Visuospatial Working Memory	The ability to temporarily hold information in memory, and manipulate or update it based on changing circumstances or demands. This task involves reproducing a set of relationships between objects in space.	Planning your day and the errands you need to run, then carrying out those errands in the correct order by memory.
Spatial Span	Spatial Short-Term Memory	The cognitive system that allows for temporary storage of spatial information in memory. Spatial short-term memory deals with the relationships between objects in space, as opposed to remembering the specific order of numbers or words involved in verbal short-term memory.	Following a set of dance moves, or giving directions to someone for a route you just took.
Token Search	Working Memory	Working memory is the ability to temporarily hold information in memory, and manipulate or update it based on changing circumstances or demands. This task involves self-directed searching, so there is a strategy component as well.	Systematically searching for your car keys that have been left somewhere by your partner.
Paired Associates	Episodic Memory	The ability to remember and recall specific events, paired with the context in which they occurred, such as identifying when and where an object was encountered.	When storing household items after grocery shopping, later remembering which items you put where.
REASONING			
Task	Outcome Measure	Definition	Related Example Activities
Rotations	Mental Rotation	A function of visual representation in the brain, mental rotation is the ability to efficiently manipulate mental representations of objects in order to make valid conclusions about what objects are and where they belong.	Navigating using a map on your phone that keeps rotating every time you turn, or finding the route to a room inside a building even though you came in through a different door when you first learned your way around.
Polygons	Visuospatial Processing	The ability to effectively process and interpret visual information, such as complex visual stimuli and relationships between objects.	Performing actions that require precise assessment and reasoning about objects, such as drawing, constructing models, aligning decorations on a wall, or designing a web page.
Odd One Out	Deductive Reasoning	The core cognitive ability to apply rules to information in order to arrive at a logical conclusion.	The ability to determine that something is true because of a set of facts. For instance, when doing your taxes, you may determine that you qualify for a tax rebate based on certain rules set out by your country.
Spatial Planning	Planning	A fundamental property of intelligent behavior, planning is the ability to act with forethought and sequence behaviour in an orderly fashion to reach specific goals.	Packing items into your car's trunk so that they all fit, or assembling a piece of furniture.

## VERBAL ABILITY

Task	Outcome Measure	Definition	Related Example Activities
Grammatical Reasoning	Verbal Reasoning	The ability to quickly understand and make valid conclusions about concepts expressed in words.	Understanding everyday speech that may contain negative statements - for instance, "I didn't know that he wasn't going to show up".
Digit Span	Verbal Short-Term Memory	Short-term memory is the cognitive system that allows for temporary storage of information in memory. Verbal short-term memory deals with numbers or words in a specific order, as opposed to spatial short-term memory.	Remembering a telephone number as you're entering it into your phone.

## CONCENTRATION

Task	Outcome Measure	Definition	Related Example Activities
Feature Match	Attention	The ability to muster mental concentration and focus in order to monitor for a specific stimulus or difference.	Identifying similarities and differences when comparing two things, such as deciding which of many great photos of your friends to share from an evening out.
Double Trouble	Response Inhibition	The ability to concentrate on relevant information in order to make a correct response despite interference or distracting information.	Blocking out background conversations when you're trying to focus on something, or ignoring buzz words when viewing a television ad ("Fresh! Simple! Revolutionary!") and focusing your attention on more important factors, like price and quality of the item being sold.

References to a sample of published academic studies in which the tasks were used to assess individuals who possessed the cognitive disorders noted in the table above are shown below.

MEMORY	
Task	Sample Published Studies
Monkey Ladder	<ul style="list-style-type: none"> <li>Owen, A. M., Morris, R. G., Sahakian, J. L., Polkey, C. E., Robbins, T. W., &amp; Sahakian, B. J. (1996). Double dissociations of memory and executive functions in working memory task following frontal lobe excision, temporal lobe excisions or amygdala-hippocampectomy in man. <i>Brain</i>, 119, 1597–1615.</li> </ul>
Spatial Span	<ul style="list-style-type: none"> <li>Bor, D., Duncan, J., Lee, A. C., Parr, A., &amp; Owen, A. M. (2006). Frontal lobe involvement in spatial span: Converging studies of normal and impaired function. <i>Neuropsychologia</i>, 44(2), 229-237.</li> <li>Lawrence, A. D., Sahakian, B. J., Hodges, J. R., Rosser, A. E., Lange, K. W., &amp; Robbins, T. W. (1996). Executive and mnemonic functions in early Huntington's disease. <i>Brain</i>, 119(5), 1633-1645.</li> <li>Mehta, M. A., Owen, A. M., Sahakian, B. J., Mavaddat, N., Pickard, J. D., &amp; Robbins, T. W. (2000). Methylphenidate enhances working memory by modulating discrete frontal and parietal lobe regions in the human brain. <i>The Journal of Neuroscience</i>, 20(6), RC65.</li> <li>Owen, A. M., James, M., Leigh, P. N., Summers, B. A., Marsden, C. D., Quinn, N. A., ... &amp; Robbins, T. W. (1992). Fronto-striatal cognitive deficits at different stages of Parkinson's disease. <i>Brain</i>, 115(6), 1727-1751.</li> <li>Owen, A. M., Morris, R. G., Sahakian, J. L., Polkey, C. E., Robbins, T. W., &amp; Sahakian, B. J. (1996). Double dissociations of memory and executive functions in working memory task following frontal lobe excision, temporal lobe excisions or amygdala-hippocampectomy in man. <i>Brain</i>, 119, 1597–1615.</li> <li>Pantelis, C., Barnes, T. R., Nelson, H. E., Tanner, S., Weatherley, L., Owen, A. M., &amp; Robbins, T. W. (1997). Frontal-striatal cognitive deficits in patients with chronic schizophrenia. <i>Brain: a journal of neurology</i>, 120(10), 1823-1843.</li> </ul>
Token Search	<ul style="list-style-type: none"> <li>Jiang, Y.V., Capistrano, C.G., &amp; Palm, B.E. (2014). Spatial working memory in children with high-functioning autism: intact configural processing but impaired capacity. <i>Journal of Abnormal Psychology</i>, 123(1), 248-57.</li> <li>Lawrence, A. D., Sahakian, B. J., Hodges, J. R., Rosser, A. E., Lange, K. W., &amp; Robbins, T. W. (1996). Executive and mnemonic functions in early Huntington's disease. <i>Brain</i>, 119(5), 1633-1645.</li> <li>Matsuura N, Ishitobi M, Arai S, Kawamura K, Asano M, Inohara K, Narimoto T, Wada Y, Hiratani M, Kosaka H. Distinguishing between autism spectrum disorder and attention deficit hyperactivity disorder by using behavioral checklists, cognitive assessments, and neuropsychological test battery. <i>Asian J Psychiatr</i>. 2014 Dec;12:50-7.</li> <li>Owen, A. M., Beksinska, M., James, M., Leigh, P. N., Summers, B. A., Marsden, C. D., ... &amp; Robbins, T. W. (1993). Visuospatial memory deficits at different stages of Parkinson's disease. <i>Neuropsychologia</i>, 31(7), 627-644.</li> <li>Owen, A. M., Downes, J. J., Sahakian, B. J., Polkey, C. E., &amp; Robbins, T. W. (1990). Planning and spatial working memory following frontal lobe lesions in man. <i>Neuropsychologia</i>, 28(10), 1021-1034.</li> <li>Owen, A.M., Hampshire, A., Grahn, J.A., Stenton, R., Dajani, S., Burns, A. S., Howard, R. J., &amp; Ballard, C. G. (2010). Putting brain training to the test. <i>Nature</i>, 465, 775-779.</li> <li>Owen, A. M., Roberts, A. C., Polkey, C. E., Sahakian, B. J., &amp; Robbins, T. W. (1991). Extra-dimensional versus intra-dimensional set shifting performance following frontal lobe excisions, temporal lobe excisions or amygdalo-hippocampectomy in man. <i>Neuropsychologia</i>, 29(10), 993-1006.</li> <li>Owen, A. M., Roberts, A. C., Hodges, J. R., &amp; Robbins, T. W. (1993). Contrasting mechanisms of impaired attentional set-shifting in patients with frontal lobe damage or Parkinson's disease. <i>Brain</i>, 116(5), 1159-1175.</li> <li>Pantelis, C., Barnes, T. R., Nelson, H. E., Tanner, S., Weatherley, L., Owen, A. M., &amp; Robbins, T. W. (1997). Frontal-striatal cognitive deficits in patients with chronic schizophrenia. <i>Brain: A Journal of Neurology</i>, 120(10), 1823-1843.</li> </ul>
Paired Associates	<ul style="list-style-type: none"> <li>Ferreira, N., Owen, A., Mohan, A., Corbett, A., &amp; Ballard, C. (2015). Associations between cognitively stimulating leisure activities, cognitive function and age-related cognitive decline. <i>International Journal of Geriatric Psychiatry</i>, 30(4), 422–430.</li> <li>Gould, R. L., Brown, R. G., Owen, A. M., Bullmore, E. T., &amp; Howard, R. J. (2006). Task-induced deactivations during successful paired associates learning: An effect of age but not Alzheimer's disease. <i>NeuroImage</i>, 31(2), 818–831.</li> <li>Gould, R. L., Arroyo, B., Brown, R. G., Owen, A. M., Bullmore, E. T., &amp; Howard, R. J. (2006). Brain mechanisms of successful compensation during learning in Alzheimer disease. <i>Neurology</i>, 67(6), 1011–1017.</li> <li>Owen, A. M., Beksinska, M., James, M., Leigh, P. N., Summers, B. A., Marsden, C. D., ... &amp; Robbins, T. W. (1993). Visuospatial memory deficits at different stages of Parkinson's disease. <i>Neuropsychologia</i>, 31(7), 627-644.</li> <li>Owen, A., Sahakian, B., Semple, J., Polkey, C., &amp; Robbins, T.W. (1995). Visuo-spatial short-term recognition memory and learning after temporal lobe excisions, frontal lobe excisions or amygdalo- hippocampectomy in man. <i>Neuropsychologia</i>, 33(1), 1–24.</li> </ul>

## REASONING

Task	Sample Published Studies
Rotations	<ul style="list-style-type: none"> <li>• Zapf, A.C., Glindemann, L.A., Vogeley, K., &amp; Falter, C.M. (2015). Sex differences in mental rotation and how they add to the understanding of autism. <i>PLoS ONE</i>, 10(4), e0124628.</li> </ul>
Polygons	<ul style="list-style-type: none"> <li>• Ala, T. A., Hughes, L. F., Kyrouac, G. A., Ghobrial, M. W., &amp; Elble, R. J. (2001). Pentagon copying is more impaired in dementia with Lewy bodies than in Alzheimer's disease. <i>Journal of Neurology, Neurosurgery &amp; Psychiatry</i>, 70(4), 483-488.</li> <li>• Lee, B. H., Kim, E. J., Ku, B. D., Choi, K. M., Seo, S. W., Kim, G. M., ... &amp; Na, D. L. (2008). Cognitive impairments in patients with hemispatial neglect from acute right hemisphere stroke. <i>Cognitive and Behavioral Neurology</i>, 21(2), 73-76.</li> </ul>
Odd One Out	<ul style="list-style-type: none"> <li>• Hayashi, M., Kato, M., Igarashi, K., &amp; Kashima, H. (2008). Superior fluid intelligence in children with Asperger's disorder. <i>Brain and Cognition</i>, 66(3), 306-310.</li> <li>• Loughman, A., Bowden, S.C., &amp; D'Souza, W. (2014). Cognitive functioning in idiopathic generalised epilepsies: a systematic review and meta-analysis. <i>Neuroscience and Biobehavioral Reviews</i>, 43, 20-34.</li> <li>• Kodituwakku, P. W., Handmaker, N. S., Cutler, S. K., Weathersby, E. K., &amp; Handmaker, S. D. (1995). Specific impairments in self-regulation in children exposed to alcohol prenatally. <i>Alcoholism: Clinical and Experimental Research</i>, 19(6), 1558-1564.</li> <li>• Soulières, I., Dawson, M., Samson, F., Barbeau, E. B., Sahyoun, C. P., Strangman, G. E., ... &amp; Mottron, L. (2009). Enhanced visual processing contributes to matrix reasoning in autism. <i>Human Brain Mapping</i>, 30(12), 4082-4107.</li> </ul>
Spatial Planning	<p>Beats, B. C., Sahakian, B. J., &amp; Levy, R. (1996). Cognitive performance in tests sensitive to frontal lobe dysfunction in the elderly depressed. <i>Psychological Medicine</i>, 26(3), 591-603.</p> <p>Hampshire, A., Highfield, R., Parkin, B., &amp; Owen, A.M. (2012). Fractioning human intelligence. <i>Neuron</i>, 76, 1225-1237.</p> <p>Lawrence, A. D., Sahakian, B. J., Hodges, J. R., Rosser, A. E., Lange, K. W., &amp; Robbins, T. W. (1996). Executive and mnemonic functions in early Huntington's disease. <i>Brain</i>, 119(5), 1633-1645.</p> <p>Owen, A. M., Downes, J. J., Sahakian, B. J., Polkey, C. E., &amp; Robbins, T. W. (1990). Planning and spatial working memory following frontal lobe lesions in man. <i>Neuropsychologia</i>, 28(10), 1021-1034.</p> <p>Owen A.M., James, M., Leigh, P.N., Summers, B.A., Marsden, C.D, Quinn, N.P., Lange, K.W., &amp; Robbins T.W. (1992). Frontostriatal cognitive deficits at different stages of Parkinson's disease. <i>Brain</i>, 115 (Pt 6), 1727-1751.</p> <p>Owen, A. M., Roberts, A. C., Polkey, C. E., Sahakian, B. J., &amp; Robbins, T. W. (1991). Extra-dimensional versus intra-dimensional set shifting performance following frontal lobe excisions, temporal lobe excisions or amygdalo-hippocampotomy in man. <i>Neuropsychologia</i>, 29(10), 993-1006.</p> <p>Owen, A. M., Roberts, A. C., Hodges, J. R., &amp; Robbins, T. W. (1993). Contrasting mechanisms of impaired attentional set-shifting in patients with frontal lobe damage or Parkinson's disease. <i>Brain</i>, 116(5), 1159-1175.</p> <p>Ozonoff, S., Cook, I., Coon, H., Dawson, G., Joseph, R.M., Klin, A., McMahon, W.M., Minshew, N., Munson, J.A., Pennington, B.F., Rogers, S.J., Spence, M.A., Tager-Flusberg, H., Volkmar, F.R., &amp; Wrathall, D. (2004). Performance on Cambridge Neuropsychological Test Automated Battery subtests sensitive to frontal lobe function in people with autistic disorder: evidence from the Collaborative Programs of Excellence in Autism network. <i>Journal of Autism and Developmental Disorders</i>, 34(2), 139-50.</p> <p>Pantelis, C., Barnes, T. R., Nelson, H. E., Tanner, S., Weatherley, L., Owen, A. M., &amp; Robbins, T. W. (1997). Frontal-striatal cognitive deficits in patients with chronic schizophrenia. <i>Brain: A Journal of Neurology</i>, 120(10), 1823-1843.</p>

## VERBAL ABILITY

Task	Sample Published Studies
Grammatical Reasoning	<ul style="list-style-type: none"> <li>• Ferreira, N., Owen, A., Mohan, A., Corbett, A., &amp; Ballard, C. (2015). Associations between cognitively stimulating leisure activities, cognitive function and age-related cognitive decline. <i>International Journal of Geriatric Psychiatry</i>, 30(4), 422-430.</li> <li>• Hampshire, A., Highfield, R., Parkin, B., &amp; Owen, A.M. (2012). Fractioning human intelligence. <i>Neuron</i>, 76, 1225-1237.</li> </ul>
Digit Span	<ul style="list-style-type: none"> <li>• Conklin, H. M., Curtis, C. E., Katsanis, J., &amp; Iacono, W. G. (2000). Verbal working memory impairment in schizophrenia patients and their first-degree relatives: evidence from the digit span task. <i>American Journal of Psychiatry</i>, 157(2), 275-277.</li> <li>• Gray, S. (2006). The relationship between phonological memory, receptive vocabulary, and fast mapping in young children with specific language impairment. <i>Journal of Speech, Language, and Hearing Research</i>, 49(5), 955-969.</li> <li>• Helland, T., &amp; Asbjørnsen, A. (2004). Digit span in dyslexia: Variations according to language comprehension and mathematics skills. <i>Journal of Clinical and Experimental Neuropsychology</i>, 26(1), 31-42.</li> <li>• Owen, A.M., Hampshire, A., Grahn, J.A., Stenton, R., Dajani, S., Burns, A. S., Howard, R. J., &amp; Ballard, C. G. (2010). Putting brain training to the test. <i>Nature</i>, 465, 775-779.</li> </ul>

# CONCENTRATION

Task	Sample Published Studies
Feature Match	<ul style="list-style-type: none"> <li>• <i>Beats, B. C., Sahakian, B. J., &amp; Levy, R. (1996). Cognitive performance in tests sensitive to frontal lobe dysfunction in the elderly depressed. Psychological Medicine, 26(3), 591-603.</i></li> <li>• <i>Lange, K. W., Sahakian, B. J., Quinn, N. P., Marsden, C. D., &amp; Robbins, T. W. (1995). Comparison of executive and visuospatial memory function in Huntington's disease and dementia of Alzheimer type matched for degree of dementia. Journal of Neurology, Neurosurgery &amp; Psychiatry, 58(5), 598-606.</i></li> <li>• <i>Sahakian, B. J., Morris, R. G., Evenden, J. L., Heald, A., Levy, R., Philpot, M., &amp; Robbins, T. W. (1988). A comparative study of visuospatial memory and learning in Alzheimer-type dementia and Parkinson's disease. Brain, 111(3), 695-718.</i></li> <li>• <i>Sahgal, A., Galloway, P. H., McKeith, I. G., Lloyd, S., Cook, J. H., Ferrier, I. N., &amp; Edwardson, J. A. (1992). Matching-to-sample deficits in patients with senile dementias of the Alzheimer and Lewy body types. Archives of Neurology, 49(10), 1043-1046.</i></li> </ul>
Double Trouble	<ul style="list-style-type: none"> <li>• <i>Bélanger, S., Belleville, S., &amp; Gauthier, S. (2010). Inhibition impairments in Alzheimer's disease, mild cognitive impairment and healthy aging: Effect of congruency proportion in a Stroop task. Neuropsychologia, 48(2), 581-590.</i></li> <li>• <i>Belleville, S., Rouleau, N., &amp; Van der Linden, M. (2006). Use of the Hayling task to measure inhibition of prepotent responses in normal aging and Alzheimer's disease. Brain and Cognition, 62(2), 113-119.</i></li> <li>• <i>Dong, G., Zhou, H., &amp; Zhao, X. (2011a). Male Internet addicts show impaired executive control ability: evidence from a color-word Stroop task. Neuroscience Letters, 499(2), 114-118.</i></li> <li>• <i>Dong, G., Huang, J., &amp; Du, X. (2011b). Enhanced reward sensitivity and decreased loss sensitivity in Internet addicts: an fMRI study during a guessing task. Journal of Psychiatric Research, 45(11), 1525-1529.</i></li> <li>• <i>Loughman, A., Bowden, S.C., &amp; D'Souza, W. (2014). Cognitive functioning in idiopathic generalised epilepsies: a systematic review and meta-analysis. Neuroscience and Biobehavioral Reviews, 43, 20-34.</i></li> <li>• <i>Owen, A. M., Downes, J. J., Sahakian, B. J., Polkey, C. E., &amp; Robbins, T. W. (1990). Planning and spatial working memory following frontal lobe lesions in man. Neuropsychologia, 28(10), 1021-1034.</i></li> <li>• <i>Owen, A. M., Roberts, A. C., Polkey, C. E., Sahakian, B. J., &amp; Robbins, T. W. (1991). Extra-dimensional versus intra-dimensional set shifting performance following frontal lobe excisions, temporal lobe excisions or amygdalo-hippocampectomy in man. Neuropsychologia, 29(10), 993-1006.</i></li> <li>• <i>Owen, A. M., Roberts, A. C., Hodges, J. R., &amp; Robbins, T. W. (1993). Contrasting mechanisms of impaired attentional set-shifting in patients with frontal lobe damage or Parkinson's disease. Brain, 116(5), 1159-1175.</i></li> <li>• <i>Penades, R., Catalan, R., Rubia, K., Andres, S., Salamero, M., &amp; Gasto, C. (2007). Impaired response inhibition in obsessive compulsive disorder. European Psychiatry, 22(6), 404-410.</i></li> <li>• <i>Swerdlow, N. R., Paulsen, J., Braff, D. L., Butters, N., Geyer, M. A., &amp; Swenson, M. R. (1995). Impaired prepulse inhibition of acoustic and tactile startle response in patients with Huntington's disease. Journal of Neurology, Neurosurgery &amp; Psychiatry, 58(2), 192-200.</i></li> <li>• <i>Vendrell, P., Junqué, C., Pujol, J., Jurado, M. A., Molet, J., &amp; Grafman, J. (1995). The role of prefrontal regions in the Stroop task. Neuropsychologia, 33(3), 341-352.</i></li> </ul>