

**The Influence of Surface Detail on Object Identification in  
Alzheimer's Patients and Healthy Participants**

By

Rebecca Adlington

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## PUBLICATIONS

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Laws K.R, Gale, T.M., Moreno-Martínez F.J., **Adlington R.L,** Irvine K & Sthanakiya S. In Cognitive Psychology Research Developments (Ed:) Stella P. Weingarten and Helena O. Penat

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## CONFERENCES

**Adlington, R. L.,** Laws, K. R., & Gale, T. M. (2008). The Hatfield Image Test (HIT): A new picture set and norms for clinical and experimental use. The Federation of the European Societies of Neuroscience, Edinburgh, September 2008.

**Adlington, R. L.,** Laws, K. R., & Gale, T. M. (2008). The role of surface information and colour on category-specific naming in Alzheimer's dementia. International Neuropsychological Society, Buenos Aires, Argentina, July 2008.

**Adlington, R. L.,** Laws, K. R., & Gale, T. M. (2008). The role of surface information and colour on category-specific naming in Alzheimer's dementia. PsyPAG Human Neuropsychology and Neuroscience Conference, April, 2008.

**Adlington, R. L.,** Laws, K. R., & Gale, T. M. (2007). The influence of gender on category-specific naming in non-brain injured individuals. British Psychological Society, Cognitive Section, Aberdeen, September 2007.

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