Dr. Temple Grandin: A Neuroimaging Case Study

Jason R. Cooperrider1,2, Temple Grandin5, Erin D. Bigler2,6, Jeffrey S. Anderson1,3, Nicholas Lange7, Andrew L. Alexander8, Molly B. DuBray1,2, Alyson Froehlich2, Brandon A. Zielinski4 and Janet E. Lainhart1,2
1Interdepartmental Program in Neuroscience, 2Department of Psychiatry, 3Department of Radiology, 4Department of Pediatrics, University of Utah
5Department of Animal Sciences, Colorado State University
6Department of Psychology, Neuroscience Center, Brigham Young University
7Departments of Psychiatry and Biostatistics, Harvard University Schools of Medicine and Public Health
8Waisman Center, Departments of Medical Physics and Psychiatry, University of Wisconsin at Madison

INTRODUCTION

Dr. Temple Grandin, internationally renowned scientist with autism, has generously provided science with many insights into the mind of individuals with autism. She has a unique mind, exceptional memory, and savant visuospatial abilities. She graciously allowed us to study her brain to understand better how brain structure and function are related to outstanding ability and disability within the same brain.

OBJECTIVE

The objective was to elucidate the neuroanatomical and functional basis of Dr. Grandin’s cognitive strengths and weaknesses.

PARTICIPANTS

• Dr. Grandin’s data were compared to those from three female control participants.
• Controls were matched to Dr. Grandin on age (Dr. Grandin 61.3 years; controls: mean 62.3 years, range 59.1-67.9 years); two control participants.

METHODS

• Anatomical, diffusion tensor, and functional magnetic resonance imaging (MRI, DTI, and fMRI) was performed at 3-Tesla on Dr. Grandin and the three control participants.
• MP-RAGE, T2-weighted anatomical, 12-direction DTI, and BOLD fMRI (resting state, visual language, auditory language, and music) data were collected from all participants.
• Measures analyzed were total and regional brain volume, cortical thickness, white matter microstructure (DTI), and functional (fMRI BOLD signal) differences.
• FreeSurfer was used for volumetric and cortical thickness analyses and visualizations.
• The functional analyses were done with MATLAB and SPM8 (Wellcome Trust Centre for Neuroimaging).
• All analyses used a whole-brain voxel-wise comparison approach.
• This case study is similar to past savant neuroimaging case studies (see Gonzalez-Garrido et al., 2002; Boddaert et al., 2005; Bor et al., 2007; Wallace et al., 2009; and Sevik et al., 2010).

RESULTS

In addition to significantly increased left lateral ventricular volume and intracranial volume, Dr. Grandin had significantly increased volumes of the left cingulate, bilateral amygdala, and bilateral entorhinal cortex.

ACKNOWLEDGEMENTS

We would like to thank Tracy Abildskov, Melody Johnson, Tricia Merkley, and Dr. June Taylor for their roles in the data collection or analysis for this study. Special thanks go to Dr. Grandin and the control participants for their participation in the study. Dr. Grandin provided written and verbal consent for her name to be used in this presentation. This study was supported by NIMH grant ROI MH080826. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Mental Health or the National Institutes of Health.

CONCLUSIONS

• There is evidence of some unique differences found in Dr. Grandin’s brain structure and function compared to the neurotypical population as represented by our sample.
• Due to sample size limitations and the problem of making inferences based on a single case, the results of this study should be interpreted with caution.