The Neurophysiology of Giftedness, a Literature Review

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METHODS

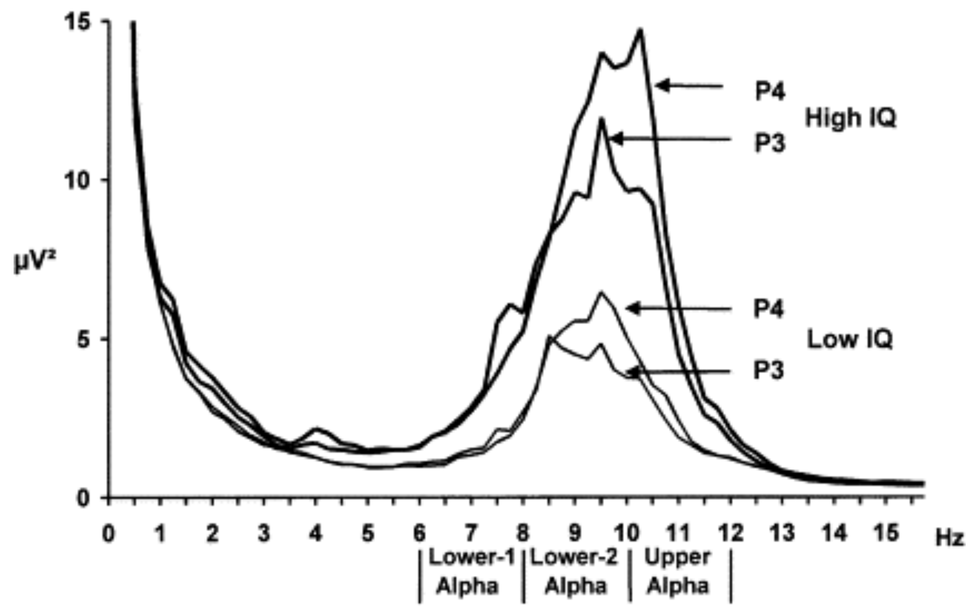
- Resources were winnowed by keyword inclusions of: gifted, giftedness, and neurophysiology.
- Sources that did specify ‘gifted’ or ‘giftedness’ and also featured ‘IQ’ or ‘High IQ’ were included.
- Once ‘gifted’ specific sources were identified, articles discussing the role of the prefrontal cortex (PFC) as it relates to superior cognition were sought.
- Keyword specifications were not maintained when searching for articles related to PFC and superior cognition.
- Sources which did not specify the term ‘gifted’ or ‘giftedness’ were intentionally excluded as they often favored the terms ‘IQ’ or ‘High IQ’, which hold certain sociocultural limitations not within the scope of this presentation.

SUMMARY & CONLCUSIONS

Gifted individuals process information differently due to specific neurophysiological underpinnings:

- More complex neuronal schemas which promote fluid analogising
- Higher alpha power
- Less cortical activation when receiving apt stimulation
- Up to 6% higher gray matter ratio
- Enhanced bilateral communication
- Heightened fronto-parietal activation during task performance
- More efficacious working memory, a result of higher PFC activation

Gifted individuals take in more information, more efficiently, and are able to direct attention to promote conscious and unconscious information processing. The ability to take in and hold more information also comes with social emotional struggles, i.e. peer relationship struggles, emotional sensitivities, etc.



Results

FUNCTION

It takes gifted people less time to process information and they have less overall activation which promotes more complex neural schemas. These more complex neural schemas and reduced latent inhibition promote fluid analogising: the ability to generate more creative solutions and hold more possibilities. Gifted individuals also tend to have heightened bilateral alpha activity during fluid reasoning tasks and in eyes-open event related potential (ERP) tasks: Alexander, O’Boyle, & Benbow, (1996); Carson, Peterson, & Higgins, (2003); Chen, & Buckley, (1988); Dombrowski & Mrazik, (2010); Duncan et al., (2001); Geake, (2005); Geake, (2009);Geake and Hansen (2005)(2006); Gray & Thompson, (2004); Haier & Benbow, (1995); Haier et al., (1988); Hofstadter, (1995) (2001); Jaušovec, (1998); Luo et al., (2003); O’Boyle’s (2008); O’Boyle, et. al, (2005); Prabhakaran et al., (1997); Stepanova, Vavrecka, Durdiakova, & Lhostka, (2015); Wharton et al., (2000).

Gifted individuals have more bilateral communication between the two hemispheres. More communication between the two hemispheres allows for more fluid analogizing. A gifted person’s success at specific intellectually demanding tasks is significantly determined by how well their brain enables fluid analogising as a fundamental cognitive process: Dombrowski & Mrazik, (2010); Christoff et al., (2001); Geake, (2005); Geake, (2009); Gray & Thompson (2004); Hofstadter, (1995); Koechlin et al., (1999); Kroger et al., (2002); O’Boyle, Benbow, & Alexander, (1995); Parsons & Osherson, (2001); Singh & O’Boyle, (2004); Strange et al., (2001).

STRUCTURE

Heightened fronto-parietal network activation helps gifted individuals maintain task focus: Duncan, (2001); Dombrowski & Mrazik, (2010); Geake, (2005); Geake, (2009); Geake & Dobson, (2005); Geake & Hansen, (2006); Gray, Chabris, & Braver, (2003); Gray & Thompson, (2004); Hofstadter, (1995) (2001); Vandervert & Liu, (2007).

Heightened posterior-parietal activations involved in forming conceptual inter-relationships, especially of a quasi-spatial representation. This also supports heightened unconscious processing: Dombrowski & Mrazik (2010); Geake, (2005); Geake, (2009); Gray & Thompson,(2004); Koziol, Chidekel, & Budding, (2010); Luria, (1973); Zhang et al. (2006).

Higher grey matter ratio in the PFC results in high levels of executive functioning, working memory, and enhanced bilaterality of an extended cortical network. This higher PFC functioning then allows for more, mostly unconscious, attentional focus and selective inhibition: Chen & Buckley, (1988); Christoff et al., (2001); Dombrowski & Mrazik, (2010); Frangou, Chitins, & Williams,(2004); Geake, (2005); Geake, (2009); Geake and Hansen, (2005), (2006); Gray, Chabris, & Braver, (2003); Gray & Thompson, (2004); Haier et al., (2004); Hofstadter, (1995) (2001); Koechlin et al., (1999); Koziol, Chidekel, & Budding, (2010); Kroger et al., (2002); Lee et al. (2006); Parsons & Osherson,(2001); Strange et al., (2001).