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Psychology Data Resource Pack

Complementing the Queensland Senior Psychology Syllabus, Unit 1 – Individual development, and Unit 3 – Individual thinking

Dataset 1

Researchers at QIMR Berghofer Medical Research Institute in Queensland investigated whether the temperature of facial regions could change in response to loud sounds (auditory stimuli). The temperature of different parts of the face was monitored with an infrared thermal imaging camera. Physiological changes in response to sound stimuli have previously been demonstrated with other recording tools such as the widely-used skin conductance (aka. "lie-detector test") and heart-rate measures, both of which require electrodes to be attached to participants. The driving hypothesis for this study was that non-contact thermal imaging could be as sensitive as these earlier-reported measures.

Design
- Sample size: 20 healthy human adults (11 females, mean age = 25.7 years)

Methods
- Participants viewed a 60-second calming ocean video.
- At 40 seconds, a loud gunshot sound lasting 1 sec was played. This is called an auditory stimulus.
- Measures of heart rate, skin conductance, and infrared thermal signals from specific regions of participants' faces were recorded, before and after the unexpected sound.
- Measures are presented as signal sizes.

Table 1: Statistical analysis to compare physiological measures before ("pre-stimulus") and after ("post-stimulus") the sound was played. To account for different baseline readings between participants, measurements were computed into signal scores that centre on zero. An increase in signal value indicates an increase in heart rate, conductance or temperature, whereas a decrease in signal value indicates a reduction in that measurement.

Physiological measure	Mean signal		Standard Error of the Mean		p-value
	Pre-stimulus	Post-stimulus	Pre-stimulus	Post-stimulus	
Inter-beat interval	−0.40	0.36	0.18	0.15	0.0001
Skin conductance	−1.19	0.31	0.13	0.18	0.00001
Right cheek temperature	0.43	0.17	0.21	0.11	0.31
Left cheek temperature	0.62	0.12	0.23	0.11	0.09
Nose tip temperature	0.72	0.11	0.20	0.11	0.02
Forehead temperature	0.04	0.03	0.28	0.12	0.97

Source: Sonksare, S, Ahmedt-Aristizabal, D, Aburn, MJ et al. 2019, 'Detecting changes in facial temperature induced by a sudden auditory stimulus based on deep learning-assisted face tracking', *Scientific Reports*, vol. 9, no. 4729, pp. 1-11, https://doi.org/10.1038/s41598-019-41172-7

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Questions

Apply understanding

1. Determine which cheek exhibited a greater change in temperature signal following the stimulus.

2. Calculate the change in the inter-beat interval signal following the stimulus.

3. Identify which measures showed a statistically significant change after the loud sound.

Analyse evidence

4. Sequence the measurement types from the largest to the smallest change in signal. Show your working.

5. Contrast the results for nose tip temperature and cheek temperatures.

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6. Draw a conclusion about the validity of using thermal imaging to detect psychophysiological changes.

7. Predict what would happen to the inter-beat interval and forehead temperature if a second gunshot sound was played at 50 seconds into the video. Explain your reasoning.

Researcher Profile

Dr Saurabh Sonkusare

Dr Sonkusare is a research scientist at QIMR Berghofer Medical Research Institute, where he studies neurophysiology. Dr Sonkusare grew up in India where he trained and worked as a medical doctor before undertaking a Masters degree in cognitive neuroscience in the UK (York). For his PhD studies, Dr Sonkusare came to Brisbane to study at QIMR Berghofer. The research reported in this dataset was generated during his PhD studies.

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Dataset 2

The association between larger, more-folded brains and greater intelligence in humans is well-established, as are the joint contributions of genetics and environment to the development of intelligence. Researchers at QIMR Berghofer Medical Research Institute sought to identify the particular regions and features of the brain that underpin these relationships.

Design
- Sample size – twin and sibling young adults from the *Queensland Twin Imaging Study* (N=1097) underwent brain imaging and genetic sequencing.

Methods
- Three measures of overall brain size were recorded using magnetic resonance imaging (MRI) of participants' brains. The measures were: total surface area (TSA), intra-cranial volume (ICV) and average cortical thickness (ACT).
- The surface area of 34 smaller, specific regions of the cortex were also measured using MRI.
- Education attainment, defined as "the number of full-time years of education an individual receives", was used as a proxy for the measure of intelligence for each participant.
- Researchers used previously identified genes associated with educational attainment to calculate an "education attainment genetic score" for each participant.
- For each brain size measure, researchers calculated how much of the sample variance could be explained by educational attainment genetic scores (EA-GS).

Figure 1: The percentage variance in brain measures (total surface area, intercranial volume and average cortical thickness) explained by educational attainment genetic scores. Error bars represent 95% confidence intervals. Asterisks (*) indicate significance, calculated as $p < 0.05$.
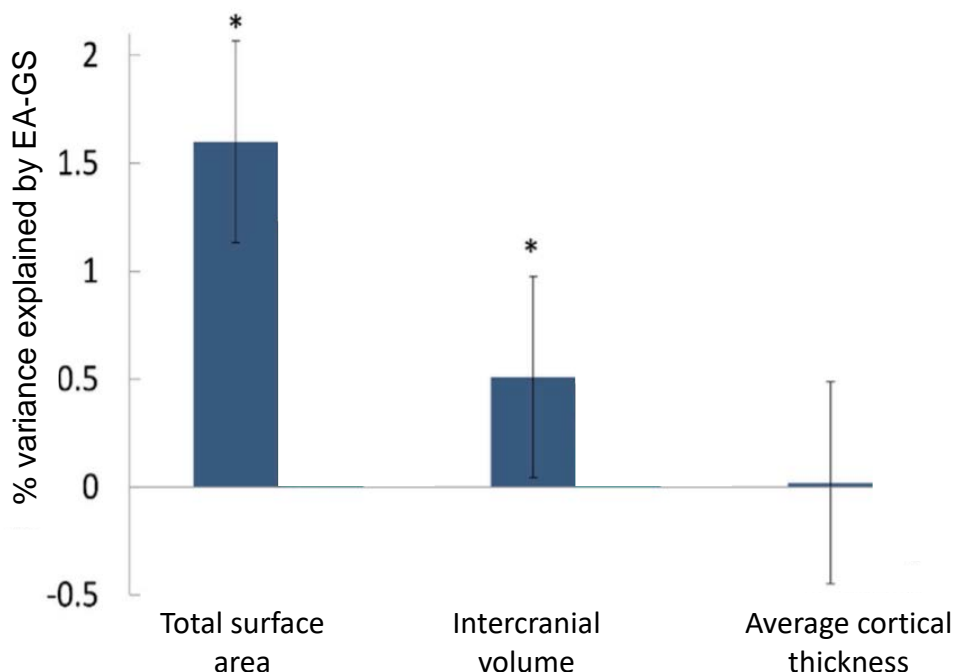
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Figure 2: A heat map showing the strength of association between educational attainment genetic scores (EA-GS) and the surface area (SA) of 21 regions of the cortex for 1097 participants in the Queensland Twin Imaging Study. The left y-axis represents the p-value cut-off thresholds for the gene sequences used to calculate the educational attainment genetic scores. Darker cells indicate a greater percentage of variance explained. Asterisks (**) indicate significance, calculated as $p < 0.0001$.
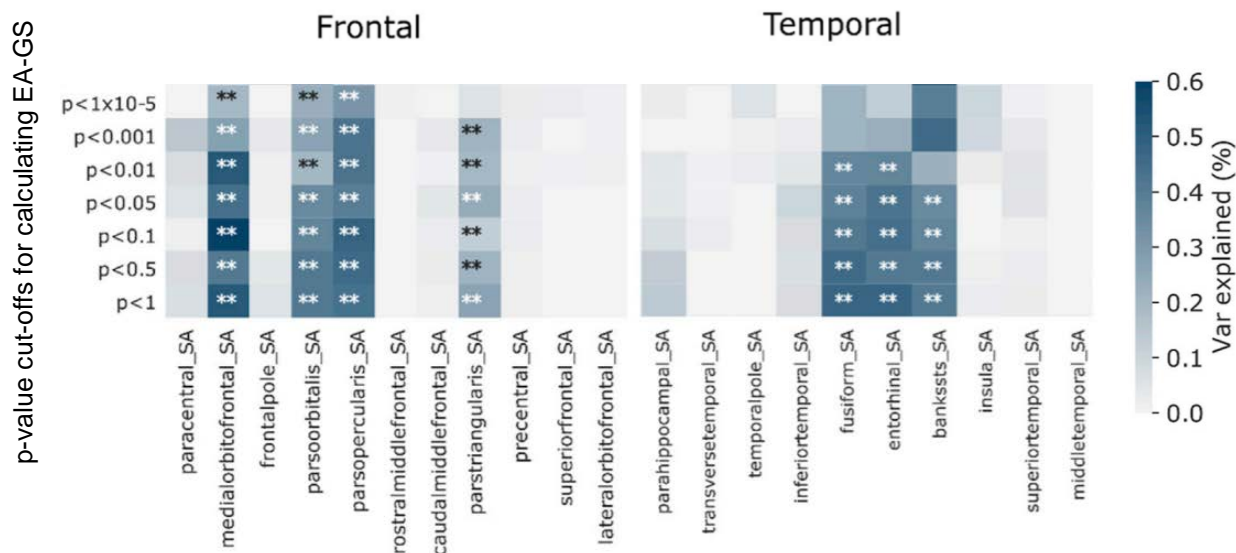
Questions

Apply understanding

1. Determine which brain size measure explained the greatest amount of variance in educational attainment genetic scores in Figure 1.

2. Calculate the size of the 95% confidence interval for the total surface area and intercranial volume measures in Figure 1.

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3. Identify the maximum variance value reported in Figure 2 and the corresponding brain region for which it was reported.

4. Contrast the strength of association between surface area and educational attainment genetic scores for the frontal brain region with those of the temporal lobe.

5. Identify the brain regions for which statistically significant associations between surface area and educational attainment scores were reported in Figure 2.

Interpret evidence

6. Deduce which brain measure had the greatest variability in its data.

7. Draw a conclusion about why surface area was used to investigate the relationship between the size of specific brain regions and educational attainment.

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8. Infer which specific brain regions should be prioritised for future investigations of the relationship between size and intelligence.

Researcher Profile

Ms Brittany Mitchell

Ms Mitchell is a PhD student at QIMR Berghofer Medical Research Institute, where she studies the genetics underlying Alzheimer's disease and cognitive ability. Ms Mitchell grew up in South Africa and has a broad background in science. She studied Medical Science as an undergraduate and then undertook a Masters degree in agricultural science where she examined the genetics of avocado (true story). Her favourite aspects of research are the opportunity to collaborate with people from all over the world, and the process of writing research papers for publication.

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