

## Barkley-Levenson and Galván (2014)

### *Neural Representation of Expected Value in the Adolescent Brain.*

**Background and aim:** Prior to this research, it was not clear whether the adolescent brain attributes greater value to available rewards, or whether adolescents value money to a greater extent than adults because they have had less experience with it. The aim of this study was to shed some light on these possibilities by examining subjective valuation of objectively valued choices. Barkley-Levenson and Galván investigated the influence of brain development on **risk taking behaviour** and they proposed three hypotheses:

1. Adolescents will accept more gambles of increasing **Expected Value (EV)** than adults.
2. **Ventral Striatum (VS)** activation will increase in proportion to increasing EV in adolescents.
3. Adults who behave like adolescents in terms of gambling behaviour will not exhibit hyperactive Ventral Striatal activation.

**Method:** As the **IV** was whether the person was an adult or an adolescent, the study was **quasi-experimental** with an **independent measures design**. It was conducted in a laboratory. Performance was measured on a simple mixed gambles game and an **fMRI** was used to measure VS activity (**DV**). 19 healthy right-handed adults aged between 25-30 (11 females and 8 males) and 22 healthy, right-



handed adolescents aged 13 to 17, (11 females and 11 males) were the sample. They were all volunteers who responded to posters and internet adverts. Participants initially attended the laboratory for 'an intake session' for **neuro-imaging** and to provide **consent** (from themselves or their parents). In this session they were asked about their primary source and amount of spending money per month: the mean for adolescents was \$52.50; for adults it was \$467. Participants were given \$20 for completing the intake session and were told that they would use the \$20 as "playing" money during the fMRI task. Furthermore, they were told there was a chance to win up to \$20 more, but they could lose the \$20 during the gambling fMRI task.

One week later, participants returned for the fMRI session. During the scan, they were presented with a series of gambles with a 50% probability of gaining the amount shown on one side of a "spinner" and a 50% probability of losing the amount shown on the other side. There were a range of profit values between +\$5 and +\$20 and loss amounts between -\$5 and -\$20, for a total of 144 trials. Within these trials there were 24 gain-only trials and 24 loss-only trials, with values drawn from the same range, for a total

ranging from +\$6 to +\$19 and -\$6 to -\$19. The side of the spinner in which the gain and loss appeared and the order of the stimuli was counterbalanced across participants. In each trial, participants had to decide whether they would be willing to gamble for real money. Participants were informed that one of the trials that they chose to accept would be selected at the end of the scan and played for real money. Before the scan the task was explained to ensure they fully understood all aspects of the **gambling task**.

**Results:** For the initial analysis, three participants were excluded as outliers based on the deviation of their data; therefore, 20 adolescent and 17 adult participants were included in the results. Results showed that acceptance rates did not change in either adolescents or adults when there was no risk involved in both gain-only and loss-only trials, suggesting that adolescents **behave similarly** to adults when there is no risk involved. All trials with positive EV were accepted **significantly more** than trials with an EV of zero, which in turn were accepted **significantly more** than trials with negative EV. The amount of disposable income **did not** have an effect and there were **no differences** in reaction times. Acceptance rates **did not** change in either group when there was no risk involved in both gain-only and loss-only trials.

However, most pertinently, the higher the EV of the win the **more likely** the adolescent was to gamble in comparison to the adult. This was also **correlated** with greater activation in the ventral striatum in adolescents. The VS response remained even after matching groups on acceptance behaviour. The fMRI also showed **changes** in activities in other areas of the adolescent brain, including decreased activity in the **amygdala** (responsible for fear) and increased activity in the **medial prefrontal cortex** (responsible for memory and decision making).

**Conclusions:** It can be concluded from this study that the value of available options has a greater influence in adolescent choices compared to adult choices, even when objective value and subjective choice remain constant. Neural differences in sensitivity to EV **change** across development, particularly in the VS. **Hyper activation of the VS**, a unique adolescent response to rewards, is mediated by developmental differences in valuation and is not a methodological consequence of using money as the rewarding stimulus. When there is no risk involved in gambling, adolescents behave similarly to adults. In short, adolescents are more likely to engage in **advantageous risk tasking**.

## Evaluation

**Usefulness of research:** Findings from this study suggest that **developmental** differences in the brains of adolescents means they are more likely to take risks when there is an advantage. It is extremely useful for educators to be aware of this **predisposition** to risk taking and therefore develop curriculum to highlight the dangers and disadvantages of such behaviours. This is particularly important in young drivers. Furthermore, discussions with young people can be effective. This can be done by downplaying the advantages of risk-taking behaviour; this is most likely to work if peers are also involved.

**Psychology as a science:** This piece of research provides evidence to support this **debate**. Conditions were highly **controlled** and **standardised** in a laboratory, which are

easy to **replicate**. The experimental method was used with different conditions and the DV was measured using an fMRI, which is very scientific and provides us with **objective** results that are **falsifiable**. **Deduction** was used as a hypothesis was tested and useful **causal conclusions** were then made.

**Nature/nurture:** This study clearly supports the **nature** side of the **debate** in that biological features cause us to behave in certain ways, i.e. a hyperactive VS causes risk taking behaviour. However, those on the **nurture** side of the argument would argue that nurture, i.e. education, can reduce such behaviour.

## Exam Style Questions

Using the research by Barkley-Levenson and Galván (2014), explain brain development and the impact on risk taking behaviour. (10)

Explain how the research by Barkley-Levenson and Galván (2014), could be used to reduce risk taking behaviours. (10)

IMAGE – SIMILAR TO <http://www.shutterstock.com/pic-437496892/stock-photo-shocked-young-male-doctor-reviewing-an-mri.html?src=t5m4PKwiBgHW9j4Zpc2EBw-1-42>