Ambidextrous children 'more likely to be hyperactive'

Children who write with both hands are more likely to struggle in school and have hyperactivity disorder symptoms, research suggests.

A study by scientists from Imperial College London found ambidextrous children were twice as likely to struggle as their classmates.

They were also more likely to have difficulties with language.

Experts told Paediatrics journal the differences might be down to the brain’s wiring.

But they said much more work was needed to explore this.

Lead researcher Dr Alina Rodriguez said: “Mixed-handedness is intriguing - we don't know why some people prefer to make use of both hands when most people use only one.”

Ambidextrous

Around one in every 100 people is ambidextrous, or mixed-handed.

The study looked at nearly 8,000 children from Northern Finland, of whom 87 were mixed-handed.

Mixed-handed children aged seven and eight were twice as likely as their right-handed peers to have difficulties with language and to perform poorly in school.

When they reached 15 or 16, mixed-handed adolescents were also at twice the risk of having symptoms of Attention Deficit Hyperactivity Disorder (ADHD).

And they tended to have more severe symptoms of ADHD than their right-handed schoolmates.

They also reported having greater difficulties with language than those who were left or right-handed.

This is in line with earlier studies that have linked mixed-handedness with dyslexia.

Hard-wired

Experts know that handedness is linked to the brain’s left and right halves or hemispheres.

Research has shown that where a person's natural preference is for using their right hand, the left hemisphere of their brain is more dominant, which is where the centre for language lies.

Scientists have suggested that ADHD could be linked to having a weaker function in the right hemisphere of the brain.

Dr Rodriguez said it was possible that brain differences might explain the findings.

But she cautioned: "Our results should not be taken to mean that all children who are mixed-handed will have problems at school or...

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Children who are mixed-handed will have problems at school of develop ADHD.

"We found that mixed-handed children and adolescents were at a higher risk of having certain problems, but we'd like to stress that most of the mixed-handed children we followed didn't have any of these difficulties."

Marjorie Wallace, chief executive of the mental health charity SANE, said they had been carrying out similar work.

"In particular, Professor Tim Crow and his team are exploring the idea that brain asymmetry and handedness may play a role in the development of language and the origins of psychosis.

"All research which investigates possible links between brain difference and behaviour is vital to increase our understanding of many conditions, including mental health problems."

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Experiment or observational study?

Randomized controlled double blind experiment.

allows determination of causation and confounding factors are the same for treatment & control group.

other sorts of experiments are possible.

Sample. 8000 kids from northern Finland

- likely to be a representative sample
  (as opposed to a biased sample).

Retrospective cross-sectional prospective

identify participants now, follow them forwards in time
1 in 100 is ambidiextrous.

Population

\[ p = \frac{1}{100} \]

Sample size \( n \)

# amb. people in sample

follows the Binomial distribution.

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A Pareto chart.

A "histogram for a categorical variable"

categorical

qualitative

nominal ordinal

quantitative

discrete continuous
Probability.

Simple event - ambiguous or hypoactive, \( A \) or \( H \).

Sample space - set of all possible simple events:

\[ \{ AH, A\bar{H}, \bar{A}H, \bar{A}\bar{H} \} \]

Event - set of simple events.

If each simple event is equally likely, each has probability \( \frac{1}{n} \).

Rules:

\[ 0 \leq P(A) \leq 1 \]

\[ P(\text{not } A) = 1 - P(A) \]

Addition Rule

\[ P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \]

\[ \uparrow \]

or both.

\[ = 0 \text{ if } A \text{ and } B \text{ are mutually exclusive} \]

\[ P(\text{Ambidextrous or Hypoactive}) = P(\text{amb.}) + P(\text{hyp.}) - P(\text{amb and hyp}) \]
Multiplication Rule.

\[ P(A \text{ and } B) = P(A | B) \cdot P(B) \]

- conditional probability - "prob. of A given B"

\[ = P(A) \times P(B) \quad \text{if} \quad A + B \text{ are independent.} \]

\[ P(\text{amb and hyperactive}) \]

\[ = P(\text{amb | hyperactive}) \cdot P(\text{hyperactive}) \]

amb and hyperactive are NOT independent.

- title of the article.

if I know you are ambivalent, that changes the probability of you being hyperactive (it increases the prob. of hyperactive).
\[ P(\text{ambidextrous}) = \frac{1}{100} \]

\[ P(\text{language difficulty} \mid \text{ambidextrous}) \]

\[ = 2 \cdot P(\text{language difficulty} \mid \text{not ambidextrous}) \]

If I choose a random 7 year old who has a language difficulty, what's the chance they are ambidextrous?

\[ P(\text{amb.} \mid \text{language difficulty}) \]

\[ P(A \text{ and } B) = P(A \mid B) P(B) \]

\[ = P(B \mid A) P(A) \]

\[ P(A \mid B) = \frac{P(B \mid A) P(A)}{P(B)} \quad \text{Bayes thm.} \]

\[ P(\text{amb.} \mid \text{language difficulty}) = \frac{P(\text{lang. diff.} \mid \text{amb}) P(\text{amb})}{P(\text{lang. diff.})}. \]

\[ P(B) = P(B \mid A) P(A) + P(B \mid \bar{A}) P(\bar{A}). \]

\[ = P(B \text{ and } A) + P(B \text{ and } \bar{A}) \]
\[ P(\text{amb} | \text{lang diff.}) = \frac{P(\text{lang diff.} | \text{amb}) \cdot \varphi(\text{amb})}{P(\text{lang diff.} | \text{amb}) \cdot P(\text{amb}) + P(\text{lang diff.} \not\text{amb}) \cdot P(\not\text{amb})} \]

\[ = \frac{2 \cdot P(LA) \cdot \frac{1}{100}}{2 \cdot P(LA) \cdot \frac{1}{100} + P(LA) \cdot \frac{99}{100}} = \frac{2}{101} = \frac{1}{50} \]

A kid with a language difficulty has a chance of \( \approx 2\% \) to also be ambidextrous, because being ambidextrous is actually quite rare.
1000 kids.

70% of non ambidextrous kids have language difficulty.

\[ \Rightarrow \frac{40}{100} \] of amb kids have language difficulty.

\[
P(\text{amb} | \text{language difficulty}) = \frac{4}{198 + 4} = \frac{4}{202} = \frac{1}{50}.
\]
Random variable

Prob. distribution

Binomial distribution

\[ n \text{ trials} \]
\[ k \text{ successes} \]
\[ p \text{ prob of success on a given trial} \]

\[ p(k \text{ out of } n) = \frac{n!}{k!(n-k)!} p^k (1-p)^{n-k} . \]

Expected values.

\[ \mu = E[x] = \sum x \cdot p(x) \]
\[ \sigma^2 = \text{Var}[x] = \sum (x - \mu)^2 \cdot p(x) \]

Binomial

\[ \mu = np \]
\[ \sigma = \sqrt{np(1-p)} \]

Poisson

\[ p(x) = \frac{\mu^x e^{-\mu}}{x!} , \text{ for } x > 0 \]

\[ \mu - \text{mean rate} \]
\[ \sigma = \sqrt{\mu} \]
Normal Distribution.

\[ p \left( \frac{z}{\sigma} < z \right) = \text{area to the left of } z \text{ under the normal curve} \]

Approximate Binomial / discrete distribution by the normal distribution - continuity correction

\[ p(x \leq 5) = p(x \leq 5.5 \text{ when using the normal approximation}) \]

so that include the bar that represents \( p(x = 5) \)

CLT

Sample mean \( \bar{x} \) is normally distributed

\[ \mu_{\bar{x}} = \mu, \quad \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \]

\( \bar{x} \) is a good approximation if population is normally distributed and \( n \) is "large" greater than 30.
Measures of variability:

- Range
- Interquartile range
- Standard deviation

\[ \sigma = \sqrt{\frac{\sum (x_i - \mu)^2}{n}} \quad \text{— population} \]

\[ s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}} \quad \text{— sample} \]