Heritability of different aggression phenotypes in an Australian and a Dutch cohort

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Phenotypes

- Conduct Disorder (CD)
- Oppositional Defiant Disorder (ODD)
- Aggression
  - Verbal aggression
  - Physical aggression
  - Anger
  - Hostility
  - Total aggression
Conduct Disorder (DSM-5)

- **Aggression to people and animals**
  - often bullies, threatens, or intimidates others
  - often initiates physical fights
  - has used a weapon that can cause serious physical harm to others
  - has been physically cruel to people
  - has been physically cruel to animals
  - has stolen while confronting a victim
  - has forced someone into sexual activity

- **Destruction of property**
  - has deliberately engaged in fire setting with the intention of causing serious damage
  - has deliberately destroyed others’ property
  - deceitfulness or theft
  - has broken into someone else’s house, building, or car
  - often lies to obtain goods or favors or to avoid obligations
  - has stolen items of nontrivial value without confronting a victim

- **Serious violations of rules**
  - often stays out at night despite parental prohibitions, beginning before age 13 years
  - has run away from home overnight at least twice while living in parental home
  - is often truant from school, beginning before age 13 years
• **Angry and irritable mood:**
  – Often loses temper
  – Is often touchy or easily annoyed
  – Is often angry and resentful

• **Argumentative and defiant behaviour:**
  – Often argues with adults or people in authority
  – Often actively defies or refuses to comply with adults' requests or rules
  – Often deliberately annoys people
  – Often blames others for his or her mistakes or misbehaviour

• **Vindictiveness:**
  – Has been spiteful or vindictive at least twice in the past six months
Netherlands Twin Registry (NTR)

The NTR began in 1986 by recruiting twins at birth. Parents are approached at several points during the childhood. Since 2005 the adolescent twins are also sent questionnaires.

Data on conduct disorder were collected at age ~12 by parent’s report, and ~16 by self-report.

Brisbane Longitudinal Adolescent Twin Study (BLATS)

The BLAT study began in 1992 and has been continuously recruiting 12 year old twins since this time with Parent’s and self-report.

Data were collected at ages 12, 14, 16, 19 and 25. Several subsets have provided information on aggression related phenotypes: aggression, ODD and CD.
Instruments: CD (1)

Achenbach System of Empirically Based Assessment (ASEBA)
School-Age Forms and Profiles

**Child Behavior Checklist (CBCL, Achenbach 2001)**

**Youth Self Report (YSR, Achenbach 2001)**

- They can yield Empirical Syndrome scores and DSM-Oriented scores, created according to the judgments of experts based on rational criteria.

→ Items assessing conduct disorder items made up the *DSM-oriented Conduct Problems scale* (16 items in CBCL12, 15 items in YSR)
Screening

Many children and teenagers go through periods when they do things adults don’t want them to do, like lying, stealing, or breaking rules. Did you ever go through a period during your childhood or teenage years when you did any of these things?

Did you ever run away from home, or repeatedly wag school, or often stay out much later at night than you were supposed to?

Did you ever go through a period where you either broke into cars, set fires, or destroyed property on purpose?
Many children and teenagers go through periods when they do things adults don’t want them to do, like lying, stealing, or breaking rules. Did you ever go through a period during your childhood or teenage years when you did any of these things?

Did you ever run away from home, or repeatedly wag school, or often stay out much later at night than you were supposed to?

Did you ever go through a period where you either broke into cars, set fires, or destroyed property on purpose?
SWAN scale (Strengths and Weaknesses of ADHD-symptoms and Normal-behavior, Swanson et al., 2012)

For each item listed below, how does this child compare to other children of the same age?

“Control temper”
“Avoid quarreling”
“Ignore annoyances of others”
SWAN scale (Strengths and Weaknesses of ADHD-symptoms and Normal-behavior, Swanson et al., 2012)

For each item listed below, how does this child compare to other children of the same age?

“Control temper”
“Avoid quarreling”
“Ignore annoyances of others”

Screening

Did you ever have a period lasting six months or longer when you often did things that got you in trouble with adults such as losing your temper, arguing or talking back to adults, refusing to do what your teachers or parents asked you to do, annoying people on purpose, or being grouchy or irritable?
Aggression Questionnaire (Buss & Perry, 1992)

Using this 5 point scale, indicate how uncharacteristic or characteristic each of the following statements is in describing you

- Physical aggression
  - “If somebody hits me, I hit back”
- Verbal aggression
  - “I can’t help getting into arguments when people disagree with me.”
- Hostility
  - “When people are especially nice to me, I wonder what they want.”
- Anger
  - “I have trouble controlling my temper.”
- Total score
### Overview of samples and phenotypes

#### The Netherlands

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Gender</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBCL12</td>
<td>16,566</td>
<td>50.7% females</td>
<td>12.2 y.o. (SD: 0.4, range: 11-15)</td>
</tr>
<tr>
<td>YSR</td>
<td>4,855</td>
<td>57.9% females</td>
<td>16.9 y.o. (SD: 0.5, range: 15-21)</td>
</tr>
<tr>
<td>SWAN</td>
<td>513</td>
<td>55.5% females</td>
<td>12.3 y.o. (SD: 1, range 10-17)</td>
</tr>
<tr>
<td>CD&amp;ODD screen, Buss-Perry</td>
<td>464</td>
<td>57.9% females</td>
<td>16.6 y.o. (SD: 0.8, range 15-18)</td>
</tr>
<tr>
<td>Buss-Perry (PA)</td>
<td>577</td>
<td>57.9% females</td>
<td>24.6 y.o. (SD: 3, range: 18-30)</td>
</tr>
<tr>
<td>CD&amp;ODD screen, Buss-Perry</td>
<td>219</td>
<td>68.4% females</td>
<td>33.3 y.o. (SD: 2.3, range 22-44)</td>
</tr>
</tbody>
</table>

#### Australia

http://www.action-euproject.eu
Analyses

- Assumption testing
- Twin correlations
- Binary/continuous models
- ACE/ADE modeling correcting for age and sex
- OpenMx
CD: CBCL12

N = 16,566, 50.65% females, age M: 12.25, SD: 0.4, range: 11-15.

http://www.action-euproject.eu
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\[ r_{MZ} = 0.91 \ (0.89, 0.93) \]
\[ r_{DZ} = 0.75 \ (0.69, 0.74) \]
N = 4,855, 57.98% females, age M: 16.95, SD: 0.55, range: 15-22..
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N = 4,855, 57.98% females, age M: 16.95, SD: 0.55, range: 15-22.

$r_{MZ} = 0.50 (0.41, 0.58)$

$r_{DZ} = 0.28 (0.19, 0.37)$
N = 636, 62.3% female, age 23.02, SD: 8.27, range: 15-37

Many children and teenagers go through periods when they do things adults don’t want them to do, like lying, stealing, or breaking rules. Did you ever go through a period during your childhood or teenage years when you did any of these things? → 34.87%

Did you ever go through a period where you either broke into cars, set fires, or destroyed property on purpose? → 3.3%

Did you ever run away from home, or repeatedly wag school, or often stay out much later at night than you were supposed to? → 9.79%

beginning at age 13.94 (SD = 2.2, range 5-27)
most recent episode at age 15.71 (SD=2.8, range: 6-30), 23.9% in the last year
Many children and teenagers go through periods when they do things adults don’t want them to do, like lying, stealing, or breaking rules. Did you ever go through a period during your childhood or teenage years when you did any of these things? → 34.87%

\[ r_{MZ} = 0.63 (0.37, 0.81) \]

\[ r_{DZ} = -0.0001 (-0.29, 0.29) \]

Did you ever run away from home, or repeatedly wag school, or often stay out much later at night than you were supposed to? → 9.79%

\[ r_{MZ} = 0.52 (0.27, 0.74) \]

\[ r_{DZ} = 0.54 (0.17, 0.80) \]
N = 439, 54.2% female, age 12.14, SD: 0.51, range: 12-14

\[ r_{MZ} = 0.78 \ (0.67, 0.85) \]

\[ r_{DZ} = 0.29 \ (0.25, 0.51) \]
N = 620, 62.74% female, age 23.11, SD: 8.29, range: 15-37

14.5% reported ODD,
- beginning at age 13.3 (SD = 3.9, range 5-35), most recent episode at age 16.8 (SD=4.5, range: 6-37), 73.9% was in the year

\[ r_{MZ} = 0.65 \ (0.30, \ 0.87) \]

\[ r_{DZ} = 0.25 \ (-0.13, \ 0.59) \]
Aggression Buss Perry (AN)

N = 596, 60.9% female, age 22.96, SD: 8.26, range: 15-37

$r_{MZ} = 0.52 (0.36, 0.62)$

$r_{DZ} = 0.11 (-0.07, 0.28)$
N = 596, 60.9% female, age 22.96, SD: 8.26, range: 15-37

\[ r_{MZ} = 0.43 \ (0.26, 0.56) \]

\[ r_{DZ} = 0.15 \ (-0.03, 0.31) \]
Aggression Buss Perry (VA)

N = 596, 60.9% female, age 22.96, SD: 8.26, range: 15-37

\[ r_{MZ} = 0.41 \ (0.24, 0.54) \]

\[ r_{DZ} = 0.02 \ (-0.17, 0.20) \]
Aggression Buss Perry (PA)

N = 1,038, 60.21% female, age 22.4 (SD: 5.4, 15-37)

\[ r_{\text{MZ}} = 0.26 \ (0.14, 0.38) \]

\[ r_{\text{DZ}} = 0.23 \ (0.09, 0.34) \]
Aggression Buss Perry (total)

N = 596, 60.9% female, age 22.96, SD: 8.26, range: 15-37

\[ r_{MZ} = 0.45 \ (0.29, 0.58) \]

\[ r_{DZ} = 0.12 \ (-0.05, 0.29) \]
CD – A% in best fitting model

http://www.action-euproject.eu
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ODD – A% in best fitting model

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ODD – A% in best fitting model
Aggression – A% in best fitting model
Conclusions

- Aggression phenotypes are partially heritable (h² ranging between 30% and 60%).
- Common environmental experiences are important in childhood as shown by the mother’s reports.
- Sources of variance were similar in the Dutch and Australian samples for conduct problems.
- Results are comparable with previous studies.
- Further research to find common genetic variants.
- Possibility of combining phenotypes?
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