What do drawing tasks measure?

- Fine motor skills? (Shepers, Deković, Feltzer, 2012)
- Social skills? (Naglieri, MacNeish, & Bardos, 1991)
- Language? (Toomela, 2002)
- Intelligence? (Arden, Traskowski, Garfield, & Plomin, 2014; Goodenough, 1928; Reynolds, & Hickman, 2004)

Drawing & Intelligence: Pro

- Motivation for using figuring drawing as a measure of intelligence
  - Children’s drawings differ from their real-world counterparts (Goodenough, 1928)
    - Drawings indicate world knowledge
    - Alternatively, cognitive flexibility (Bremner & Moore, 1984; Picard & Durand, 2005, Taylor & Bacharach, 1982)
  - Draw-a-Person (DAP) scoring schema: validated against various full-scale and nonverbal IQ measures (Abell, Wood, & Liebman, 2001; Reynolds & Hickman, 2004)
  - Convenient for use in young children and special populations

Drawing & Intelligence: Con

- Imuta et al. (2013): DAP-IQ vs. WPPSI-III and WASI full scale-IQ (Wechsler, 1999; Wechsler, 2002)
  - Correlations with IQ tests are modest
  - High false positive and negative rates for high and low ends of the spectrum

DAP and Prematurity

- Schepers, Deković, & Feltzer (2012)
  - Participants:
    - Preterm children: M chronological age = 5.1 years [GA corrected = 4.85]
    - Term children: M chronological age = 5.4 years [GA corrected = 5.4]
  - Measure:
    - DAPIQ
  - Results:
    - Preterm: DAPIQ correlated with cognitive & motor development
    - Preterm children DAPIQ lower than full term children
Current Study

Aims
- Investigate developmental skills tapped by DAP task
- Determine whether DAP task captures artistic ability
- Identify risk factors for poor human figure drawing

Participants

- N = 345 children
- GA-corrected Age at testing: $M = 60.8$ months, range = 48-72
- Sex: 51% males
- 94% twins
- Birth weight: $M = 2444$ grams (range 471-3912)
- Gestational age at birth: $M = 35.5$ weeks, range = 24 - 42

Measures

Measures of developmental abilities (fine motor, gross motor, language, cognitive, social)
- Ages and Stages Questionnaire (Bricker et al., 1999)
- Parent assessment
- Therapist assessment

Measure of drawing
- DAP:IQ scores
- Aesthetic scores

Draw-a-Person Task

Instructions to participants:
“I want you to draw a picture of yourself. Be sure to draw your whole body, not just your head, and draw how you look from the front, not the side. Do not draw a cartoon or stick figure. Draw the very best picture of yourself that you can. Take your time and work carefully. Go ahead.”

DAP:IQ Coding Criteria

- DAP:IQ Raw Scores
  - Scored according to rubric (range: 0-49)
  - Use raw score and gestational age (GA) corrected age to get standard IQ scores

Aesthetic Coding Criteria

- Aesthetic scoring system (range: 0-9)
  - Criteria developed by two experimenters with fine arts training

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No identifiable person/figure, random dots or patterns only</td>
</tr>
<tr>
<td>1</td>
<td>Some identifiable person or figure, no head or body parts</td>
</tr>
<tr>
<td>2</td>
<td>Meets criteria for 1 but resembles a complete human form and is clearly drawn</td>
</tr>
<tr>
<td>3</td>
<td>No stick figure representation of body parts</td>
</tr>
<tr>
<td>4</td>
<td>Has clearly defined clothing, hair, etc.</td>
</tr>
<tr>
<td>5</td>
<td>Cartoon-like appearance, has improved body proportions relative to lower-scoring drawings</td>
</tr>
<tr>
<td>6</td>
<td>Proportional features appropriate for a human figure</td>
</tr>
<tr>
<td>7</td>
<td>Shows clearly defined features, figure is well drawn</td>
</tr>
<tr>
<td>8</td>
<td>Very well drawn, features becoming realistic relative to lower-scoring drawings</td>
</tr>
<tr>
<td>9</td>
<td>Almost realistic, drawing with some flaws that reduce realism</td>
</tr>
</tbody>
</table>
Inter-Rater Reliability

- Inter-rater reliability measures
  - 300 drawings were scored by 4 experimenters according to the DAP:IQ scoring system (r(298) = 0.94, p < .001)
  - 97 drawings were scored for aesthetic quality by 2 experimenters with artistic training and their scores were correlated (r(95) = 0.86, p < .001)

DAP:IQ by Aesthetic Score

- Aesthetic Score vs. DAP:IQ
  - y = 0.03x - 1.6, r(540) = 0.64, p < .001

DAP:IQ by Age

- DAP:IQ vs. Age
  - y = 0.31x + 50, r(540) = 0.72, p < .001

Aesthetic Score by Age

- Aesthetic Score vs. Age
  - y = 0.005x - 0.84, r(540) = 0.39, p < .001
DAP:IQ and Skills

Multiple regression analysis comparing DAP:IQ scores with age, sex, and measures of developmental skills

<table>
<thead>
<tr>
<th></th>
<th>ASQ scores</th>
<th>Parent rating</th>
<th>Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 345)</td>
<td>(N = 272)</td>
<td>(N = 345)</td>
</tr>
<tr>
<td>Age</td>
<td>β</td>
<td>p</td>
<td>β</td>
</tr>
<tr>
<td></td>
<td>.09</td>
<td>.05</td>
<td>.14</td>
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<tr>
<td>Sex</td>
<td>.17</td>
<td>.004</td>
<td>.24</td>
</tr>
<tr>
<td>Fine Motor</td>
<td>.43</td>
<td>&lt; .0001</td>
<td>.27</td>
</tr>
<tr>
<td>Gross Motor</td>
<td>-.10</td>
<td>ns</td>
<td>.14</td>
</tr>
<tr>
<td>Language</td>
<td>.07</td>
<td>ns</td>
<td>.17</td>
</tr>
<tr>
<td>Cognitive</td>
<td>.06</td>
<td>ns</td>
<td>.09</td>
</tr>
<tr>
<td>Social</td>
<td>-.03</td>
<td>ns</td>
<td>-.04</td>
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</table>

Alpha = .05

\( p < .01 \)

\( p < .05 \)

Aesthetics and Skills

Multiple regression analysis comparing aesthetic scores with age, sex, and measures of developmental skills

<table>
<thead>
<tr>
<th></th>
<th>ASQ scores</th>
<th>Parent rating</th>
<th>Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 345)</td>
<td>(N = 272)</td>
<td>(N = 345)</td>
</tr>
<tr>
<td>Age</td>
<td>β</td>
<td>p</td>
<td>β</td>
</tr>
<tr>
<td></td>
<td>.28</td>
<td>&lt; .0001</td>
<td>.32</td>
</tr>
<tr>
<td>Sex</td>
<td>.18</td>
<td>.0001</td>
<td>.26</td>
</tr>
<tr>
<td>Fine Motor</td>
<td>.36</td>
<td>&lt; .0001</td>
<td>.09</td>
</tr>
<tr>
<td>Gross Motor</td>
<td>-.11</td>
<td>.03</td>
<td>-.04</td>
</tr>
<tr>
<td>Language</td>
<td>.02</td>
<td>ns</td>
<td>.13</td>
</tr>
<tr>
<td>Cognitive</td>
<td>.11</td>
<td>.047</td>
<td>.04</td>
</tr>
<tr>
<td>Social</td>
<td>.0005</td>
<td>ns</td>
<td>.006</td>
</tr>
</tbody>
</table>

Alpha = .05

\( p < .01 \)

\( p < .05 \)

DAP:IQ and Demographics

Multiple regression analysis comparing DAP:IQ scores with perinatal hardships

<table>
<thead>
<tr>
<th></th>
<th>All Children</th>
<th>Girls</th>
<th>Boys</th>
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</thead>
<tbody>
<tr>
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<td>(N = 345)</td>
<td>(N = 169)</td>
<td>(N = 176)</td>
</tr>
<tr>
<td>Age at testing</td>
<td>β</td>
<td>p</td>
<td>β</td>
</tr>
<tr>
<td></td>
<td>.14</td>
<td>.008</td>
<td>.07</td>
</tr>
<tr>
<td>Sex</td>
<td>.29</td>
<td>&lt; .0001</td>
<td>-</td>
</tr>
<tr>
<td>Birth weight (BW)</td>
<td>.13</td>
<td>ns</td>
<td>-.002</td>
</tr>
<tr>
<td>Gestational Age at Birth (GA)</td>
<td>.12</td>
<td>ns</td>
<td>-.14</td>
</tr>
</tbody>
</table>

Alpha = .05

\( p < .01 \)

\( p < .05 \)

Results Summary

- Older children drew better than younger children
- Females scored higher than males on both drawing measures
- DAP:IQ primarily measures fine motor ability
  - No relationship with cognitive measures
  - Predicted by low birth weight for males
- Aesthetic scores measure fine motor ability to an extent
  - Also capture other skills

Discussion: Drawing Components

- Drawing is linked to fine motor skills not cognitive skills
- Why have other studies found link between human figure drawing and intelligence?
  - Drawing ability and intelligence may develop in parallel
    - May be misleading to compare them directly
    - Similar to argument made by Leslie & Thaiss (1992)
  - ASQ Cognitive strongly predicts DAP:IQ when only Age, Sex, and ASQ Cognitive are included in the model (\( \beta_{\text{COG}} = 0.21, p < .0001 \))
    - Disappears when ASQ Fine Motor is added to the model
      - (\( \beta_{\text{COG}} = 0.04, p = .44 \))
  - Need additional testing to rule out this possibility
Discussion: Perinatal

- DAP:IQ
  - Contra Schepers, et al. (2012), no effect of prematurity on DAP-IQ
    - We used GA-corrected age, Schepers used chronological age
    - Schepers’ premies were younger than their full-term children
      - Chronologically 4 months younger
      - Gestationally 7 months younger
  - Boys only: Marginal effect of birth weight (BW)

- Aesthetic scores
  - All children: Marginal effect of GA
  - Boys only: Significant independent effects of GA and BW

Future Directions

- Compare competence to reproduce line drawings with performance on DAP-IQ
  - Evaluate fidelity to original drawing using an algorithm

- Process drawings using a face-detection algorithm
  - Extract measure of how well the drawing matches algorithm’s definition of a “good” human face

- Run experiment comparing drawing ability and other measures not included in this study
  - Spatial reasoning, depth perception, etc.

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References