Motor Activity and Cognitive Development in Infancy

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Development as a Cascade

- Change at one level (i.e., nutrition), can trigger changes at many other levels (i.e., weight, metabolic health, motor skills, cognitive abilities)

Talk Overview

- Review evidence examining the relationship between weight, motor activity, and cognitive development in infancy and early childhood
- Role of sensory-motor activity on cognitive development
- Reduced motor activity and TV viewing on cognitive development
Weight & Motor Development


- Being overweight in infancy is associated with delayed motor development (Slining et al., *J. Pediatrics*, 2010)
  - Motor delay was 1.80 times greater in overweight infants compared to non-overweight infants
  - Motor delay was 2.32 times greater in overweight infants with high subcutaneous fat

Weight & Skill Attainment

- Obesity is associated with lower skill attainment in 2-3 years old children (Cawley & Spiess, *Economics & Human Biol.*, 2008)
  - Reduced verbal skills in boys and girls
  - In boys, social skills, motor skills, and activities of daily living were also significantly reduced
  - Correlations existed in both preschool children attending and not attending day care

- Being overweight is associated with decreased cognitive functioning in school-age children and adolescents (Yanfeng Li et al., *Obesity*, 2008)
  - Overweight children and children at risk of becoming overweight performed significantly worse on block design tasks (measure of visuo-spatial organization and general mental ability)

What is the link between unhealthy weight & skill/cognitive attainment?

- The link is motor/physical activity

[Diagram: Developmental cascade: Weight → Physical/Motor Activity → Cognitive Functioning]
Role of sensory-motor activity on cognitive development

- Exploring, discovering the world
- Fundamental pathway to the process of learning

On the attainment of motor milestones

- Achievement of each new motor milestone opens the door to new experiences, new discoveries, and new skill development

Motor milestones and opportunities for learning

- Early perception and action is fundamental for learning (Gibson, 1981; Piaget, 1962; Thelen & Smith, 1994)
  
  - Sitting onset → new perspective/new action possibilities on the world
  - Reaching & object manipulation → discovery of objects
  - Locomotion → exploration of environment in new ways → impact on social world
Sensory-motor exploration can truly make a difference
(Bojczyk & Corbetta, Dev. Psych., 2004)

Can simple, repeated exposure to the task enhance the rate of development and mastery of the task?

Object Retrieval Task

Before the age of 12 months old, infants perform poorly at this task because they struggle dissociating the activity of both hands.

If box is transparent → struggle even more
(Brunner, 1972; Diamond, 1990; Fagard & Peake, 1997)

Can infants learn to solve this task at an earlier age if provided with regular, but limited exposure to this task?
If learning occurs, do contextual effects matter? (box transparency)

Object Retrieval Task
(Bojczyk & Corbetta, Dev. Psych., 2004)

LONGITUDINAL INFANTS
- 12 infants (6 boys, 6 girls)
- Observed weekly from 6½ mo until successful at task
- 6 trials per week
- ½ tested with opaque box
- ½ tested with semi-transparent box

AGE-MATCHED CONTROLS
- 12 infants (6 boys, 6 girls)
- Tested only once
- ½ with opaque box
- ½ with semi-transparent box
Object Retrieval Task (Bojczyk & Corbetta, Dev. Psych., 2004)

Box out of reach. Experimenter puts an attractive toy in the box while child watches.

Box is closed and pushed toward child. Child is given 1 min to retrieve toy.

Experimenter remained silent throughout the minute to not provide cues.

Infant KH – Opaque box

HK week 2 - failure
HK week 8 – 1st week of retrieval
HK week 12 – 1st week of good coordination

Weeks to Successful Retrieval

Mann-Whitney, p = .026 (exact)
For both Onset 1 & Onset 2

(Bojczyk & Corbetta, Dev. Psych., 2004)
Conclusions

- Infants were not taught the solution
- Discovery of the solution occurred before the expected age because of sensory-motor activity and exploratory behaviors which ultimately lead to the selection of the optimal action solution
- Box transparency modulated developmental trajectories (learned quicker with transparent box)
- Generalization of learned behavior at home
Similar studies

On reaching:
2½ months old infants learn to reach for objects after 16 days of exposure to toys in their reaching space, compared to infants who did not receive daily object exposure (Williams & Corbetta, submitted)

On kicking:
86-106 days old infants learn to select specific leg postures to trigger the motion of a mobile hanging over their crib (Angulo-Kinzler, J. Mot. Beh., 2001)

Bottom line

• These developmental changes do not occur automatically by themselves
• They are the product of exploratory sensory-motor activity
  Practice makes perfect, but is that it?

Ramifications of sensory-motor activity on infant cognitive development

• Sitting skills in infants improve object exploration and 3D perception (Soska et al., Dev. Psych., 2010)
• Locomotor skills influences
  – Language development (Overman, J. Child Lang., 2010)
  – Socioemotional development (Campos et al., 1990)
  – Spatial search of hidden objects (Harriman & Campos, Child Dev., 1988)

All those studies support the argument that it is the sensory-motor and active engagement with the environment that boosts cognitive development
What is the impact of reduced motor activity on cognitive development?

A picture of a baby in a stroller (courtesy of J. Mei).

(Jan Mei, 1994)

What is the impact of reduced motor activity on motor development?

Table 2: Developmental milestones for Sandbag (n=250) and control group (n=252).

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Sandbag (n=250)</th>
<th>Control (n=252)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sit alone (13 months)</td>
<td>86 (33%)</td>
<td>106 (41%)</td>
</tr>
<tr>
<td>Walk alone (13 months)</td>
<td>35 (14%)</td>
<td>68 (27%)</td>
</tr>
<tr>
<td>Point at parents (14 months)</td>
<td>68 (27%)</td>
<td>30 (11%)</td>
</tr>
<tr>
<td>Not walk alone (15 months)</td>
<td>73 (29%)</td>
<td>30 (11%)</td>
</tr>
</tbody>
</table>

(Jan Mei, 1994)

What is the impact of reduced motor activity on cognitive development?

Table 3: Distribution of 1Q scores (Raven's test) for Sandbag and Control groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>&lt;40</th>
<th>40-60</th>
<th>61-80</th>
<th>81-100</th>
<th>101-120</th>
<th>&gt;120</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandbag</td>
<td>44</td>
<td>63</td>
<td>20</td>
<td>18</td>
<td>12</td>
<td>202</td>
<td>262</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>45</td>
<td>118</td>
<td>22</td>
<td>27</td>
<td>202</td>
<td>262</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>76</td>
<td>108</td>
<td>206</td>
<td>40</td>
<td>534</td>
<td>534</td>
</tr>
</tbody>
</table>

(Jan Mei, 1994)
Contexts potentially leading to reduced motor activity in western societies

Obesity:

- Being overweight in infancy is associated with delayed motor development (Slining et al., *J Pediatrics*, 2010)

- Rapid gain in fat in 2, 4, and 6 weeks months old infants was shown to decrease the rate of spontaneous kicking (Thelen et al., *Inf. Beh. & Dev.*, 1984)

Contexts potentially leading to reduced motor activity in western societies

TV viewing:

→ Obesity
→ Attention Deficit Disorders
→ Cognitive Development?

Baby Videos

- Marketed as fun and educational
- Baby Einstein’s company’s motto: “a little genius in the making”

2007
Time - Baby Einsteins: not so smart after all

2009
NYTimes – No Einstein in your crib?
Get a refund
“Baby Einstein videos that did not make children into geniuses”

Baby Da Vinci, Baby Van Gogh, Baby Galileo, etc.
Brainy Baby Series
Baby Videos

- Surveyed 1008 families, parents of 2 to 24 mo infants, about the child’s viewing patterns of a range of TV/DVDs shows
- They found that the 8 to 16 month olds infants who watched regularly “Baby Einstein” videos:
  - knew substantially fewer words than the non-video watchers (on average 6 to 8 less words)
  - vocabulary deficit increased with each additional hour babies were watching the videos

TV viewing in infancy

- American Academy of Pediatrics recommends no TV exposure before the year of 2
- Background TV noise has been shown to detract from play and social interactions in early childhood (Kirkorian et al., *Child Dev.*, 2009). Play is crucial for building intrinsic motivation for exploration and learning (Burghardt, 2005)
- Large scale study on daily TV viewing in infants 0 to 2 yo found no associations between some measures of language and motor skills at the age of 3 years (Schmidt et al., *Pediatrics*, 2009)

TV and motor development

- TV viewing as an educational tool in the first years of life still needs to be demonstrated
- TV induces a form of passive learning that does not rely on sensory-motor exploration
- TV should be avoided especially, during the early years when infants and young children benefit and learn most from their own sensory-motor experiences by getting actively engaged with the social and physical world
Final conclusions

- Motor/physical activity is an important mediator for weight regulation but also for boosting and stimulating cognitive development.
- Promoting a healthy weight is crucial for promoting healthy motor activity, which in turn can lead to healthy cognitive development (development cascade).