A Latent Growth Curve Model of the Relationship Between Computer Usage and Academic Performance in a Longitudinal Sample of Irish Children

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Technology in the Home

• Presence of computers and other internet enabled devices approaching saturation Europe wide
  – (EU – Kids online, 2004 to 2014)

• Many homes now have multiple devices making supervision and monitoring difficult

• Children using computers at earlier ages and for longer than ever before with important consequences for habit formation and for developmental trajectories in multiple domains

• Evidence for low overall digital literacy
  – (European commission 2013)
Computer Usage, Applications and Educational Outcomes

- Computer use has varied effects on academic performance. Mixed effects reported varying by usage intensity and application types.

- Some evidence for Impaired memory and concentration – Johnson (2006)

- Academic advantages have been seen in several large scale studies:
  - Programme for International Student Assessment (PISA) (OECD, 2005)
  - Longitudinal Study of Australian Children (Fiorini, 2010)

- Previous Research using GUI data at 9 years shows both positive and negative effects of computer use (Casey et al. 2012)
Summary of Casey et al (2012)

- Importance of controlling for social gradient in test outcomes
  - (Williams et al 2009)

- Better test outcomes at 9 years
  - Moderate computer usage
  - Unsupervised computer usage
  - Informational computer applications

- Worse test outcomes at 9 years
  - Social media use

Aims of current study

- Replicate and extend initial findings of Casey et al (2012)
- Move from cross sectional to a longitudinal view
Data Source for the Current Study

• Child Cohort GUI Anonymised Microdata File (AMF)

• **Sample size**
  - Wave 1 9yrs  Unweighted sample of - 8,568
  - Wave 2 13yrs Unweighted sample of - 7,525
  - Wave 3 17yrs Unweighted sample of - 6,210

• Pure fixed panel design

• Evidence of differential attrition across waves (Williams, 2009). Re-weighted using census information
Educational Performance Variables

• **9 Year Data**
  – Drumcondra Primary Maths Test
  – Drumcondra Primary Reading Test

• **13 Year Data**
  – Drumcondra Numerical Ability Test
  – Drumcondra Verbal Reasoning Test

• **17 Year Data**
  – Junior Certificate Mathematics
  – Junior Certificate English

• **Scoring Junior Certificate**
  – Junior Certificate (Grade A-E)

  – Junior Certificate level (Higher, Ordinary, Foundation)

  – Scale constructed following a coding scheme producing a Leaving Certificate points total equivalent range 10-100
Educational Variable Parameterisation

- **Parameterisation across variables problematic:** An assumption of growth modelling requires variables to be on the same scale.

- **Current solution:** All educational variables re-scaled as z-scores such that an average performance has a mean score of zero and SD of one.

- **Useful effects of parameterization strategy:**
  - Flattening of growth curve.
  - Intercept is free to vary across participants.
  - The average slope for the whole sample is close to zero.
  - Primary interest is in explaining variability in intercept and slope at an individual level.
Growth Model example
(Mathematics scores at 9, 13 and 17)
<table>
<thead>
<tr>
<th>Statistical models developed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Set up initial growth curve models</strong></td>
</tr>
<tr>
<td>• Model 1: Baseline model</td>
</tr>
<tr>
<td>• Model 2: Household Level covariates</td>
</tr>
<tr>
<td>• Model 3: Child level covariates</td>
</tr>
<tr>
<td><strong>Computer Usage and Applications Models</strong></td>
</tr>
<tr>
<td>• Model 4: Specific applications used at 9 and 13</td>
</tr>
<tr>
<td>• Model 5: Changes in behaviour between 9 and 13</td>
</tr>
</tbody>
</table>
Summary of Model Fit Statistics

Baseline models 1-3 Covariates (Casey et al. 2012)

- PCG/SCG Education
- HSD Structure
- HSD Social class
- Equivalised Income
- Child gender
- Child early reading

Model Fit Statistics support all models

- Chi-sq to df ratio ✓
- CFI values above 0.9 ✓
- RMSEA values below 0.10 ✓
- SRMR values below 0.10 ✓
Computer Applications

• **Applications used at 9**
  - Playing games
  - **Chatrooms**
  - Media Consumption
  - **E-mailing**
  - Instant messaging
  - Surf for fun
  - Homework
  - School projects

• **Applications used at 13**
  - Playing games
  - Social Media
  - Media Consumption
  - Surfing for fun
  - Homework
  - School Projects
Model 4: Applications
Descriptives: Applications used

Computer Applications Used at 9 years and 13 years

- Playing games
- Media Consumption
- Surf for fun
- Homework
- School projects
- Chatrooms
- E-mailing
- Instant messaging
- Social Media
### Model 4 Summary

#### Specific applications used

<table>
<thead>
<tr>
<th>Initial effects at 9 years (Intercept)</th>
<th>Mathematics</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>School projects</td>
<td>0.09**</td>
<td>0.12***</td>
</tr>
<tr>
<td>Homework</td>
<td>-0.01&lt;sub&gt;ns&lt;/sub&gt;</td>
<td>-0.04&lt;sub&gt;ns&lt;/sub&gt;</td>
</tr>
<tr>
<td>Chatrooms</td>
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<td>-0.04&lt;sub&gt;ns&lt;/sub&gt;</td>
</tr>
<tr>
<td>Playing Games</td>
<td>0.13***</td>
<td>0.09**</td>
</tr>
<tr>
<td>Surfing for fun</td>
<td>0.07*</td>
<td>0.08**</td>
</tr>
<tr>
<td>Instant messaging</td>
<td>-0.20**</td>
<td>-0.20**</td>
</tr>
<tr>
<td>E-mailing</td>
<td>0.10*</td>
<td>0.16***</td>
</tr>
<tr>
<td>Movies/Music</td>
<td>-0.12***</td>
<td>-0.17***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change over time (Slope)</th>
<th>Mathematics</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>School projects</td>
<td>0.08***</td>
<td>0.08***</td>
</tr>
<tr>
<td>Homework</td>
<td>0.05**</td>
<td>0.03*</td>
</tr>
<tr>
<td>Social media</td>
<td>-0.11***</td>
<td>-0.06**</td>
</tr>
<tr>
<td>Games</td>
<td>0.00&lt;sub&gt;ns&lt;/sub&gt;</td>
<td>-0.03*</td>
</tr>
<tr>
<td>Surfing for fun</td>
<td>0.00&lt;sub&gt;ns&lt;/sub&gt;</td>
<td>0.03*</td>
</tr>
<tr>
<td>Movies/Music</td>
<td>-0.03**</td>
<td>-0.01&lt;sub&gt;ns&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

* P < .1, ** p < .05, *** p < .001

- Findings of Casey et al 2012 are largely replicated.
- Early informational and fun uses of computer associated with better initial outcomes.
- Longitudinally, there is support for consistent positive effects for informational patterns of usage.
- Consistent negative effects are also seen for consumptive/ interruptive patterns computer usage.
Descriptives: Uptake/Dropping of Applications Between 9 & 13

Taking up or Dropping an Application Between 9 and 13

Percentage of Children

Games
Social Media
Media Consumption
Surf for fun
Homework
School Projects
# Model 5 Summary

## Changes in behaviour

<table>
<thead>
<tr>
<th>Change over time (Slope)</th>
<th>Mathematics</th>
<th>Reading</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Games</strong></td>
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<td>-0.06&lt;sup&gt;**&lt;/sup&gt;</td>
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<td></td>
</tr>
<tr>
<td><strong>Social Media</strong></td>
<td>-0.04&lt;sup&gt;**&lt;/sup&gt;</td>
<td>0.00&lt;sub&gt;ns&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Videos/Music</strong></td>
<td>-0.03&lt;sup&gt;**&lt;/sup&gt;</td>
<td>-0.03&lt;sub&gt;ns&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surf for Fun</strong></td>
<td>0.00&lt;sub&gt;ns&lt;/sub&gt;</td>
<td>0.02&lt;sub&gt;ns&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Homework</strong></td>
<td>0.05&lt;sup&gt;**&lt;/sup&gt;</td>
<td>0.03&lt;sub&gt;ns&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Projects for School</strong></td>
<td>0.06&lt;sup&gt;**&lt;/sup&gt;</td>
<td>0.09&lt;sup&gt;***&lt;/sup&gt;</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drop activity between 9 and 13</th>
<th>Mathematics</th>
<th>Reading</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.01&lt;sub&gt;ns&lt;/sub&gt;</td>
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<tr>
<td><strong>Social Media</strong></td>
<td>0.06&lt;sub&gt;ns&lt;/sub&gt;</td>
<td>0.08&lt;sup&gt;*&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Videos/Music</strong></td>
<td>-0.02&lt;sub&gt;ns&lt;/sub&gt;</td>
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<td><strong>Homework</strong></td>
<td>0.02&lt;sub&gt;ns&lt;/sub&gt;</td>
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Information gained from behaviour change model strengthens previous analysis.

Additional support for “ladder of opportunities” or informational vs consumptive/interruptive uses classification.

Positive effect on reading for dropping social media in early teens is a theoretically consistent but tentative finding.
Implications

• Findings are supported both **cross-sectionally** and **longitudinally**

• Evidence that informational computer use supports better educational outcomes

• Evidence that Media consumption and Social Media use have negative effects on educational outcomes

• Support for “Ladder of opportunities” concept
  – (Livingstone et al 2011)
Opportunities

• Structured guidelines on screen time could help parents know when to limit their children's activities
  – www.makeastart.ie (Safefood, 2018)

• Guidelines should also include information on beneficial types of activities on computers and mobile devices

• Endless potential to use access to media and games as a powerful behavioural motivator for success
  – Game based learning
  – Age appropriate reward charts / targets
  – Increased parental controls on systems
Future Research

• Challenges of parameterisation of educational outcomes

• Application by Usage interactions

• Possibilities of establishing classes of use and their consequences

• Develop useful guidelines for age appropriate activity cutoffs
Acknowledgements

Thanks to all GUI team members
Especially Aisling Murray - Dorothy Watson – Eoin McNamara
Emer Smyth - Sean Lyons

Questions, comments and suggestions are very welcome

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