Sound Start Study:
A community-based randomised controlled trial of
Phoneme Factory Sound Sorter

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Sue Roulstone, Kathryn Crowe, and Sarah Masso

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teaching assistants, and preschools who participated
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Disclosure statement

Sharynne McLeod, Elise Baker*, Jane McCormack**, Kathryn Crowe, and Sarah Masso

- **Financial Relationship**: Received salary from Charles Sturt University/*The University of Sydney/**University of Sheffield during the project
- **Non-financial Relationship**: None

Yvonne Wren and Sue Roulstone

- **Financial Relationship**: Co-authors of Phoneme Factory Sound Sorter (PFSS) and benefit financially from royalty payments from the sale of this product by STASS publications; received salary from the University of the West of England/University of Bristol during the project
- **Non-financial Relationship**: None
Follow #SoundStartRCT for updates about the Sound Start Study RCT conducted in Sydney, Australia [csu.edu.au/research/sound](http://www.csu.edu.au/research/sound)… #slpeeps #RCT


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Background

• Early competency in speech, language, and pre-literacy impacts children’s communicative, social, and academic outcomes (Anthony et al., 2011; Lewis et al., 2011; Peterson et al., 2009)

• If speech sound disorders (SSD) persist into the school years between 30% to 77% of these children are likely to have reading difficulties (Anthony et al., 2011)

• Collaborative support between education and SLT is important to promote at risk preschool children’s speech and pre-literacy skills
Computer intervention for SSD

- Computerized support for children with speech sound disorders is an efficient, engaging and effective strategy for targeting communication goals (Shriberg et al., 1990; Wren, Roulstone & Williams, 2010)

- Wren and Roulstone (2008) found that children with SSD improved speech production skills given 8-hours of support from a computer-based program in a small-scale project with SLT support

Can computer supported intervention for SSD be delivered effectively by educators with minimal SLT support?
3 year cluster randomized controlled trial designed to evaluate the **effectiveness of a computer-based service** (Phoneme Factory Sound Sorter; PFSS) compared with typical classroom practices in supporting speech and pre-literacy development for Australian preschoolers with SSD.

The study aimed to determine whether PFSS improves

- speech production accuracy
- emergent literacy and phonological awareness
- underlying phonological processing skills
- children’s participation and wellbeing
Ethical approval

- Institutional approval
  - Charles Sturt University
    Ethics approval number – 2013/070
  - NSW Department of Education SERAP Ethics approval number 2013267
- Preschools’ consent
  - Approval from each preschool, director, and teaching assistants
- Parents’ consent
  - Including parent consent to link to teacher screening information
- Children’s assent
Participant recruitment (over 3 years)

- 77 early childhood centres in Sydney, Australia were invited to participate
  - represented the range of socioeconomic areas based on Index of Relative Socio-economic Advantage and Disadvantage (Australian Bureau of Statistics, 2011)
- 45 agreed to participate
  - 1,920 4- to 5-year-olds were enrolled at the participating centres
Stages and total number of participants

- **Stage 1** Screening to identify concern: 1,205 children
- **Stage 2** Direct screening assessment: 275 children
- **Stage 3** Direct comprehensive assessment: 132 children
- **Stage 4** Randomized trial: 123 children (3 children withdrew)
  - Computer-based intervention: 65 children (63)
  - Control (typical classroom practice): 58 children (57)
- **Stage 5** Follow-up assessment (immediate): 114 children
- **Stage 6** Follow-up assessment (6-8 weeks): 115 children
**Intervention Phoneme Factory Sound Sorter**

(Wren & Roulstone, 2006)

- Uses a psycholinguistic approach for children with SSD
- Targets speech input – NOT speech output
- Perceptual tasks
  - Sound symbol familiarisation
  - Phoneme detection
  - Phoneme blending
  - Minimal pairs
  - Rhyme awareness
Australian adaptation

- Australian voices
- 4 x speakers
- a few changes in pictures and vocabulary
- cluster reduction
- option for automatic progression in preset settings

Undertaken over 9 weeks with support from educators then 2 stages of post-intervention follow-up

Results: Speech (PCC)

- Statistically significant improvement between Stages for the intervention group AND the control group
- When Mean PCC was adjusted for baseline levels, there was no statistically significant interaction between Group
- No statistically significant interaction between Group and Stage
## Results: Speech and pre-literacy outcomes

<table>
<thead>
<tr>
<th>Speech</th>
<th>Difference between Stages?</th>
<th>Interaction between Stage and Group?</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCC</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Probes (% occurrence of targeted phonological processes)</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Intelligibility</td>
<td>**</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-literacy</th>
<th>Difference between Stages?</th>
<th>Interaction between Stage and Group?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter knowledge</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Print awareness</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Elision</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Blending words</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Sound matching</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*** $p<.001$, ** $p<.01$, * $p<.05$, - not significant
### Results: Phonological processing and wellbeing outcomes

<table>
<thead>
<tr>
<th>Phonological processing</th>
<th>Difference between Stages?</th>
<th>Interaction between Stage and Group?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory for digits</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Nonword repetition</td>
<td>**</td>
<td>-</td>
</tr>
<tr>
<td>Rapid colour naming</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rapid object naming</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wellbeing</th>
<th>Difference between Stages?</th>
<th>Interaction between Stage and Group?</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOCUS</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>KiddyCAT</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>SPAA-C</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*** $p<.001$, ** $p<.01$, * $p<.05$, - not significant
Results: Summary

• Generally, the speech and pre-literacy skills of the children in the intervention condition significantly improved from baseline (stages 2 and 3) to immediate post-intervention (stage 5) and 6-8 weeks post intervention (stage 6)

• However, generally, their improvement was not significantly different from the children within the control group

• Their average improvement was not clinically significant
  • Speech, emergent literacy, and phonological processing difficulties were still apparent post-intervention
Results: Summary

These results were similar for the intention-to-treat data per protocol data

- subgroup of participants in the Intervention group who received an acceptable dosage of PFSS
- subgroup of participants in the Intervention and Control groups who did not receive any additional speech-language pathology intervention over the course of the study
Possible reasons why the intervention effects were not significant

1. The intervention was delivered by educators
2. The intervention used teacher settings
3. The intervention was input-based
4. Dosage varied from one child to another, and in contrast to that recommended in the protocol
5. The intervention was time-based
   i.e., 9 week block rather than performance-based
6. Individual variation
## Implementation

### Intervention agent and reported dosage

<table>
<thead>
<tr>
<th></th>
<th>Optimum dose</th>
<th>Computer reported dose $M$ (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days</td>
<td>N/A (approx 18)</td>
<td>15.46 (1-28)</td>
</tr>
<tr>
<td>Games</td>
<td>36 (27-45)</td>
<td>31.41 (4-44)</td>
</tr>
<tr>
<td>Plays</td>
<td>144 (108-180)</td>
<td>105.72 (4-160)</td>
</tr>
</tbody>
</table>

### Intervention agent

- Educator

### Dosage

- 39 of the 63 Intervention participants (61.9%) received at least 70% of the intended intervention

Note. Data based on 61 children (2 were missing ECE and/or computer records every week)
## Individual variation: Intervention group

<table>
<thead>
<tr>
<th>Condition: INTERVENTION</th>
<th>PCC</th>
<th>% occurrence of targeted phonological process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post-1</td>
</tr>
<tr>
<td>Child #984</td>
<td>66%</td>
<td>70%</td>
</tr>
<tr>
<td>Child #1174</td>
<td>59%</td>
<td>83%</td>
</tr>
<tr>
<td>Child #424</td>
<td>67%</td>
<td>71%</td>
</tr>
<tr>
<td>Child #742</td>
<td>62%</td>
<td>63%</td>
</tr>
</tbody>
</table>
## Individual variation: Control group

<table>
<thead>
<tr>
<th>Condition: CONTROL</th>
<th>PCC</th>
<th>% occurrence of targeted phonological process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post-1</td>
</tr>
<tr>
<td>Child #465</td>
<td>46%</td>
<td>55%</td>
</tr>
<tr>
<td>Child #404</td>
<td>66%</td>
<td>76%</td>
</tr>
<tr>
<td>Child #1155</td>
<td>58%</td>
<td>62%</td>
</tr>
<tr>
<td>Child #657</td>
<td>75%</td>
<td>76%</td>
</tr>
</tbody>
</table>
Limitations

Although we used a variety of outcome measures speech perception measures were not included.

- Did PFSS improve the quality of the children’s acoustic-perceptual representations for speech?

PFSS was implemented by different educators from different early childhood centres

- We were attempting to undertake a real-world study

Not all participants received the recommended intensity

We attempted to screen out children with articulation difficulties, but some may have had articulation + phonology difficulties
Where does this leave us?

Is PFSS effective?
- With SLT support?
- With educator support?

Does the consultative model of intervention for SSD work?
- Don’t know – this tested one approach, others might work differently

What does the ‘individual variation’ show us?
- Single cases – useful exploratory work but low strength evidence
Where does this leave us?

• Careful examination of research findings to understand the implications for practice

• Need to examine interventions thoroughly using robust methods but in real life settings

• The Sound Start research design could be replicated for other interventions
Future directions

Current evidence reporting effective interventions for children with SSD involves:

- **Speech production practice of carefully selected targets (+/- input) implemented by SLP using a variety of instructional cues and feedback** (Baker & McLeod, 2011)

To close the gap between supply and demand for intervention by using non-SLPs we need to use effective interventions suited to children’s needs, and adopt empirically-supported training strategies that demonstrate clinically significant outcomes.
For further information about the Sound Start Study contact

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# Instruments

<table>
<thead>
<tr>
<th>Stage</th>
<th>Measure</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Parents Evaluation of Developmental Status (PEDS) Centre demographics</td>
<td>Parents / ECEs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ECEs</td>
</tr>
<tr>
<td>2</td>
<td>DEAP; PTONI; PLS-5; OMA; audiometry</td>
<td>Child</td>
</tr>
<tr>
<td></td>
<td>Case history &amp; FOCUS</td>
<td>Parent</td>
</tr>
<tr>
<td></td>
<td>AusTOMS &amp; ICS</td>
<td>SLP</td>
</tr>
<tr>
<td>3</td>
<td>Phon probes; POP; CTOPP; Print awareness; PPVT-4; SPAA-C; Kiddy-CAT</td>
<td>Child</td>
</tr>
<tr>
<td>4</td>
<td><strong>INTERVENTION</strong></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DEAP; Phon probes; POP; PPVT-4; CTOPP; SPAA-C; Kiddy-CAT ICS &amp; FOCUS AusTOMS; ICS; FOCUS</td>
<td>Child</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLP</td>
</tr>
<tr>
<td>6</td>
<td><em>As for stage 5</em></td>
<td></td>
</tr>
</tbody>
</table>