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

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Australian Government
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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

Sound Start Study on Twitter

Follow #SoundStartRCT for updates about the Sound Start Study RCT conducted in Sydney, Australia csu.edu.au/research/sound… #slpeeps #RCT

http://www.csu.edu.au/research/sound-start

@yvonnewren @SharynneMcLeod

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?

Sound Start Study: Aims

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 approv
    2013267
- Preschools' consent
  - Approval from each preschool, director, and teachi
- 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

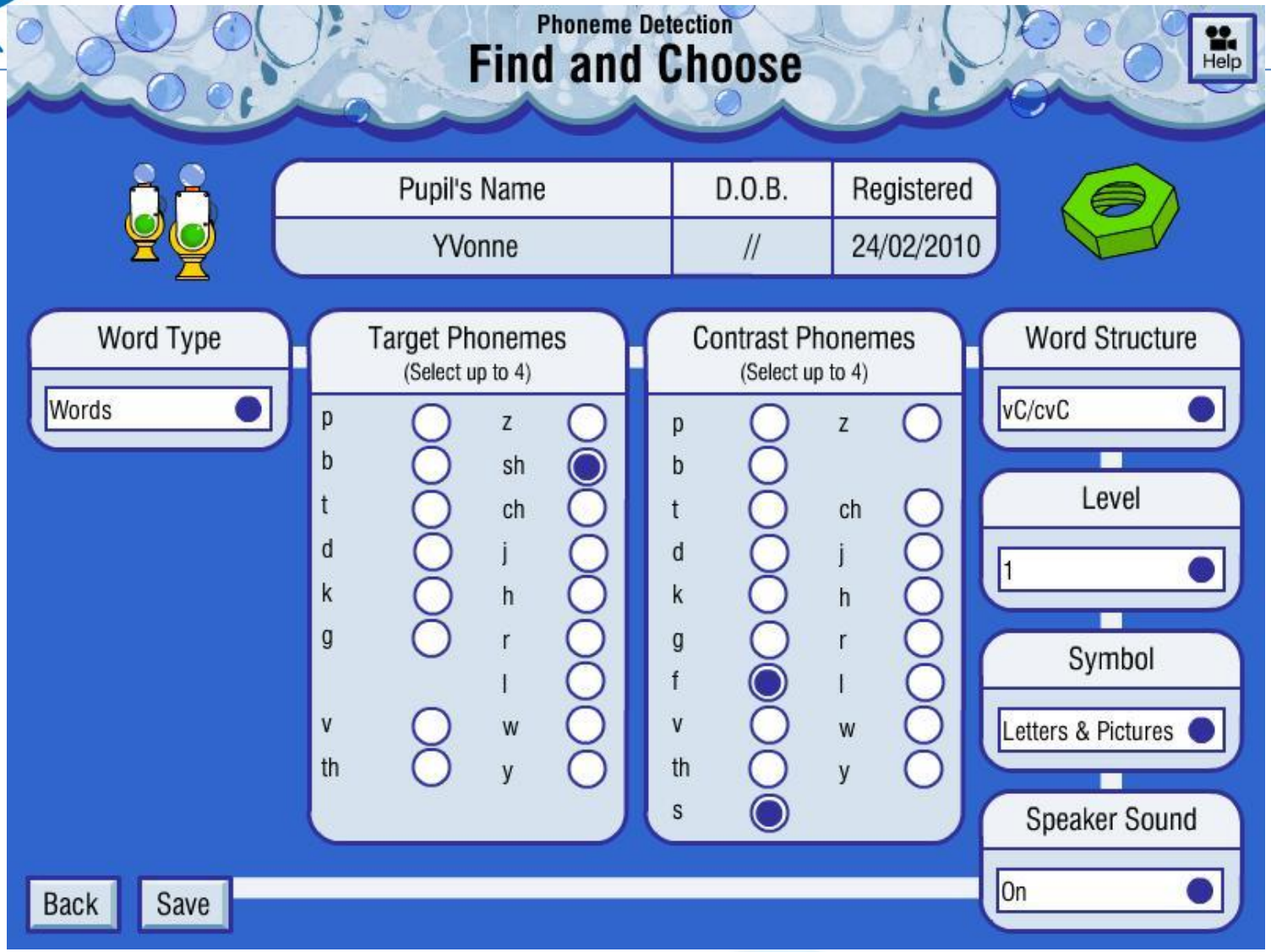
Stages and total number of participants

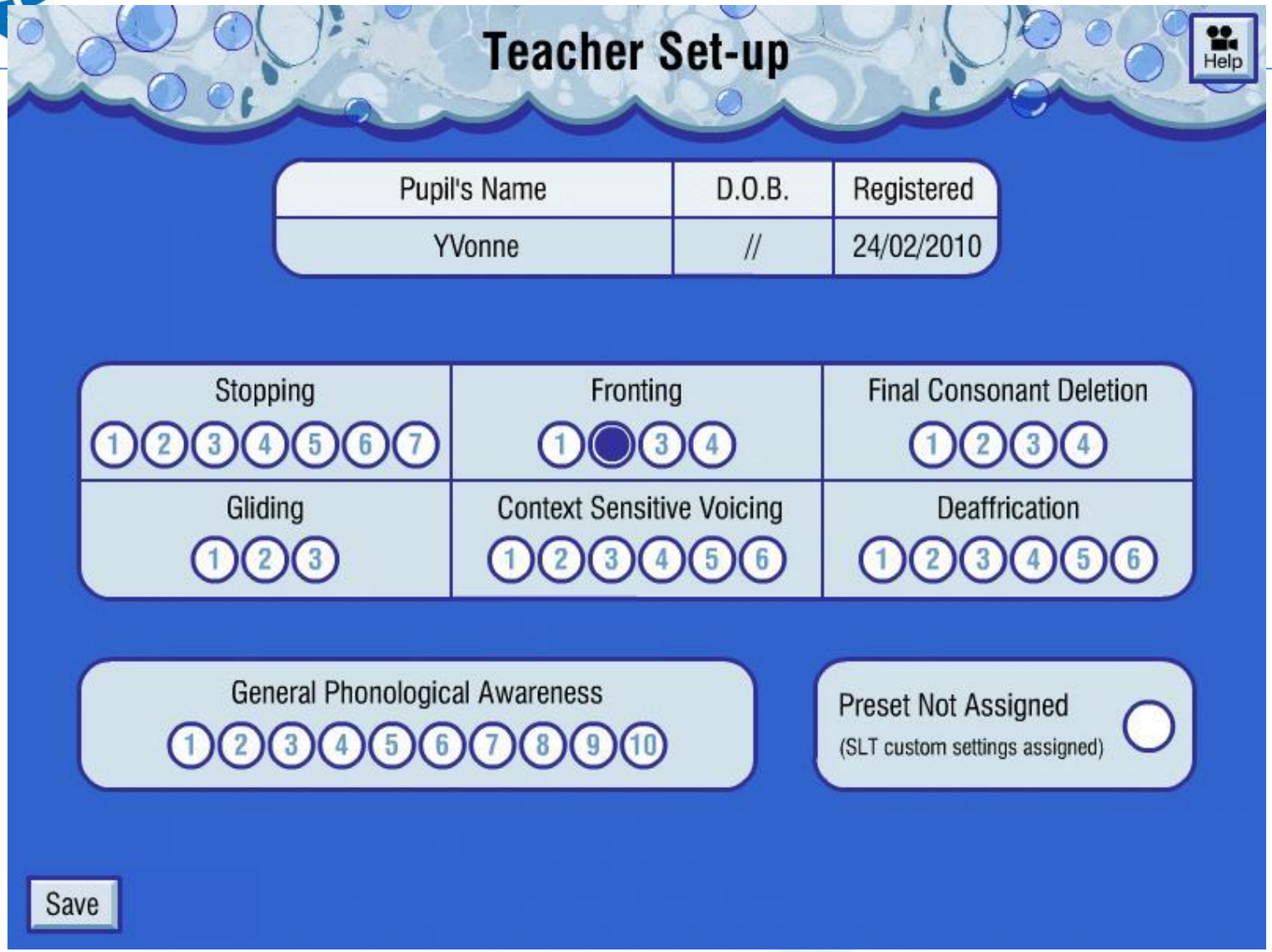
- **Stage 1** Screening to identify concern: 1,205 children
- **Stage 2** Direct screening assessment: 275 children
- **Stage 3** Direct comprehensive assessment: 132 children
- **Stage 4** Randomized trial: 123 children (3 children withdrew)
  - Computer-based intervention: 65 children (63)
  - Control (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


Phoneme Detection
Find and Choose
Help
Pupil's Name
D.O.B.
Registered
YVonne
//
24/02/2010
Word Type
Words
Target Phonemes
(Select up to 4)
p
b
t
d
k
g
v
th
z
sh
ch
j
h
r
l
w
y
Contrast Phonemes
(Select up to 4)
p
b
t
d
k
g
f
v
th
s
z
ch
j
h
r
l
w
y
Word Structure
vC/cvC
Level
1
Symbol
Letters & Pictures
Speaker Sound
On
Back
Save


Teacher Set-up
Help
Pupil's Name
D.O.B.
Registered
YVonne
//
24/02/2010
Stopping
1 2 3 4 5 6 7
Fronting
1 3 4
Final Consonant Deletion
1 2 3 4
Gliding
1 2 3
Context Sensitive Voicing
1 2 3 4 5 6
Deaffrication
1 2 3 4 5 6
General Phonological Awareness
1 2 3 4 5 6 7 8 9 10
Preset Not Assigned
(SLT custom settings assigned)
Save

Phoneme Factory Sound Sorter – 2nd ed

(Wren & Roulstone, 2013)

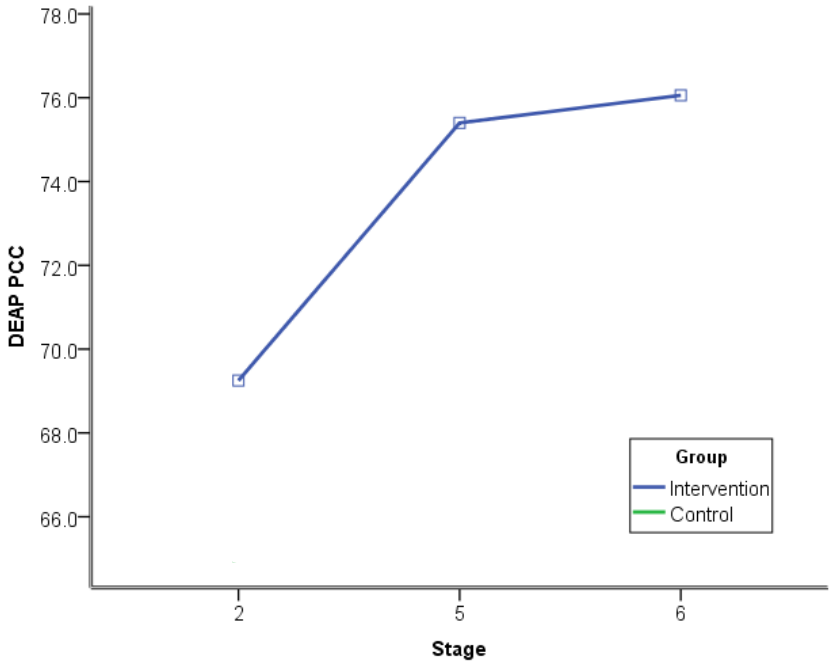
Australian adaptation

- 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

Wren, Y. & Roulstone, S. (2013). *Phoneme Factory Sound Sorter* (version 2, Australian adaptation) [Computer software]. Bristol, UK: Bristol Speech and Language Therapy Research Unit.

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

Speech	Difference between Stages?	Interaction between Stage and Group?
PCC	***	-
Probes (% occurrence of targeted phonological processes)	***	-
Intelligibility	**	-

Pre-literacy	Difference between Stages?	Interaction between Stage and Group?
Letter knowledge	***	-
Print awareness	***	-
Elision	***	-
Blending words	***	-
Sound matching	-	-

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

Results: Phonological processing and wellbeing outcomes

Phonological processing	Difference between Stages?	Interaction between Stage and Group?
Memory for digits	***	-
Nonword repetition	**	-
Rapid colour naming	-	-
Rapid object naming	-	-

Wellbeing	Difference between Stages?	Interaction between Stage and Group?
FOCUS	-	-
KiddyCAT	***	-
SPAA-C ☺	-	-

*** $p<.001$, ** $p<.01$, * $p<.05$, - 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**
   - cf. Rvachew and Brosseau-Lapré (2015) RCT
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

	Optimum dose	Computer reported dose *M* (range)
Days	N/A (approx 18)	15.46 (1-28)
Games	36 (27-45)	31.41 (4-44)
Plays	144 (108-180)	105.72 (4-160)

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

Condition: INTERVENTION	PCC			% occurrence of targeted phonological process		
	Pre	Post-1	Post-2	Pre	Post-1	Post-2
Child #984	66%	70%	76%	75%	0%	0%
Child #1174	59%	83%	84%	94%	6%	0%
Child #424	67%	71%	74%	100%	100%	88%
Child #742	62%	63%	60%	100%	88%	94%

Individual variation: Control group

Condition: CONTROL	PCC			% occurrence of targeted phonological process		
	Pre	Post-1	Post-2	Pre	Post-1	Post-2
Child #465	46%	55%	61%	94%	6%	19%
Child #404	66%	76%	79%	80%	69%	31%
Child #1155	58%	62%	63%	94%	100%	100%
Child #657	75%	76%	72%	100%	100%	100%

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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Sound Start Study on Twitter

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@yvonnewren @SharynneMcLeod

Instruments

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