Technologies Effective In Evoking
First Instances of Speech
In Large Cohorts of
Non-Vocal Children With Autism

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Dr. Karola Dillenburger

My 170+ strong team

And the innumerable families of children with autism who trusted our team at Behavior Momentum India (BMI) with their non-vocal children.
• About Behavior Momentum India

• How it became a place for research
Introduction


• NT kids acquire w/o direct training. (Harlaar, Hayiou-Thomas, Dale, & Plomin, 2008)

• Communication begins before speech emerges

• Children with ASD require highly specialized training to acquire speech, language and communication. (Harlaar et al., 2008; Rutter, 1985; Snowling)
Autism & Vocalization

• Estimated that 25-50% individuals with autism fail to develop vocal speech (DeWeerdt, 2013; Wodka, Mathy & Kalb, 2013; Weiss & Demiri, 2011; Lord & McGee, 2001)

• 30% CWAs remain minimally verbal despite years of intervention (Autism Speaks & National Institute of Health)

• Intensive Speech Therapy to individuals with autism may not be enough to develop vocal speech (Sundberg & Partington, 2013)

• Speech is a behavioral cusp (Koegel & Suratt, 1992)
Autism & Vocalization

• The range of speech abilities in CWA vary considerably from non-vocal to having fluent speech

• Inconsistencies in terms vocal, verbal non-vocal, non-verbal exists in literature

• Skinner differentiated between these terms (1957)

• Vocal behavior was defined as the ‘production of auditory stimuli resulting from the movements of the muscles of the vocal apparatus’ (Skinner, 1957; Carbone, 2013)

• Verbal behaviour refers to ‘behavior reinforced through the mediation of other persons’ (Skinner, 1957).
Variance in the definition of vocal in the literature

- Being vocal but an inability to use functional speech – non-vocal

- Many studies had children with pre-existing vocals

- Vocal-verbal (Sundberg, 1996). Vocalizations that are speech related in contrast to non-speech vocalizations

- Verbal repertoire - based on number of vocalizations / and the number of functional response forms (Miguel et al. 2002)
Autism & Vocalization

- Verbal behavior included all forms of responses – speech, sign, gestures, written word, symbols (Culotta & Hanson, 2004)

- Despite this clarity, there is variance in the definition of vocal in the behavioral literature.

- Drash et al., 1999 – (3) Non-Verbal kids (all 3 echoed
- Miguel et al., 2002 – (3), 2 –no vocals, 1- had 100 echoics
- Anderson et al., 2007 – (206) non-verbal <5 words
- Esch et al., 2005/2009 (3) 2 non-vocal, 1 was vocal
Literature Review


• Stimulus Stimulus Pairing  Sundberg, et al. (1996)

• Rapid Motor Imitation & Mand Training (Ross & Greer, 2003 & Tsiouri & Greer, 2003)

• Total Communication (Tincani, 2004)

• Augmentative and Alternative Communication Strategies (Bondy & Frost, 1994; Carbone et al. 2010; Gervarter et al., 2015)
Lovaas et al., 1966
Drash & Leibowitz, 1973
Lovaas et al, 1973
Carr, 1979
Barrera et al., 1980
Koegel et al., 1987
Laski et al., 1988
Bondy & Frost, 1994
Koegel et al., 1998
Sundberg et al., 1996
Smith et al., 1996


Yoon & Bennett, 2000
Miguel et al., 2002
Blischak et al., 2003
Esch et al., 2005
Normand & Knoll, 2006
Ward & Partington, 2007
Sweeny et al., 2007
Yoon & Feliciano 2007
Carroll & Klatt 2008


Esch et al., 2009
Petersdottir et al., 2011
Millotis, et al., 2012
Radar et al., 2014
Shillingsberg et al., 2015
Cividini-Motta et al., 2016
Mulhern et al., 2017

2002
Kravitz et al., 2002
Ross & Greer, 2003
Tsiouri & Greer, 2003
Yoder & Stone, 2006
Tincani et al., 2006
Carr & Felce, 2007
Howlin et al., 2007
Stock et al., 2008
Esch et al., 2009
Jurgens et al., 2009
Hart & Banda, 2010
Greenberg et al., 2014
Petursdottir & Lepper, 2015
Barry & Holloway, 2019

2003
Frost & Bondy, 2002
Blischak et al., 2003
Yoder & Stone, 2006
Tincani et al., 2006
Carr & Felce, 2007
Howlin et al., 2007
Stock et al., 2008
Esch et al., 2009
Jurgens et al., 2009
Hart & Banda, 2010
Greenberg et al., 2014
Petursdottir & Lepper, 2015
Barry & Holloway, 2019

2007
Carbone et al., 2010
Carbone & Carroll, 2011
Petursdottir et al., 2011
Millotis, et al., 2012
Radar et al., 2014
Shillingsberg et al., 2015
Cividini-Motta et al., 2016
Mulhern et al., 2017
Echoic Training + Shaping

- Evoking vocals in non-vocal kids most challenging (Koegel, O’Dell, & Dunlap, 1988)

- Vocal imitation a pre-requisite for teaching other operants (Sundberg, 1990)

- 3 children trained to echo under mand conditions. However echoic repertoire pre-existing (Drash, High & Tudor, 1999)

- Examined and compared the most effective echoic procedure VIT, SSP & MM in 6 children (Cividini-Motta, Scharrer & Ahearn, 2016)
Rapid Motor Imitation & Mand Training

• Rapid motor Imitation followed by a vocal model in 5 non-vocal children with ASD. 5.5-7.8 Y. Evoked vocals & mands (Ross & Greer, 2003)

• Replication with 2 participants. One was non-vocal. Emergence of first instances of echoics (mands and tacts). (Tsiouri & Greer, 2003)
Stimulus-Stimulus Pairing

• **Stimulus Stimulus Pairing** Sundberg, et al. (1996); Yoon and Bennet (2000); Miguel, et al. (2002); Esch, et al. (2005, 2009); Normand and Knoll (2006); Yoon and Feliciano (2007); Carroll and Klatt (2008); Stock et al., (2008); ); Esch et al., (2009); Petursdottir et al. (2011); Miliotis et al., (2012); Rader et al., (2014); Shillingsberg et al. (2015); Petersdottir & Lepper (2015); Barry & Holloway (2019)

• Demonstrated increase in vocalizations

• Temporary effects

• Several variables studied

Period: 1996-2014

- 13 studies with 39 participants selected
- 6 procedural variations
  a) Target Sound paired – novel / current
  b) No. Of experimenter- emitted sounds per pairing
  c) No. Of pairings/min
  d) Type of pairing,
  e) Adventitious reinforcement control,
  f) Type of preferred item paired,

Conclusion: Moderate intervention effects
Younger participants benefitted more
Firm conclusions not possible - procedural variations.

Period: 1967-2015

- Identified behavioral/non-behavioral/mixed interventions
- 63 behavioral intervention 968 participants
- # SSP included in n=10 (14.5%) studies
- 2 non behavioral intervention 52 participants
- 7 mixed Interventions 193 participants

Conclusion: a) Only behavioral interventions constituted EBP for speech deficits
b) SSP & PECS were considered ineffective methods for promoting language acquisition
We can therefore conclude that

- moderate to poor evidence for evocation/emergence of speech in non-vocal children with autism.

- Very few non-vocal participants across 50 years of research

- The definition of Non-vocal and non-verbal lacked clarity

- Various variables need to be studied further
Research Questions

Which methods would be most effective in evoking first instances of speech in non-vocal CWA?

a. Can non-vocal CWA acquire speech?

b. Which technology would be most effective?

c. Which AAC would be most suitable?

d. Would SSP under MO evoke speech in non-vocal CWA?

e. Would direct reinforcement support speech emergence?

f. Would the introduction of time-delay induce vocalization?

g. How many pairings during SSP?
Research Objectives:

a. To define what constitutes being vocal

b. To set a criteria for mastery

c. To select the most suitable response form

d. To assess experimental control

e. To identify clinically significant and replicable procedures.
Response Topography

• AAC – unaided (signs) and aided (graphic symbols, communication boards and SGD’s)

• The role of augmentative and alternative communication (AAC) for non-vocal CWA is considered emerging (NAC Panel 2009, 2015)

• Aided vs Unaided Communication (Gevarter et al., 2013)

• Inconclusive on vocal emergence (Boesch, 2011; Ganz et al., 2010; Iacono et al., 2015))

• Collateral Speech Outcomes (Beck et al., 2008; Curtis, 2012; Tincani, 2014)
Response Topography

• Manual Sign Training
  (Bonvillian & Nelson, 1978; Carr, 1979; Carr & Kologinsky, 1983; Hurlbut, Iwata & Green, 1982; Sundberg, 1980, DiCarlo, Stricklin, Banajee, & Reid, 2001; Bartman & Freeman, 2003; Scattone & Billhofer, 2008; Carbone et al., 2010)

• Picture Exchange Communication Systems
  (Bondy & Frost, 1993; Tincani, Crozier, & Alazetta, 2006; Canella-Malone, Fant, & Tullis 2010; Fliopin, Reszka & Watson, 2010; Greenberg, Tomaino & Charlop, 2014)

• SGD’s
  Parsons & La Sorte, 1993; Lancioni, Reilly, Cuvo, Singh, Sigafoos & Didden, 2007; Schlosser et al., 2007; Olive et al., 2007)
AAC – Meta Analysis

(Effect of AAC on vocal production)


Response Topography Selection

The current study preferred the use of Manual Sign Training

SGD’s not affordable in India

Standard PECS training across all levels for staff, ensuring procedural integrity etc. required allocation of resources (time and money)

Staff training & monitoring on using signs – low response effort
Intervention Centers & Staff

Participants were enrolled at one of 7 centers run by Behavior Momentum India

BCBA (2): staff training, supervision and monitoring, treatment integrity checks, IOA and data reviews.

Supervisors (17): min. 2 years hand-on experience. Involved in staff training, treatment integrity, IOA

Therapists (50): worked 1:1, conducted preference assessment, collected & transferred data and reported deviance / vocals
Method – (All Experiments)

Setting & Materials

- Clinic based 1:1 Setting
- 5 days/week (Mon – Fri)
- Class rooms
- Play park with
- Computer preloaded rhymes and movie songs
Participant Selection

Inclusion criteria:

a) diagnosis of ASD  b) being non-vocal

Non-vocal was defined as an inability to produce syllables, phonemes, sounds or words during assessments conducted under motivating operations.
Exclusion criteria

- Having a disability other than autism

- The presence of any vocal phoneme, syllable, word approximation mand, tact, echoic, or intraverbal fill-in.

- Having speech but not under stimulus control, ability to sing rhymes but not talk or echo after model.
Participant Selection

Assessments

- Behavior Language Assessment (BLA)

- Early Echoic Skills Assessment (EESA) – Group 1
  included twenty-five simple and reduplicated syllables e.g. ‘ah’, ‘papa’ ‘moo’.
  Esch, 2008 (VBMAP).
Current Study (2010-2016)

- Identified 144 non-vocal children with autism
- Excluded 18
- Total 126 children across 4 experiments
- Period: 6 years 8 months
Response Measurement

Baseline:
Assessment on vocal responses conducted on pre-selected Mands, Tacts, Echoics and Intraverbal fill-ins.

Intervention:
Daily first trial probes on target mands

After Each Vocal was Acquired as per Mastery Criteria:
Same as baseline
Mand Probes
- 30 minutes across 6 mands x 3 sessions
- Across table, in the play-park & computer with pre-loaded rhymes & songs
- Presented stimuli, offered play setting or contrived situation
- Access delayed by 3-5 seconds
- No verbal prompts were provided

Echoic Probe
- 5 sounds selected—aa, o, bu, ee & mmm
- The therapist sat across the child
- A vocal model “say _______” presented followed by a 3-sec pause
- 2 presentations for each sound in random order.
- No Sr+ was provided
**Tact Probe**
- The therapist sat across the child
- 5 pictures of common items selected
- Therapist asked “What is this?” followed by 3-5 sec pause
- 2 presentations made in random order for each.
- No Sr+

**Intraverbal Probe**
- Probes conducted at the table and natural environment
- 2 animal sounds, 2 rhymes & 2 fun fill-ins preselected
- Therapist initiated Cow says ______ / Twinkle\(^2\) little ______ / Ready, steady ___ followed by a 3-5 second pause
- No vocal model or Sr+ provided
- 
Inter Observer Agreement

Baseline: IOA on vocal status conducted on 100% trials on pre-selected mands, tacts, echoics and intraverbal
Results: 100% IOA on non-vocal status

Intervention: IOA on 5 probes on emerged vocals, followed by IOA across all operants as in Baseline
IOA = \( \frac{\text{Total agreements}}{\text{Total Probes}} \times 100 \)

Mean IOA of Study: 89% (Range 83% - 94%)
Treatment Integrity

50% intervention sessions observed by supervisor in 1st Week

Trainer Retraining on a score <80%

TI checks made one trial / target / month till end of intervention

Mean Treatment Integrity: 87% (57-100%)
Data Taking

Yes / No Data collected

• Using clickers
• Vocal emergence transcribed in English / Hindi
• Every trial – Baseline
• Probe trials – Intervention
• After each vocal acquired
• Inter Observe Agreement
• Treatment Integrity Checks
Dependent Variable

Emergence of 7 topographically distinct vocals
- Emitted as a phoneme, word approximation or word
- Emitted independently or after a vocal model
- As (a)mand (b)echoic (c)echoic-mand (d)tact (e)intraverbal

Vocals:
Example: Saying bu, bis, biki for Biscuit
Non-examples: Saying any other syllable; fa, pa, moo
Excluded: crying, grunting, giggling or babbling
Experimental Design

• Non-concurrent, Delayed Multiple Baseline

• Each participant added to MBL as they became available once previous participant acquired minimum one vocal
A preference assessment was conducted prior to target selection for each participant

- 6 targets selected across settings i.e.
  - table top toys & edibles
  - Play park equipment's
  - Rhymes & songs on computer
## Current Study

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Participants</th>
<th>MBL</th>
<th>Independent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>58</td>
<td>13</td>
<td>Sign Mand Training + Paired Vocals</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
<td>Sign Mand Training + Delayed Vocal Prompt</td>
</tr>
<tr>
<td>3</td>
<td>46</td>
<td>11</td>
<td>(1) Sign Mand Training (2) Added Intraverbal Trg</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>5</td>
<td>Sign Mand Training + Intraverbal Training</td>
</tr>
</tbody>
</table>
Non-vocal student seeks admission

Screening medical diagnosis for ASD

BLA & EESA Assessment for Vocal status

Exclude from Study

Vocal

Randomly Assigned to Experiment 1 or 4

Baseline IOA Data on Form 7 across Mands, Tacts, Echolics & Intraverbals

Preference Assessment & Target Selection

Experiment 1
Mand + SSP Training

Vocal Emergence

Add next participant on same or another MBL & continue with earlier participant

Participant Met Vocalization Criteria N=7

Intervention Ends

Yes

No

Continue Intervention

9-33 weeks Mand Training

Assign to Experiment 2 or 3

Mand + SSP with Time-delay

27-42 weeks Mand Training

Experiment 3 Introduce Intraverbal Training

Experiment 2
Mand + SSP

Preference Assessment & Target Selection

Experiment 4
Mand + SSP + Intraverbal Training

Exclude from Study

Vocal

Yes

No

Randomly Assigned to Experiment 1 or 4

Baseline IOA Data on Form 7 across Mands, Tacts, Echolics & Intraverbals

Preference Assessment & Target Selection

Experiment 1
Mand + SSP Training

Vocal Emergence

Add next participant on same or another MBL & continue with earlier participant

Participant Met Vocalization Criteria N=7

Intervention Ends

Yes
Experiment 1

Role of Sign Mand Training and Paired Vocals On The Emergence of Speech in 58 Non-Vocal Children With Autism
Experiment 1: MBL 1

Participants

5 Non-vocal participants with autism

Age range 2.8 – 13.5 years

BLA score range 12 - 24/60

EESA score 0
## Participants – Expt. 1 MBL 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age</th>
<th>Diagnosis</th>
<th>BLA</th>
<th>EESA</th>
<th>H/O Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biso</td>
<td>M</td>
<td>3.0</td>
<td>ASD</td>
<td>18/60</td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>Amaz</td>
<td>M</td>
<td>2.8</td>
<td>ASD</td>
<td>14/60</td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>Liv</td>
<td>M</td>
<td>2.10</td>
<td>ASD</td>
<td>12/60</td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>Digun</td>
<td>M</td>
<td>3.8</td>
<td>ASD</td>
<td>25/60</td>
<td>0</td>
<td>Speech Therapy 8 mth</td>
</tr>
<tr>
<td>Dako</td>
<td>M</td>
<td>13.5</td>
<td>ASD</td>
<td>18/60</td>
<td>0</td>
<td>Speech Therapy &amp; OT 10 years Intermittent</td>
</tr>
</tbody>
</table>
# Preference Assessment

## Table 8: List of Preferred Items

<table>
<thead>
<tr>
<th>Participants</th>
<th>Preferred Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biso</td>
<td>Toys: Light toy, Musical toy, Bubbles, Book, Squeezy Ball, Piano, Puzzle, Music</td>
</tr>
<tr>
<td></td>
<td>Outdoor: Swing, Trampoline, Merry-go-round, Rocking-horse</td>
</tr>
<tr>
<td></td>
<td>Contrived: Jump, Push</td>
</tr>
<tr>
<td>Amaz</td>
<td>Toys: Light toy, Musical toy, Puzzle, Crayon, Pencil, Book, Music on Computer</td>
</tr>
<tr>
<td></td>
<td>Outdoor: Swing, Slide, Ball</td>
</tr>
<tr>
<td></td>
<td>Edibles: Biscuit, Chips, Water, Banana</td>
</tr>
<tr>
<td>Liv</td>
<td>Toys: Musical toy, Music on phone, Music on computer, Pen</td>
</tr>
<tr>
<td></td>
<td>Outdoor: Trampoline, Slide, Swing, Merry-go-round</td>
</tr>
<tr>
<td></td>
<td>Edibles: Chips, Chocolate, Water</td>
</tr>
<tr>
<td></td>
<td>Contrived: Jump, Open</td>
</tr>
<tr>
<td>Digun</td>
<td>Toys: Bubbles, Book, Puzzle, Toys, Music on computer</td>
</tr>
<tr>
<td></td>
<td>Outdoor: Swing, Trampoline, Merry-go-round, Bicycle</td>
</tr>
<tr>
<td></td>
<td>Edibles: Biscuit, Chips, Chocos</td>
</tr>
<tr>
<td></td>
<td>Contrived: Jump, Toilet</td>
</tr>
<tr>
<td>Dako</td>
<td>Toys: Book,</td>
</tr>
<tr>
<td></td>
<td>Outdoor: Swing, Merry-go-round, Play area</td>
</tr>
<tr>
<td></td>
<td>Edibles: Chips, Juice, Water (Pani in Hindi), Apple</td>
</tr>
<tr>
<td></td>
<td>Contrived: Out, Move, Jump</td>
</tr>
</tbody>
</table>
Intervention

- Sign-Mand training trials conducted with item in view
- Out of reach
- Each trial had 3 pairings
- 40 mand trials / day for all 6 targets
Mastery Criterion

For Vocalization: \( n=7 \) vocals across any operant.

For Each Vocal: Specific vocal on 1st trial for 5 consecutive sessions

IOA on 80% vocals

Vocals could be independent or repeated after the model during pairing. Participants who emerged with \( <n=7 \) vocals, or did not achieve mastery, continued on the intervention till the end of the study.
Independent Variable

Learner Demonstrates Interest

Prompt Sign + Pair Target Word
2 sec pause

Prompt Fade Sign + Pair Target Word
2 sec pause

Deliver Preferred Item/Activity
2 sec pause

Pair target word
Videos
Experiment 1

Figure: 1.0

Cumulative Instances of Speech Acquired by Each Participant.
Sign Mand Training with Paired Vocal

6 Signs prior to vocals
1\textsuperscript{st} vocal 2\textsuperscript{nd} week
7\textsuperscript{th} vocal 5\textsuperscript{th} week
Acquired Independent mands

No Signs prior to vocals
1\textsuperscript{st} vocal week 3
7\textsuperscript{th} vocal week 5
All independent mands
Figure 1.0: A multiple baseline across subjects to study the effect of manual sign mand training with paired vocals on inducing first instances of speech in non vocal-verbal children with autism.
Videos
## Results – Study 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Period of Intervention</th>
<th>Weeks to 1st Vocal</th>
<th>Weeks to 7&lt;sup&gt;th&lt;/sup&gt; Vocal</th>
<th>Manual Signs Ach prior to vocal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biso</td>
<td>5 weeks</td>
<td>2</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Amaz</td>
<td>5 weeks</td>
<td>3</td>
<td>5</td>
<td>none</td>
</tr>
<tr>
<td>Liv</td>
<td>48 weeks</td>
<td>None</td>
<td>None</td>
<td>11</td>
</tr>
<tr>
<td>Digun</td>
<td>22 weeks</td>
<td>8</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>Dako</td>
<td>22 weeks</td>
<td>3</td>
<td>28</td>
<td>3</td>
</tr>
</tbody>
</table>
Results & Discussion MBL 1.0

- Of the 5 children 4 emerged with vocals
- Taking 2 – 28 weeks
- Biso & Amaz had negligible fine and gross motor imitation
- Digun was most cooperative and had better eye contact but Biso, Amaz, Dako emerged with 1st vocal in 203 weeks
- Early vocal emergence in participants’ lacking observing responses suggests eye contact during stimulus-stimulus pairing might have little or no effect on vocal emergence. It may also rule out any blocking effect that the verbal auditory stimulus (presented during pairing) might have; as children with autism often exhibit stimulus over-selectivity
- Training for observing response was initiated for Liv after 16 weeks as he did not acquire vocals
While previous studies paired arbitrary words during SSP, in this study functional words were paired for lasting effects.

Three participants had no histories of intervention and were below 4 years, however, Dako at the age of 13.5 years vocalized his first syllable in 3 weeks of intervention. This clearly demonstrates SSP can be effective in developing vocals in individuals with autism irrespective of age.

The similarity of the emergent vocalizations to the paired auditory stimulus confirmed the role of automatic reinforcement during vocal emergence (Bijou & Baer, 1965; Skinner, 1957). Vocalizing /o-p/ for open, /jun/ for juice, /side/ for slide, and /ju/ for jump suggests SSP established the auditory verbal stimulus as a conditioned reinforcer.
Expt. 1 Replications

Replication Participants: 53
Across 12 Multiple Baseline studies
83% Male & 17% Females
All non-vocal with a diagnosis of ASD
Participant Age range 1.4 – 9.6 years
Results Experiment 1

Total Participants: 58

- 48 participants acquired vocals
- 10 participants remained non-vocal

Mean IOA 89% (54% – 100%)
Results Study 1

• 48 (of n=58 mute) participants acquired vocals
• Vocals acquired had permanent effects
• Vocals emerged as phonemes, word or approximations
• Vocals emerged across verbal operants mands, echoic mands and intraverbals but never as tacts
• The vocal which emerged had similarities with the vocal paired
Results Study 1

- 24 of 58 participants who acquired vocals were <3.5 yrs.
- One male child 2.1 yrs did not acquire vocals
- Vocal emergence in <50 days
Results Experiment 1

• 3 participants reached mastery criteria (n=7 vocals) within 10 days

• 27 (of 58) participants acquired the 1\textsuperscript{st} vocal between 25-50 days

• 3 participants emerged with all vocals on the same day

• Age may not be a criteria for vocalization- Youngest was 2.1 years Oldest 13.5 years
Discussion Experiment 1

• Sign-mand training with stimulus-stimulus pairing led to emergence of vocals in 83% participants

• 10 participants remained non-vocal

• A common variables among those who remained non-vocal was an overall low rate of learning (from IBI records). This requires further study
Study 2

Role of Sign Mand Training Using Time-Delay in 3 Non-Vocal Children With Autism
Flow Diagram Representing Participant Inclusion & Assignment on Experiments

Non-vocal student seeks admission

Screening medical diagnosis for ASD

BLA & EESA Assessment for Vocal status

Exclude from Study

Yes

Vocal

No

Randomly Assigned to Experiment 1 or 4

Baseline IOA Data on Form 7 across Mands, Tacts, Echolics & Intraverbals

Preference Assessment & Target Selection

Experiment 4
Mand + SSP + Intraverbal Training

Yes

Vocal Emergence

Add next participant on same or another MBL & continue with earlier participant

No

Continue Intervention

Participant Met Vocalization Criteria N=7

Experiment 3
Introduce Intraverbal Training

Assess to Experiment 2 or 3

9-33 weeks Mand Training

Experiment 2
Mand + SSP with Time-delay

27-42 weeks Mand Training

Experiment 1
Mand + SSP Training

Exclude from Study

Yes
Introductions

- Tincani (2004) and Tincani, Crozier, & Alazetta (2006) found increase in vocal responses when PECS was used with time-delay.
  - In their study, prompt delay was used for both behaviors, namely, manual sign and vocal prompt.
  - A least to most prompting method was used and the participants were expected to use signs with or without vocals. The independent variable included prompt delay and vocal prompt.
  - On declaration of motivation for an item, the participant made a manual sign after the preferred item was not delivered and instead a 5-second time delay was introduced. If the participant did not emit a vocal a vocal prompt was provided followed by a 2-second delay, if there was no vocal, the vocal prompt was re-presented twice.
  - The preferred item was delivered on any vocal emergence or after the final sequence.
  - Increases in vocal responses were seen across all three participants with this intervention.
Participant Selection

• 2 boys Ashar & Hipal already on the sign-mand training with vocal pairing for 33 weeks

• No speech acquisition

• All at the same center

• Randomly selected for Experiment 2

• Ashar joined later and was added to the study
## Participants – Study 2

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age</th>
<th>Diagnosis</th>
<th>BLA</th>
<th>EESA</th>
<th>H/O Intervention</th>
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<tbody>
<tr>
<td>Ashar</td>
<td>M</td>
<td>3.0</td>
<td>ASD</td>
<td>13/60</td>
<td>0</td>
<td>USA - 6 months 27 hrs/week ABA BMI - 33 weeks Sign-mand training</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.5 yrs</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Akon</td>
<td>M</td>
<td>2.8</td>
<td>ASD</td>
<td>12/60</td>
<td>0</td>
<td>9 month of Speech &amp; SI therapy thrice/week BMI- 9 weeks Sign-mand training</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.8 yrs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hipal</td>
<td>M</td>
<td>2.10</td>
<td>ASD</td>
<td>22/60</td>
<td>0</td>
<td>Special school - Speech therapy 2 years + OT BMI- 33 weeks Sign-mand training</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.6 yrs</td>
<td></td>
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<tr>
<td>Name</td>
<td>Toys</td>
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<td>Edibles</td>
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<td>-------------------------------------------</td>
<td>--------------------------------------</td>
<td>------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ashar</td>
<td>Toy, Blocks, Balloon, Music on Computer</td>
<td>Swing, Merry-go-round, Slide, Trampoline</td>
<td>Biscuit, Chips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Akon</td>
<td>Toy, Spoon, Spring toy</td>
<td>Merry-go-round, Gym-ball</td>
<td>French-fries, Grapes, Candy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hipal</td>
<td>Ball, Music on Computer, Toy, Block, Bubble</td>
<td>Swing, Merry-go-round, Trampoline</td>
<td>Biscuit, Chips</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Experimental Design

• Multiple Baseline across participants

• A participant was included when the previous participant acquired at least one instance of speech.
Response Definition, Measurement, IOA

Similar to previous study

Baseline
    Probes were conducted across mands, tacts, Intraverbals and echoics. IOA was 100%

Intervention
    Probes similar as Expt 1
    IOA was 97% (range 94% - 100%)
Independent Variable

- **Learner Demonstrates Interest**
  - Prompt Sign
    - 5 sec pause
  - Therapist says target word
    - 2 sec pause
  - Repeat target word
    - 2 sec pause
  - Deliver item & pair target word

**Treatment Integrity**
90% (range 83-93%)
Figure 2: A multiple baseline across subjects to study the effect of delayed vocal auditory stimulus on acquisition of speech by children with autism undergoing sign mand training.
Results

- Ashar acquired 1\textsuperscript{st} vocal in 1\textsuperscript{st} week & 7\textsuperscript{th} vocal in 7 weeks
- After he acquired 4 vocals IV introduced for Akon.
- Akon 1\textsuperscript{st} vocal in 3\textsuperscript{rd} week (ta=toy/ fie=fries)
- 8 week break. after another 5 weeks he acquired 2 mands
- On acquisition probe – 3 intraverbal fill-ins
- Hipal added as a 3\textsuperscript{rd} participant as the pre-requisite for waiting for 5 sec was on target
- Hipal 1\textsuperscript{st} vocal 9\textsuperscript{th} week and 7\textsuperscript{th} vocal 13\textsuperscript{th} week all mands
Follow up: Week 30

- Ashar acquired 12 vocal mands, 6 intraverbal fill-ins and 14 echoics.
- Most of his vocals were approximations such as saying ‘doe’ for no, ‘wa’ for water, ‘apah’ for apple, ‘koh’ for chocolate.
- His EESA score at 30 weeks was 14/100.
- Akon acquired 13 mands and 11 intraverbal fill-ins.
- His vocals were initial sounds of each target word like ‘joo’ for juice, ‘wa’ for water, ‘o’ for open. He could articulate the /st/ and /sp/ blends however not the /fr/ blend. His EESA score was 15.5/100.
- Hipal acquired 16 mands, 7 tacts, 8 intraverbal fill-ins and 25 echoics by week 30. When asked to label adjectives he labeled /fee/ for few and /ma/ for many, /kah/ for cup, /bue/ for blue colour. When filling intraverbals he vocalized /ba/ when asked dog says as well as sheep says.
- Hipal had an EESA score of 17.5/100.

- This study validates previous research on the effectiveness of time delay of 10-15-sec by Halle et al. (1979) and Ingenmey & Van Houten (1991) and 5 sec delay by Carbone et al (2010).
Discussion

- This study extends previous research by Carbone et al. (2010) with slight modifications in time-delays. The current study demonstrates this with a small set of data; it suggests that delayed-auditory-stimulus presentation can be a procedure which can be considered useful for children with autism, who have severe speech delays and have not demonstrated improvements, despite exposure to a variety of interventions including speech therapy.

- The almost immediate emergence of vocals, in the delayed-auditory-stimulus presentation condition, within a week for Ashar and Akon adds to the evidence favoring the introduction of time-delay.

- Hipal had a long history of interventions including speech therapy and had previously been on mand training with SSP for 33 weeks. He was mute and emerged with vocals within 9 weeks after the time-delay procedure was introduced, under conditions of motivating operations.

- Variability in behavior is induced in the delay period when reinforcement is withheld (Esch, et al., 2002).
Discussion

- Variability in behavior is induced in the delay period when reinforcement is withheld (Esch, et al., 2002).

- The results in this experiment serve as a systematic replication of findings from Carbone et al. (2010) in which the independent variable was replicated except for two modifications. In the current experiment the vocal model after the initial sign was presented at 5 sec-2 sec-2 sec (9-sec) delay in comparison to 5sec-2sec-2sec-2sec (11-sec) delay in Carbone et al study.

- This study validates previous studies on the effectiveness of time-delay where a 15-sec & 10-sec time delay by Halle et al. (1979) and Ingenmey and Van Houten (1991) respectively resulted in speech in three children with intellectual disabilities and improved spontaneous communication in a child with ASD. This suggests that increasing the waiting time from 2-sec during time-delay to 9-seconds with time-delays in the current study could evoke vocal behavior in some children.

- Limitations of the study include limited generality as the intervention was applied on only 3 participants. Further, while generalization was evidenced across operants the same was not systematically tested across settings such as home and school.
Study 3

Effect of Addition of Intraverbal Training Sign Mand Training
Studies on intraverbal training have established a new repertoire of language development such as

- **storytelling** (Valentino, Conine and Delfs, 2015),
- **reverse intraverbals** (Allan, Vladescu and Kisamore, 2015),
- **bi-directional intraverbals** (Dounavi, 2014),
- **yes-no responding** (Shillingsburg, Kelley, Roane, Kisamore & Brown, 2009)
- **complex intraverbal responding** (Sautter, LeBlanc, Jay, Goldsmith & Carr, 2011).

Several studies have also focused on the variables impacting intraverbal acquisition (Coon & Miguel, 2012; Finkel, Williams, 2002; Grannan & Rehfeldt, 2012; Ingvarsson & Hollobaugh, 2011; Valentino, Shillingsburg & Call, 2012).
A review of titles in the journal the Analysis of Verbal Behavior published between 2010-16 reveals no studies that have explored the role of intraverbal training in the emergence of speech in non-vocal children with autism.

Sundberg and Partington (1998) describe several procedures for teaching beginning intraverbal skills, to children with autism and other learning disabilities, using fill-in opportunities in songs, rhymes, animal sounds, object sounds, common associations and specific daily activities.
Experiment 3

Purpose:
To find alternatives when sign-mand training with vocal pairing failed to evoke speech.

To study the effect of addition of a second independent variable: i.e. a verbal unit paired with target vocal (intraverbal fill-in) in inducing first instances of speech in children who remained non-vocal.
Participant Selection

Phase 1:
• 5 participants randomly selected.
• All were on sign-mand training with vocal pairing for an average 27-42 weeks

• Phase 2:
• The study was replicated across 41 more participants
• Previously on sign-mand training with vocal pairing for 12-52 weeks
Response Measurement

Baseline:
• Probes on intraverbals, mands, tacts, echoics
• IOA 100%

• Intervention:
• Daily first trial probes conducted on 3 AVU
• Specific vocal across 5 consecutive days triggered an IOA on relevant AVU
• Which was followed by probes on mands, tacts, echoics & intraverbals.
Expt. 3 MBL 1

- 5 participants (4 boys & 1 girl) Reyan, Neha, Barry, Mahar & Ricky
- Underwent Sign-mand training with SSP for 27-42 weeks
- Ages 1 year 11 months to 3 years 6 months
- No vocals acquired
- All except Barry received 25 hours/week IBI intervention
## Expt 3 - Participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Acquisitions</th>
<th>Age in Yrs./mths</th>
<th>BLA 1</th>
<th>BLA 2</th>
<th>EESA</th>
<th>Duration on Intervention1</th>
<th>Signs Acquired In Expt 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reyan</td>
<td>Rec 4 body parts, 3 OSI,</td>
<td>1.11</td>
<td>20</td>
<td>22</td>
<td>0</td>
<td>28 weeks</td>
<td>12</td>
</tr>
<tr>
<td>Neha</td>
<td></td>
<td>3.6</td>
<td>13</td>
<td>21</td>
<td>0</td>
<td>32 weeks</td>
<td>9</td>
</tr>
<tr>
<td>Barry</td>
<td></td>
<td>3.2</td>
<td>12</td>
<td>20</td>
<td>0</td>
<td>42 weeks</td>
<td>1</td>
</tr>
<tr>
<td>Mahar</td>
<td></td>
<td>3.2</td>
<td>12</td>
<td>20</td>
<td>0</td>
<td>30 weeks</td>
<td>4</td>
</tr>
<tr>
<td>Ricky</td>
<td></td>
<td>3.2</td>
<td>12</td>
<td>16</td>
<td>0</td>
<td>27 weeks</td>
<td>2</td>
</tr>
</tbody>
</table>
Experimental Design

Multiple baseline design

Each participant was added when the previous acquired at least one vocal
Independent Variable

Therapist presents Antecedent Verbal Unit (AVU)
(Ex: initial part of rhyme or fun-fill-in)

pauses 2 seconds

pairs target verbal stimulus with delivery of preferred item.

(Multiple words do not equate to multiple stimuli and may function as a single unit. Eikeseth, 2013; Skinner, 1957)
Independent Variable

Mand Trials

As per Expt 1

No Vocal emergence

12–42 weeks

Intraverbal Training Introduced

Present Antecedent Verbal Unit

1-2 sec pause

Therapist Says Target word

Delivers Reinforcer

Mand Trials continue

40 trials/day

20 trials/day
Intraverbal Training

**Rhyme Fill-in**

Johnny^2 Yes..... (1-2 sec pause) ............ **“Papa”** Preferred item delivered
(Antecedent Verbal Unit) (Paired stimulus)

**Contextual Fill-in**

One, Two........ (1-2 sec pause) ............ **“3”** — Preferred item delivered
(Antecedent Verbal Unit) (Paired stimulus)

**Animal Sounds**

Cow says......... (2 sec pause) ....... **“Moo”** — Preferred item delivered
(Antecedent Verbal Unit) (Paired stimulus)

20 Intraverbal Training Trials conducted / session
Video Intraverbal training
Intraverbal vocal emergence
Cumulative Instances of Speech Acquired

- Reyan
- Neha
- Barry

Sign Mand Training + SSP + Intraverbal Training

BL

Graphs showing cumulative instances of speech acquired for three individuals: Reyan, Neha, and Barry, with various words tracked over time.
Figure 3.0: A multiple baseline across subjects to study the effect of adding Intraverbal fill-in training to mand training with stimulus-stimulus pairing on non-vocal children with autism.
### Results: Expt 3 MBL 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Period of Intervention</th>
<th>Week to 1st Vocal</th>
<th>Week to 7th Vocal</th>
<th>1st Vocal Operant</th>
<th>Vocal- Operant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reyan</td>
<td>19 weeks</td>
<td>1</td>
<td>19</td>
<td>Intraverbal</td>
<td>4 Intraverbal 3 Echoics</td>
</tr>
<tr>
<td>Neha</td>
<td>33 weeks</td>
<td>4</td>
<td>33</td>
<td>Intraverbal</td>
<td>5 Intraverbal 2 Echoic-Mands</td>
</tr>
<tr>
<td>Barry</td>
<td>15 weeks</td>
<td>9</td>
<td>15</td>
<td>Intraverbal</td>
<td>7 Intraverbals</td>
</tr>
<tr>
<td>Mahar</td>
<td>44 weeks</td>
<td>16</td>
<td>44</td>
<td>Intraverbal</td>
<td>4 Intraverbal 3 Echoic-Mands</td>
</tr>
<tr>
<td>Ricky</td>
<td>50 weeks</td>
<td>None</td>
<td>None</td>
<td>-</td>
<td>None</td>
</tr>
</tbody>
</table>
Results Expt 3 MBL 1

• Four participants achieved n=7 first instances of speech
• Reyan’s 1\textsuperscript{st} two vocals were Intraverbal fill-ins. After the 2\textsuperscript{nd} vocal on the acquisition probe he emerged with 3 echoics, but no mands
• Neha’s 1\textsuperscript{st} four vocals were fill-ins. Her 5\textsuperscript{th} vocal emerged as an echoic mand
• Barry’s first 7 vocals were all fill-ins
• Mahar’s 1\textsuperscript{st} vocal was a fill-in, while the next 2 were echoic mands
• Ricky did not acquire any vocals.
<table>
<thead>
<tr>
<th></th>
<th>Neha</th>
<th>Reyan</th>
<th>Barry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ca IV-AS</td>
<td>Ba ba IV-AS</td>
<td>Go IV-Fun Fill</td>
</tr>
<tr>
<td>2</td>
<td>Ba IV-AS</td>
<td>AA E</td>
<td>O IV - Rhyme</td>
</tr>
<tr>
<td>3</td>
<td>Go IV-FF</td>
<td>Pa E</td>
<td>Star IV-Rhyme</td>
</tr>
<tr>
<td>4</td>
<td>Moo IV-AS</td>
<td>OO E</td>
<td>Boo IV-Fun Fill</td>
</tr>
<tr>
<td>5</td>
<td>Pu (Push) EM</td>
<td>Cooa (quack) IV-AS</td>
<td>Ba IV-AS</td>
</tr>
<tr>
<td>6</td>
<td>Aao EM</td>
<td>Chuku IV-S</td>
<td>Papa IV-Rhyme</td>
</tr>
<tr>
<td>7</td>
<td>Chi IV-S</td>
<td>O (Ol Mc) IV-Rhyme</td>
<td>Three IV-Fun Fill</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Mahar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Three IV-Fun Fill</td>
</tr>
<tr>
<td>2</td>
<td>Ee (chip) EM</td>
</tr>
<tr>
<td>3</td>
<td>M (music) EM</td>
</tr>
<tr>
<td>4</td>
<td>Ba IV-AS</td>
</tr>
<tr>
<td>5</td>
<td>Go EM</td>
</tr>
<tr>
<td>6</td>
<td>Oo IV-Rhyme</td>
</tr>
<tr>
<td>7</td>
<td>Pun(Bun) IV-Rhyme</td>
</tr>
</tbody>
</table>

**The First 7 vocals by participant by Operant**

IV- FF = Contextual, IV- R = Rhyme Fill in, IV- AS = Animal Sounds
M= Mand, EM= Echoic Mand
M = Mand
Study 3 Replications

Replication Participants: 41
Multiple Baselines: 9 + 2 single subjects
Gender: Male 77% & Female & 23%
Age range: 1.8 – 12.2 years
Each MBL had 3-7 participants
Results Experiment 3
Total Participants: 46

Vocal Status

- 20% Remained Non-Vocal
- 80% Acquired Vocals

Mean IOA 88% (74% – 97%)
Results Experiment 3
Total Participants: 46

First Vocal By Operant
- Mand: 20
- Intraverbal: 17
- No Vocal: 9

Total Vocals By Operant
- Mand: 48%
- Echoic: 47%
- Intraverbal: .05%
Expt 3: Results

• 37 of 46 participants acquired n=7 first instances of speech.

• 9 participants emerged with first vocals within 2 weeks confirming the effect of the independent variable

• Almost 20 participants took an average 46 days/vocal suggesting long intervals.

• Four participants emerged with all 7 first instances as intraverbal fill-ins.
Discussion

• Results suggest Intraverbal training with paired words affected emergence of vocals.

• The Antecedent Verbal Unit was established as a discriminative stimulus

• Faulty stimulus control (Sheep says baa & not moo) was not observed with any child as an outcome.

• The 1-2 second delay showed pairing effects

• One pairing was effective
Limitations & Future Research

• More research required for pairing an antecedent verbal unit with non-vocal children with autism and other developmental disabilities

• The role of Antecedent Verbal Unit needs further study with non-vocal children

• Faulty stimulus control (Sheep says baa & not moo) was not observed with any child.

• The 1-2 second delay showed pairing effects

• One pairing was effective
Study 4

The Effect of Sign Mand Training and Intraverbal Training as a Treatment Package with Non-Vocal Children With Autism

IOA 89% (Range 83%-94%)
Purpose

To observe any changes in rate of vocal emergence when intraverbal training with paired vocal is started along with mand training as a treatment package
# Expt 4 - Participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age in Yrs./mths</th>
<th>BLA 1</th>
<th>EESA</th>
<th>Multiple Baseline #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narvey</td>
<td>M</td>
<td>5.6</td>
<td>18</td>
<td>0</td>
<td>4.2</td>
</tr>
<tr>
<td>Huber</td>
<td>M</td>
<td>5.2</td>
<td>26</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Rita</td>
<td>F</td>
<td>3.6</td>
<td>19</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Response measurement & IOA

• Data collected as Yes/No
• Intake Assessments: BLA & EESA
• Baseline Probes:
  – Mands, Tacts, Echoics & Intraverbals
• Intervention Probes:
  – First mand & First Intraverbal trial of the session
  – Vocal emergence for 5 days followed by an IOA by supervisor
  – Assessment as in Baseline on Mands, Tacts, Echoics & Intraverbals
Independent Variable

**Sign-Mand Training Trials**
- 40/day
  - Prompt Sign + Pair Target Word
  - 2 sec pause
  - Prompt Fade Sign + Pair Target Word
  - 2 sec pause
  - Deliver Preferred Item/Activity
  - 2 sec pause
  - Pair target word

**Intraverbal Trials**
- 20/day
  - Present Antecedent Verbal Unit
  - Therapist Says Target word
  - 1-2 sec pause
  - Deliver Reinforcer

Treatment Integrity Scores:
- Intraverbal Training: 87% (Range 60% - 100%)
- Mand Training: 86% (Range 77% - 100%)
Results
Expt. 4 MBL 4.2

Sign Mand Training with Paired Vocal + Intraverbal Training

Cumulative Instances of Speech Acquired

Figure: A multiple baseline across subjects to study the effect of intraverbal training along with sign mand training with paired vocals in children with autism.
## Expt 4 - Participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Weeks to 1&lt;sup&gt;st&lt;/sup&gt; vocal</th>
<th>Weeks to 7&lt;sup&gt;th&lt;/sup&gt; Vocal</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; vocal under Operant</th>
<th>7 Vocals</th>
<th>Multiple Baseline #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narvey</td>
<td>6</td>
<td>12</td>
<td>Intraverbal</td>
<td>7 Intraverbals</td>
<td>4.2</td>
</tr>
<tr>
<td>Huber</td>
<td>1</td>
<td>4</td>
<td>Intraverbal</td>
<td>6 Intraverbals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 Mand</td>
<td></td>
</tr>
<tr>
<td>Rita</td>
<td>1</td>
<td>4</td>
<td>Mand</td>
<td>2 Intraverbals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 Mands</td>
<td></td>
</tr>
</tbody>
</table>
Expt 4:

Total Participants: 19

Multiple Baselines: 5

Gender: Males 85%
Females & 15%

Age range: 1.8 – 9.2 years

Diagnosis: ASD
Results

• 17 of the 19 i.e. 89% participants acquired vocals
• Of the 17 participants 16 kids took 5-23 days for each vocal.
• RGA at 8.6 years was the outlier who took 48 days for each vocal taking 338 days for mastery. Past h/o of 5 years at a special school.
• JRA a 9.2 years old boy, was using PECS and had a h/o OT, Speech and ABA based intervention. He first vocal vocalized in 35 days and met mastery in 155 days.
Results Experiment 4
Total Participants: 19

Mean IOA 89% (83% – 94%)

Vocal Status

89% Acquired Vocals
11% Remained Non-Vocal
Conclusion

• The efficacy of the procedures was demonstrated across all four interventions.

• Two interventions (Experiment 1 & 2) included sign-mand training with vocal pairing with delay of 2-9 seconds

• Two interventions (Experiment 3 & 4) included the addition of a second independent variable i.e., pairing a target word with an antecedent verbal unit (AVU) after a delay of minimum 12 weeks or as a treatment package.
## Vocal Emergence By Experiments

<table>
<thead>
<tr>
<th>Participants / Experiment</th>
<th>Expt 1</th>
<th>Expt 2</th>
<th>Expt 3</th>
<th>Expt 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Vocal Participants</td>
<td>58</td>
<td>3</td>
<td>46</td>
<td>19</td>
</tr>
<tr>
<td>Acquired Vocals</td>
<td>48</td>
<td>3</td>
<td>37</td>
<td>17</td>
</tr>
<tr>
<td>Remained Non-Vocal</td>
<td>10</td>
<td>0</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>% Vocalized</td>
<td>83%</td>
<td>100%</td>
<td>80%</td>
<td>89%</td>
</tr>
</tbody>
</table>

## Vocalization By Participant Age

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Total Participants</th>
<th>Achieved Vocals</th>
<th>% Vocal Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4 – 3.0</td>
<td>41</td>
<td>34</td>
<td>83%</td>
</tr>
<tr>
<td>3.1 – 8.0</td>
<td>79</td>
<td>66</td>
<td>84%</td>
</tr>
<tr>
<td>8.1 – 13.5</td>
<td>6</td>
<td>5</td>
<td>83%</td>
</tr>
<tr>
<td></td>
<td>126</td>
<td>105</td>
<td></td>
</tr>
</tbody>
</table>
Discussion

• 105 of 126 non-vocal kids with autism benefitted from behavioral interventions and acquired vocals. This contrasts with (Eldevik, Jahr, Hastings & Huges, 2010) recommendations

• Strong evidence of the role Stimulus-stimulus pairing played in pairing neutral target sounds with preferred item adds the evidence (Caroll & Klatt, 2008; Esch et al., 2009; Miguel et al., 2002; Smith et al., 1996; Sundberg et al., 1996; Ward et al., 2007; Yoon & Bennett, 2000).

• SSP under motivating operations was effective in vocal emergence.
The role of signs as prompts for facilitating communication is supported by the following data taken by one team at Hyderabad across all expt. (Tincani, 2004)

<table>
<thead>
<tr>
<th>S.No</th>
<th>MBL</th>
<th>Code Name</th>
<th>Total Sign-mands prior to vocals</th>
<th>Vocal / Non-vocal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.11</td>
<td>SVEE</td>
<td>14</td>
<td>V</td>
</tr>
<tr>
<td>2</td>
<td>1.12</td>
<td>VKI</td>
<td>2</td>
<td>V</td>
</tr>
<tr>
<td>3</td>
<td>1.12</td>
<td>ZMO</td>
<td>2</td>
<td>V</td>
</tr>
<tr>
<td>4</td>
<td>1.12</td>
<td>SRE</td>
<td>20</td>
<td>NV</td>
</tr>
<tr>
<td>5</td>
<td>1.12</td>
<td>AQU</td>
<td>2</td>
<td>V</td>
</tr>
<tr>
<td>6</td>
<td>1.13</td>
<td>PKE</td>
<td>3</td>
<td>V</td>
</tr>
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<td>14</td>
<td>V</td>
</tr>
<tr>
<td>8</td>
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<td>V</td>
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<td>V</td>
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<td>V</td>
</tr>
<tr>
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<td>24</td>
<td>V</td>
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<tr>
<td>12</td>
<td>4.4</td>
<td>MMA</td>
<td>0</td>
<td>V</td>
</tr>
</tbody>
</table>
First instances of speech had permanent effects unlike previous studies (Miguel et al. 2002; Normand & Knoll, 2006)

- The selection of target words after a preference assessment
- Ensuring satiation was offset and MO remained high for 40 trials/day
- Conducting teaching trials after participants demonstrated desire (Shillingsberg et al., 2015)
- Establishing the mastery criteria to achieve permanent vocals.
Mand training

– an effective strategy (Drash et al., 1999; Ross & Greer, 2008)

– produced stronger effects on various dimensions of response (Staffort, Sundberg & Bram, 1988)

– needs more research with non-vocal children
Selection of an AAC system

– attributed to individual variables such as pre-existing skills, individual needs and family preferences (Mirenda, 2005)

– While improvements in vocalization demonstrated in stage IV of PECS (Carr & Felce, 2007; Tincani et al., 2004; Yoder & Stone, 2006). Emergence weak.

– Mixed needs obtained with the use of SGD’s (Olive et al., 2007; Roche et al., 2014; Schlosser et al., 2007)

– Current research provides strong evidence of using manual sign training under mand conditions using SSP
Selection of signs (unaided AAC)

– due to cost factors, training efforts, limited response effort of preparing materials and ease of usage.

– Unlike previous studies (Ganz et al., 2002; Rose, Trembath & Bloomberg, 2016) despite limited imitation skills, most participants acquired manual signs under MO
Limitations

• Dependence on BLA as an assessment tool

• Collateral effects of IBI on speech emergence not studied

• The effect of pairing the word 3 times in mand and once with the AVU

• Factors leading to difference in rate of acquisition were not clear

• Maturation effects due to the long intervals of vocal emergence could be a possibility with some children
Thank You

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