Update on Research on Verbal Behavior and Autism

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Purpose: To summarize and synthesize recently published findings on teaching verbal behavior to individuals with ASD.

• The goal is for you to become aware of recent studies that may be relevant to what you do in your practice.

• You won’t get all the information you need to implement the procedures, but you will know where to find articles that may be useful to you.
B. F. Skinner’s (1957) analysis of verbal behavior will be used as a framework for classification and discussion

Mands, tacts, intraverbals, echoics, etc.

**VB Research: Recent Developments**

Sautter & LeBlanc (2006): Empirical research on Skinner’s verbal operants
Petursdottir & Devine (under review): Empirical research on Skinner’s verbal operants 2005-2016

Petursdottir & Devine (under review):

[Graph showing the number of citations over years]
Studies Included in Present Review

Empirical studies on teaching verbal behavior to children with autism spectrum disorder published from July 2015 through June 2017

How identified:
- Database from Petursdottir & Devine (under review)
- PsycINFO search for 2017 using verbal operant search terms
- PsycINFO search using other keywords related to commonly addressed topics in studies already identified

Excluded:
- Studies in which no participants had ASD diagnoses
- Studies in which the primary focus was reduction of problem behavior
- Studies in which the primary focus was on staff training
- Studies that focused on listener behavior exclusively
- Studies that focused on textual behavior exclusively
- Studies published in languages other than English
- Studies for which full text could not be accessed
Studies Identified

TOTAL OF 70 ARTICLES!

Themes:
1. Establishing functional vocalizations and improving echoic repertoires (3)
2. Selecting appropriate mand modality (5)
3. Establishing mands for preferred items (6)
4. Promoting variability in the form of manding (5)
5. Decreasing high rates of manding (3)
6. Teaching mands for information (4)
7. Procedural variables in tact and intraverbal instruction (8)
8. Establishing complex stimulus control over intraverbals and tacts (7)
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11. Teaching conversation skills (4)
12. The PEAK® curriculum (14)

*One article counted twice because two experiments addressed different themes*
Increasing Vocalizations and Establishing Echoic Repertoires

How can we promote vocal development and establish echoic responding in children who do not have vocal echoic repertoires or any vocal communication?

• Differential reinforcement and shaping of vocalizations (e.g., Lovaas, Berberich, Perloff, & Schaeffer, 1966; see also Lovaas, 2003)

• Stimulus-stimulus pairing to induce novel types of vocalizations (e.g., Esch, Carr, & Grow, 2009)

• Lag reinforcement schedules to increase variability of vocalizations (Koehler-Platten, Grow, Schulze, & Bertoni, 2014)

• Teaching manding (and other verbal behavior) using an augmentative or alternative (AAC) communication system (e.g., Tincani, Crozier, & Alazetta, 2006)

Recent research on establishing functional vocalizations and improving echoic repertoires

New studies on establishing functional vocalizations and improving echoic repertoires:


Several studies have shown increases in vocalizations when children begin to use AAC systems

- PECS (e.g., Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Greenberg, Tomaino, & Charlop, 2014; Tincani et al., 2006)
- Speech-generating devices (SDGs; Roche et al., 2014; Sigafoos et al., 2011)

Participants in this study were four boys (4–7 years) diagnosed with severe ASD who did not communicate vocally and had minimal echoic repertoires; all had prior experience using SDGs to mand for preferred items.

Could differential reinforcement increase vocalizations alongside or in place of SDG mands?

Application: GoTalk Now on iPad or iPad Mini

- Screen had one large button with photograph of preferred item (one item for each child)

Independent vocalization: Target vocalization emitted without therapist prompt during an instructional trial

Vocal initiation: Independent target vocalizations that occurred before the SDG speech output

- Potential mands
Baseline:

- SDG response with or without vocalization
- Immediate delivery of preferred item
- Vocalization alone
- No consequence

No vocalizations or low levels of vocalizing

Phase 1:

- FULL target vocalization with or without SGD response
- Immediate delivery of preferred item
- Vocal approximation + SGD response
- Preferred item delivered after 5-s delay
- SGD response without vocalization

Two participants’ independent vocalizations increased to mastery and vocal initiation began
- Approximations only

Two participants’ vocalizations did not increase from baseline
Phase 1:

- FULL target vocalization with or without SGD response
- Vocal approximation + SGD response
- SGD response without vocalization

Two participants’ independent vocalizations increased to mastery and vocal initiation began
- Approximations only

Two participants’ vocalizations did not increase from baseline

Phase 2 (remaining two participants):

- FULL target vocalization with or without SGD response
- Vocal approximation + SGD response
- SGD response without vocalization
- Prompted vocalization
- Preferred item

One participant’s independent vocalizations increased to high levels that were maintained after prompts were withdrawn in a return to Phase 1, and vocal initiation began

The other participant’s independent vocalizations remained at low levels and there were no vocal initiations, but he made many prompted vocalizations in Phase 2 and articulation improved
The vocal initiations (3 of 4 participants) occurred in a minority of trials but occurred reliably
• Also in generalization probes conducted without the SDG
• Potential mands, although EO control was not verified

In conclusion, the SDG did not automatically increase vocalizations (baseline), but it did so when a reinforcement contingency was placed on vocalizations
• Pairing of preferred item with its name contingent on SGD response (baseline) was not sufficient to increase vocalizations
• Response-contingent stimulus-stimulus pairing (Lepper & Petursdottir, accepted)

No prompting or vocal modeling by a therapist required for two participants

Cividini-Motta et al (2017): Compared the effects of three teaching procedures on echoic responding
• Vocal imitation training (differential reinforcement of echoic responses)
• Mand-model (“What do you want?” + prompt delay + differential reinforcement of echoic or independent vocalizations appropriate to a particular reinforcer)
• Stimulus-stimulus pairing (therapist vocalizations paired with delivery of preferred items; no response requirement and echoic control not addressed directly)

Five of six participants began to vocalize some or all target sounds during teaching sessions and showed evidence of echoic control

Most effective procedure varied across participants and all three were equally often identified as “best.”
Choi et al. (2015):
- Participants in this study (two experiments) communicated vocally but echoic repertoires were “inexact”

- Auditory matching-to-sample protocol (1) listen to a sample auditory stimulus, (2) listen to two auditory comparisons, (3) pick the comparison that matches the sample
  - Complexity increased across phases from single words (e.g., “plate” vs. “eight”) to short phrases (e.g., “my best friend” vs. “your best friend”) to long, uncommon words (e.g., “thermoplastic”)

- Accuracy of echoic responses (common words, foreign words, long and uncommon words) improved for all participants
  - As did responses to spoken instructions presented with visual distractors

Other Studies

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Selecting Mand Modality

Recent research on selecting mand modality


18 participants (age, 4 to 6 years) with developmental disabilities and language delays

- 10 had ASD diagnoses along with mild to severe intellectual disability
- 14 were receiving functional communication training (FCT) as treatment for problem behavior; reinforcer selected based on functional analysis of problem behavior
- 4 received similar mand training unrelated to problem behavior; reinforcer selected based on preference assessment

Ringdahl et al. (2016)

Identified two potential mand topographies for each participant that they could perform with similar proficiency, for example

- Vocal
- Manual sign
- Card touch
- Microswitch press

Topographies initially taught in separate sessions

Assessed preference by making both mand topographies available simultaneously and reinforcing both
All participants demonstrated a preference for one of the two mand modalities

Modality preferences varied across participants
• Vocal mands were evaluated with 5 participants and preferred by 4
• Other modalities were each preferred by about half of the participants who experienced them

Individual preference should be assessed when selecting mand modality
Three studies compared manding via picture exchange and SGDs:

- Agius and Vance (2016); three preschoolers diagnosed with ASD successfully acquired requesting via PECS and an iPad-based SGD, but SGD communication took longer to teach; preference probes were inconclusive
- Lorah (2016); seven school-aged children with ASD and Down syndrome; equal acquisition and fidelity of use by teachers; participants and teachers more likely to prefer the iPad-based SGD to PECS
- Torelli et al. (2016); 4-year-old boy with ASD and his parents preferred iPad-based SGD to GoTalk® SGD and picture exchange during functional communication training; all were similarly effective at establishing mands and reducing aggression across escape and tangible functions

Achmadi et al. (2015); social validity study; undergraduates rated intelligibility and acceptability of SGD communication higher than picture exchange and manual signing

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Establishing Mands for Preferred Items

Recent research on establishing mands for preferred items


Does the incorporation of video modeling into mand training trials enhance mand acquisition?

Successful previous demonstration of video modeling to teach manding (Plavnick & Ferreri, 2011) followed up by comparison with a training procedure that did not require video preparation.

Four children (2-3 years) diagnosed with ASD; no vocal communication and limited echoic repertoires.

Targeted vocal mands for preferred items and activities.

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**In vivo condition**

1. Establishing operation contrived by placing preferred item out of reach or giving the child only a part of the items needed to complete an activity
2. Progressive prompt delay: 3, 5, and 10 s
3. 15-s access to item following prompted vocal response, 30-s access following unprompted response

**Video modeling condition**

1. Video clip shows child manding for the participant’s preferred item and mand reinforced
2. Establishing operation contrived
3. 30-s access to item following unprompted response
4. No prompt or other consequence if no or incorrect response
5. Video model faded after 3 consecutive correct mands, by delaying its presentation for 3, 5, and 10 s after contriving establishing operation
Plavnick & Vitale (2016)

All participants mastered more mands in the video modeling condition. Role of differential reinforcement and prompt-fading procedures? Training time and total trials not reported.

FIGURE

Other studies

Thiemann-Bourque et al. (2016) taught four children to use PECS to initiate communication with peers using prompts, prompt-fading, and peer training
• PECS previously mastered at level III, IV, or V
• Peers were same-age typically developing children
• All participants learned to initiate communication with peers
• Peers’ spontaneous initiations to the participants with ASD also increased

McDonald et al. (2015): A 6-year-old boy with ASD had mastered PECS Phase IV but did not approach PECS book or initiate PECS communication spontaneously; a fixed-interval prompting procedure produced an increase in spontaneous PECS use.
Still et al. (2016) taught participants to mand for needed items using picture selection on a touchscreen computer, and then to:

(a) select each picture given its dictated name, and
(b) select the printed name of each item given its dictated name

10 of 11 participants (children, 3-12 years, ASD) subsequently mandated for the missing items by selecting their printed names.

Yosick et al. (2016) evaluated the effects of behavioral intervention mean length of utterance (MLU) in vocal manding, using retrospective analysis of existing data on 30 children whose MLU had been targeted for intervention. MLU increased with intervention; the effect was strong for a majority of the participants.

Pence and St. Peter (2015) evaluated the effects of treatment integrity on vocal mand acquisition in two experiments; 3 of 6 participants had ASD diagnoses:

- Taught to use nonsense names to mand for preferred toys
- Mand acquisition was slower in conditions with programmed treatment integrity lapses, such as intermittent delivery of incorrect toy or response-independent delivery of toy
- These lapses represent events that may occur commonly in home and other non-treatment settings.
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Promoting Variability in the Form of Manding

Why is variability in the form of manding beneficial?

Invariant mand topographies may reduce access to reinforcement in the natural environment

Multiple appropriate mand topographies for the same reinforcers may prevent resurgence of disruptive, previously extinguished mand topographies when reinforcement is delayed or omitted
Recent research on promoting mand variability


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**Drasgow et al. (2016)**

Will teaching children to alternate between two mand forms prevent resurgence to pre-existing mands when the newly acquired mands are not reinforced immediately?

Three children with ASD (3-4 years); ASD in severe range; no vocal communication; no AAC communication; manded for items and activities by leading and reaching

Taught to emit signed mands corresponding to “please” and “more” to access a variety of highly preferred foods

Assessed mand forms that occurred under (a) immediate reinforcement and (b) 6-7 s delay to reinforcement, following which first mand was reinforced
In delayed-reinforcement trials, participants were taught to substitute “please” when “more” did not produce reinforcement and vice versa.

What happened in delayed-reinforcement trials when the first response was not reinforced?
Drasgow et al. (2016)

What happened in delayed-reinforcement trials when the first response was not reinforced?

**FIGURE**

All participants successfully acquired the two mands and emitted them in the presence of novel social partners.

All participants learned to alternate between the two mands when the first mand emitted in a trial was not reinforced, but only two continued to alternate in the subsequent test condition:

- Generalization of alternation to novel social partners
- The third participant persisted in repeating the first mand ("more" or "please")

There was minimal resurgence of leading and reaching, even after only a single mand form had been taught:

- Brief delays to reinforcement
Chezan et al. (2016): Similar to Drasgow et al. (2016) but targeted negatively reinforced mands.

- Existing form: Pushing nonpreferred item away
- New forms: Picking up a rejection card, and shaking head
- Both participants learned both mand forms; one of two alternated between them in delayed test condition

Sellers et al. (2016) targeted variability in mand frames

- “I want . . .” (most participants’ default frame) vs. “May I have . . .”, “I would like . . .”, “Please give me . . .”
- Used textual scripts and script fading to teach three new frames simultaneously, as opposed to one by one (Betz et al., 2011)
- For 3 of 6 participants, there was increased variability in mand frames when all forms were reinforced
- For 2 additional participants, variability increased when extinction was implemented for repeating a mand form within a session

Brodhead et al. (2016) also used textual scripts and script-fading to teach three new mand frames

- Lag 2 or 3 reinforcement schedule vs. “no vary” condition in which only the default mand was reinforced
- Varied responding consisted in the presence of discriminative stimuli (colored placemats) that signaled these contingencies, even when all response forms were reinforced

FIGURE
Adami et al. (2017) also found increased variability in mand forms under a Lag 1 schedule of reinforcement compared to when all mand forms were reinforced

- Context: Functional Communication Training
- Functionally equivalent problem behavior not affected

**Other Studies**

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Decreasing High Rates of Manding

Mands sometimes occur at impractically high rates

High-rate reinforcement may be impossible or carry health risk

Recent research on decreasing high rates of manding


Several previous studies have evaluated the effects of *multiple* schedules to decrease rates of manding.

In a study on typically developing pre-schoolers’ mands for teacher attention, Tiger, Hanley & Heal (2006) compared two variations of multiple-schedule arrangements:

- Discrete stimuli signaling both reinforcement and extinction (S+/S- condition) vs. reinforcement only (S+).
- Both variations reduced rates of manding more effectively than a *mixed* schedule, but participants preferred the S+ variation.

This study was a replication of Tiger et al. (2006) with two adolescents diagnosed with ASD using PECS to mand for preferred edibles:

- Schedule-correlated stimuli were colored pages placed under communication page in PECS binder.
In all conditions, schedule components in each session alternated randomly across reinforcement and extinction for 15, 30, or 45 s.

All mands reinforced during reinforcement (FR 1)

Communication icon replaced in book during extinction

Reinforcement 15 s
Extinction 30 s
Reinforcement 45 s
Extinction 15 s
Extinction 45 s
Reinforcement 30 s

3-min session

Order within sessions equated across conditions

Landa & Hanley (2016)

FIGURE
Landa & Hanley (2016)

The S+ only arrangement was the only one that produced discriminated manding for Jack, and produced the highest level of discrimination for Max.

For Max, the schedule was thinned to 1 min of reinforcement to 30 min of extinction while manding remained low (no data on problem behavior).

Supports signaling periods of availability of reinforcement for manding, but may not support requiring a discrimination between discrete signals for availability and unavailability.

Did not include a S- only condition (signaling unavailability but not availability).

Other Studies

Chezan et al. (2016) and Vladescu and Kodak (2016) also evaluated multiple-schedule arrangements.

Chezan et al. (2016) achieved discriminated manding of two participants under an S+/S- signaling arrangement; successfully increased extinction duration while providing alternative activities during the S-.

Vladescu and Kodak (2016) used naturalistic activities (adult working, talking on phone, attending to baby doll) + a verbal rule to signal extinction under an S- arrangement; achieved discriminated manding across all S- stimuli and successfully increased extinction duration.
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Teaching Mands for Information

Sometimes the reinforce for a mand is verbally provided information

May take the form of wh-questions or a more general request (e.g., “I don’t know, please tell me”; e.g., Ingvarsson & Hollobaugh, 2010)
A mand under the functional control of a condition (EO) that renders information valuable (because in the presence of the information, effective action is possible)

EO1: The drawer is locked (renders key valuable)
EO2: Location of key is unknown (renders information valuable)

[Plus a third EO that renders contents of drawer valuable!]

R1: “Where is they key?” [mand]
S*: “It is hanging on a nail on the wall by the back door”
R2: Go to back door and retrieve key [listener response]
S*: Access to contents of drawer

What if you have no need for the content of the drawer? What if the drawer is unlocked? What if you already know where the key is? These abolishing operations should decrease the probability of manding for information.

To verify that you have truly taught an MFI, you need to demonstrate that it occurs more under EO than AO conditions
Recent research on teaching mands for information


Landa et al. (2017)

A previous study (Shillingsburg et al., 2011) demonstrated a procedure for teaching children to mand “when?” but did not include a conclusive demonstration of functional control by a relevant EO; Landa et al. (2017) addressed that limitation.

Three children (6-7 years) diagnosed with ASD; two had some other mands for information (“What?” “Who?” “Which?”) in their repertoires and one did not.

Target behavior was asking “When?” when a mand for a preferred item was denied with statements like “Not right now” or “You can have that later”
The consequence for asking “When?” was a contingency-specifying statement such as “After you wash your hands.”

Prior to teaching the “When?” mand, participants were taught to respond to the contingency-specifying statements by completing the task.

<table>
<thead>
<tr>
<th>Chips visible but out of reach</th>
<th>May I have chips?</th>
<th>Not right now; after you put away your toys</th>
<th>Put away toys</th>
<th>May I have chips?</th>
<th>Access to chips for 30 s</th>
</tr>
</thead>
</table>

EO present “When” instructional trials:

<table>
<thead>
<tr>
<th>Chips visible but out of reach</th>
<th>May I have chips?</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>May I have chips?</td>
<td>Access to chips for 30 s</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Teaching via prompt delay (0, 1, 3 s)

Textual or echoic prompts

If the participant correctly guessed and completed the behavioral requirement without asking “When?”, a subsequent mand was reinforced; however, this was unlikely to happen as there were five different behavior requirements.
Landa et al. (2017)

EO absent “When” instructional trials:

<table>
<thead>
<tr>
<th>Chips visible but out of reach</th>
<th>May I have chips?</th>
<th>Not right now; after you put away your toys</th>
<th>When?</th>
<th>After you put away your toys</th>
<th>Put away toys</th>
<th>Access to chips for 30 s</th>
<th>May I have chips?</th>
<th>Access to chips for 30 s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never prompted</td>
<td></td>
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</tr>
</tbody>
</table>

Landa et al. (2017)

FIGURE
All three participants acquired the “When?” mand and emitted them exclusively or almost exclusively in EO present trials.

Only after acquiring this mand were participants able to complete the behavior requirement and successfully mand for the reinforcer in EO present trials.

In baseline, mands for the item (“May I have chips?”) persisted after the request was denied in EO present trials; learning to mand “When?” decreased this inappropriate manding.

Did not include information that was actually related to time
Shillingsburg, Gayman et al. (2016) used textual prompts to teach “Who?” mands for information to four children with ASD; all participants successfully acquired the target response and emitted it in EO present but not EO absent trials.

Shillingsburg, Frampton et al. (2016) taught two children with ASD to mand for social information.

Carnett & Ingvarsson (2016) taught an 11-year-old boy to type “I don’t know, please tell me” into an SGD when asked a question to which he did not know the answer. He acquired the response, emitted it only in response to unknown questions, and ultimately learned to answer the previously unknown questions.
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Procedural Variables in Tact and Intraverbal Instruction

New tacts and intraverbials are often taught in discrete-trial format

Tacts and intraverbals are often used as acquisition targets in research on procedural variables in discrete-trial instruction

In the next group of studies, some address variables that may be generally applicable to teaching many skills; others address variables more specific to teaching tacts and intraverbals
Recent research on procedural variables in tact and intraverbal instruction


Cariveau et al. (2016)

Evaluated the effects of
- massed vs. varied instructional trials
- intertrial interval duration
on acquisition of tacts and intraverbals

Two children (7 and 9 years) diagnosed with ASD

Instructional targets were animal sound intraverbals for one participants and novel tacts (kitchen items) for the other
- 24 unmastered targets assigned to 6 conditions
- Taught using progressive prompt delay with terminal value of 10-s, and differential reinforcement of unprompted responses after the first unprompted correct response
Cariveau et al. (2016)

Massed trials condition:
The same instructional target presented in all nine trials within a session

Varied trials condition:
Three instructional targets presented three times each within each session; no target presented more than two times consecutively

Short ITI: Each trial initiated 2 s after end of reinforcement interval for previous trial
Long ITI: Each trial initiated 20 s after end of reinforcement interval for previous trial
Progressive ITI: Short ITI until 2 s prompt delay; then gradually increased until it reached 20 s
Varied trials generally produced faster acquisition than massed trials

- This effect was particularly pronounced when ITI was long

Overall, fast-paced instruction with varied targets produced the fastest acquisition

Generalization and maintenance varied across participants and targets with no consistent effect of condition or ITI

Boudreau et al. (2015) and Johnson et al. (2017) compared the effects of differential reinforcement procedures on acquisition of tacts and intraverbals

- Larger magnitude of reinforcement, higher quality reinforcement, or denser schedule of reinforcement (Johnson et al. only) for unprompted than prompted responses
- Also included nondifferential reinforcement conditions in which larger magnitude/higher quality/denser schedule was delivered for both unprompted and prompted responses
- Boudreau et al. (2015) found that participants acquired all target responses; no consistent effect of type of procedure, and nondifferential reinforcement was not detrimental
- Johnson et al. (2017) found that an assessment that identified the “best” procedure for teaching listener behavior predicted which procedure would produce fastest acquisition of future listener targets, but NOT tact or intraverbal targets
Majdalany et al. (2017) evaluated the effects of delays to reinforcement on tact acquisition. Delays as brief as 6 s were detrimental to acquisition for two of three participants.

Leaf et al. (2016) evaluated the effects of “multiple-alternative” prompts following error responses on tact acquisition
• E.g., “Is it a hammer, a drill, or a screwdriver?”
• Compared to conventional vocal prompt (e.g., “drill”)
• Trials to criterion and teaching time equal in both conditions
• Slightly better maintenance of tacts taught with multiple-alternative prompt

Vedora and Conant (2015) compared the efficacy of visual (tact or textual) prompts and echoic prompts on the intraverbal acquisition of three young adults diagnosed with ASD
• Fastest acquisition in echoic condition for one participant, textual for one participant, and equal in both conditions for one participant
• Possible role of instructional history (Coon & Miguel, 2012)

Cihon et al. (2017) found that the effectiveness of textual prompts when teaching intraverbals did not depend on the fluency of the textual response
Other Studies

Giunta-Fede et al. (2016) found that for 2 of 3 participants, collecting data on all responses during tact training was associated with faster acquisition than collecting first-trial data only; no differences in generalization or maintenance.

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Complex Stimulus Control over Tacts and Intraverbals

A simple tact or intraverbal involves a single response unit under the control of a single stimulus.

But often an appropriate verbal response is controlled by multiple stimuli present in the situation, or responses controlled by different stimuli must be emitted in rapid succession.

Examples:

(a) Subject-verb sentence construction (e.g., “the boy is jumping”) requires rapidly tacting multiple stimuli present in the situation in a specific order.

(b) A tact or an intraverbal response considered correct or appropriate in a situation may require control by multiple stimulus elements.

Recent research on establishing complex stimulus control over tacts and intraverbals


Targeted intraverbal responses to question pairs that required discrimination of verb alone vs. verb + “with”

- What do you sweep?
- What do you sweep with?
- What do you eat?
- What do you eat with?

Four children (6-8 years) diagnosed with ASD; had previously mastered a number of intraverbal programs, but had difficulty with questions requiring control by multiple stimuli

Evaluated the use of a blocked-trials procedure to establish discrimination

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Step 3 (Always presented first):
- First question presented until 5 consecutive correct responses
- Second question presented until 5 consecutive correct responses
- Advancement criterion: four consecutive errorless trial blocks

Step 4: Questions asked in counterbalanced blocks of 2 and 3 trials
- Advancement criterion: 15 consecutive correct responses

Step 5: Semi-random presentation
- Mastery criterion: 15 consecutive correct responses
Steps 1 and 2 conducted only if no success in Step 3 (one participant)

Step 1: Each question asked until 10 consecutive correct responses
  – Advancement criterion: Four consecutive trials blocks with no more than 2 errors

Step 2: Each question asked until 8 consecutive correct responses
  – Advancement criterion: Four consecutive trials blocks with no more than 1 error

*Ingvarsson et al. (2016)*
Ingvarsson et al. (2016)

Criterion-Level Probes

Two participants’ performance in Step 5 instruction with novel question pairs before and after the blocked-trials protocol was implemented.

Ingvarsson et al. (2016)

All participants acquired the target intraverbals with the blocked-trials procedure

- Remedial procedures were needed in some cases (e.g., inserting distractor trials between trial blocks in Step 5 to eliminate “win-stay” strategy)

Generalization to untrained targets was limited

However, two participants received post-training criterion-level (Step 5) probes with novel question pairs and no longer required blocked-trials to acquire them

- Limitation: Blocked-trials instruction may have continued longer than necessary for new question pairs
Haggar et al. (2017) replicated Ingvarsson et al. (2016) with criterion-level probes after each step of the blocked-trials procedure to determine the point at which blocked-trial instruction was no longer necessary.

- Two participants acquired all targets, and after the first discrimination was established, the full protocol was rarely necessary to teach additional discriminations.

Kisamore et al. (2016) also taught intraverbal responses that required control by multiple components of the verbal stimulus:

- What’s an animal that’s red?
- What’s an animal that’s yellow?
- What’s a vehicle that’s red?
- What’s a vehicle that’s yellow?

3 of 7 participants acquired all targets using a prompt delay plus error correction procedure.

4 participants required additional procedures that included differential observing responses and modifications of the prompt delay procedure.
Contreras & Betz (2016) addressed variability in intraverbal “listing” responses to category questions

- Participants exhibited rote responses such as always answering “cat, dog, pig” when asked “tell me some animals.”
  - Lacking supplemental sources of control that might promote variable responding
- For two of three participants, lag reinforcement schedules were sufficient to increase variability, and one participant also emitted novel responses without any additional instruction
- The third participant required training (prompt delay) to contact reinforcement under the lag contingency

Other Studies

Frampton et al. (2016) and Pauwels et al. (2015) evaluated the effects of matrix training on recombinative generalization when teaching children to emit phrases that required

- Tacting items and their relative location (Pauwels et al), e.g., “the strainer is to the right of the box”
- Tacting an actor performing an action (Frampton et al.), e.g., “cat jumping”

<table>
<thead>
<tr>
<th></th>
<th>Jump</th>
<th>Run</th>
<th>Sleep</th>
<th>Eat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat</td>
<td>TRAIN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>TRAIN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dog</td>
<td></td>
<td></td>
<td>TRAIN</td>
<td></td>
</tr>
<tr>
<td>Pig</td>
<td></td>
<td></td>
<td>TRAIN</td>
<td></td>
</tr>
</tbody>
</table>

Most participants in both studies showed recombinative generalization (white cells) after the first matrix was trained; the remainder did so after additional training

Frampton et al. also demonstrated generalization to matrixes in which no verbs or nouns had been trained
Conallen and Reed (2016) evaluated a procedure for teaching children with ASD to tact emotions using iconic picture cards

- 10 children who did not communicate vocally
- Taught to match situation cards to emotion cards and vice versa (selection-based tacts)
- Generalization to novel situation cards, and to selecting novel situation cards that matched their individual preferences when asked “What makes you happy?” etc.

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Other Studies

Studies Identified

TOTAL OF 70 ARTICLES!

Themes:
1. Establishing functional vocalizations and improving echoic repertoires (3)
2. Selecting appropriate mand modality (5)
3. Establishing mands for preferred items (6)
4. Promoting variability in the form of manding (5)
5. Decreasing high rates of manding (3)
6. Teaching mands for information (4)
7. Procedural variables in tact and intraverbal instruction (8)
8. Establishing complex stimulus control over intraverbals and tacts (7)
9. Emergence of untaught intraverbals and tacts (7)
10. Using instructive feedback to expand verbal repertoires (5)
11. Teaching conversation skills (4)
12. The PEAK® curriculum (14)
Emergence of Untaught Tacts and Intraverbals

Verbal or nonverbal stimuli evoke responses that have not been previously been reinforced, as a result of something else being taught

• Under which circumstances can we expect this to happen? Prerequisite skills?
• If emergent tacts or intraverbals are not observed, can we teach skills that promote emergence?

Recent research on the emergence of untaught tacts and intraverbals


Effects of listener and tact instruction on the emergence of bidirectional intraverbal relations

Six children (4-8 years) diagnosed with ASD, mostly at Level 2 on VB-MAPP

Examples of target relations:
- Who lives in the sea? / Where does a fish live?
- Who says woof? / What does a dog say?

Listener Training/Probes

“Who lives in the sea?”

[Not the actual stimuli used in the study]
Shillingsburg et al. (2017)

Tact Training/Probes

“Where does this one live?”

Intraverbal Training/Probes

“Where does a fish live?”

“Who lives in the sea?”

Taught sequentially
All participants showed some emergence of untrained intraverbal relations after tact training and/or listener training, and in a few cases the emergence of the second (reverse) intraverbal after the first was trained

- Across participants and stimulus sets, between 1/6 and 6/6 relations emerged without training

For three participants, no tacts or intraversals emerged for the first stimulus set until they were taught directly

- Began to emerge following listener and/or tact training when the procedure was repeated with additional sets

For three participants, some intraversals emerged following listener and/or tact training on the first set

- Two showed improvement across sets

Four participants also demonstrated some emergence of untrained intraversals on sets that had not been trained at all

Tact training was more likely to result in emergence of the intraverbal that shared a response form with the tact than the reverse intraverbal

“Where does this one live?”

“Where does a fish live?”
Listener training was more likely to result in the emergence of the intraverbal in which the response corresponded to a tact of the stimulus selected in listener training:

“Who lives in the sea?”

Smith et al. (2016) found that function/feature intraverbals emerged following listener training for 4 of 5 participants (age 5-15 years):

- Emerged for the 5th participant after probing procedure was modified

Cihon et al. (2017):

- Study 2 (one participant) found emergence of intraverbal questions about categories (e.g., “What are some vehicles?”) after the participant learned to tact items within a category to a fluency criterion.
Dickes & Kodak (2015) taught intraverbal responses to questions about opposites, functions, and animal sounds and assessed the emergence of reverse intraverbals

- All participants showed some, but limited, emergence of reverse intraverbals
- Directly training a subset of reverse intraverbals did not improve outcome of further training of original intraverbals

Other Studies

Frampton et al. (2017) investigated the relative efficiency of listener training and tact training for establishing both tacts and listener behavior

- Tact training was more efficient than listener behavior for 6 of 8 participants
- Tact training and listener training were equivalent for 2 of 8 participants

Olaff et al. (2017) found that after multiple-exemplar training, there was increased emergence of tacts and listener relations performing an identity matching task with novel objects while echoing their names
Lee et al. (2015) replicated a previous study by Kobari-Wright and Miguel on the effects of listener training on tact emergence and nonverbal categorization

- Two participants who passed the test for emergent category tacts were also able to nonverbally match stimuli from the same category
- Two participants failed both tests; these participants had substantially lower scores on standardized language assessment (24-30 months, compared to 45-65 months)

Studies Identified

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What is Instructive Feedback?

A discrete trial consists of the presentation of

- a stimulus: *Intended to acquire discriminative control over target response*
- a response: *Well-defined target response*
- a consequence: *Praise (+ tangible item or token) or response to error (e.g., prompt)*

Instructive feedback refers to incorporating information that is extraneous to the target operant into some portion of the instructional trial.

Recent research on instructive feedback


Therapist: What is this?
Student: A cat
Therapist: That’s right! And a cat says meow.

Instructive feedback in antecedent portion of trial:
Therapist: A cow says moo, but a cat says what?
Student: Meow
Therapist: That’s right!
What is Instructive Feedback?

Has been around for a long time (e.g., Gast et al., 1994; Wolery et al., 1991),

Research has only recently begun to extend previous findings to discrete-trials instruction with children diagnosed with ASD (e.g., Reichow & Wolery, 2011; Vladiescu & Kodak, 2013)

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Nottingham et al. (2017)

Incorporating multiple IF stimuli into a single trial

Two children (5 and 8 years) with ASD diagnoses

Primary and secondary targets were unknown tacts (e.g., mango, pinecone, hammock)

Secondary tacts tested at the beginning of each instructional session without feedback or reinforcement

Four instructional conditions:
- No secondary targets
- IF stimulus in consequence portion of trial
- Two IF stimuli in consequence portion of trial
- One IF stimulus in the consequence and one in the antecedent portion of the trial
- No-instruction control
Nottingham et al. (2017)

Similar results for both participants

Including secondary targets did not interfere with acquisition of primary target

Kelly acquired all three secondary targets and Simon acquired 5 of 6 secondary targets without instruction

No systematic differences between conditions

FIGURE

By incorporating secondary targets into instructional trials, more can be taught in less time

• Does not have to be in the form of “feedback” (i.e., consequence portion)

• OK to include information on two secondary targets in the same trial

• Consistent with other studies on instructive feedback

FIGURE
Tullis et al. (2017) used instructive feedback in the consequence portion of trials to teach problem explanations to children with ASD

- Primary target was the selection of a picture card depicting a “problem” from an array of cards (e.g., “Show me the problem”)
- Secondary target was stating why the scenario depicted in the picture was a problem.
- Probed every two treatment sessions under extinction (“Why is this a problem?”) and trained if not acquired with IF alone
- One participant acquired all secondary targets with IF alone; the other two required direct training on first set but not on the others

Leaf et al. (2017): Implementation of IF during group instruction

- Nine participants (age 4 to 7 years) with ASD diagnoses but normal IQ and age-appropriate language skills
- Primary targets were tacts of comic book characters and professional basketball players; secondary targets were information on hero’s superpower or player’s team
- Instructed in groups of 3 children, trials delivered to one child at a time while others observed
- Participants acquired both primary and secondary targets
- Also acquired observational primary and secondary targets (those taught to other members of their group)
Haq et al. (2017): What explains acquisition of the secondary target?

• Is it related to participant behavior during instructive feedback?
• Tacts were primary and secondary targets for one participant; preliminary evidence that attending to the visual stimulus was related to secondary target acquisition
• Intraverbals were primary and secondary targets for another participant; no evidence that echoing IF stimulus was related to secondary target acquisition

Future research might take a closer look at prerequisites from benefitting from instructive feedback.

Carroll & Kodak (2015) used instructive feedback to increase variability of intraverbal “listing” responses

• Similar to Contreras & Betz (2016), participants exhibited rote responses to category questions
• Instructive feedback consisted of modeling additional response options after a correct response (e.g., “Pink, orange, and green are colors too”)
• Both participants’ novel response combinations and novel responses increased as a result of IF
• Effect was limited to previously untaught categories for one participant, and to previously mastered categories for the other
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Teaching Conversation Skills

Conversation involves complex verbal interchanges between speaker and listener.

Individuals diagnosed with ASD may present with difficulties in this area in spite of fluent verbal repertoires; for example
• Initiating conversation
• Responding appropriately to conversation initiations
• Sensitivity to conversation partners’ interests
Recent research on teaching conversation skills


Some individuals with autism are easily engaged in conversation but tend to perseverate on conversation topics that do not interest their listeners

• E.g., circumscribed interests (Klin, Danovitch, Merz, & Volkmar, 2007).

The goal of this study was to teach children to respond appropriately to their conversation partner’s interest in the conversation
10 children (5-9 years) diagnosed with ASD participated in two experiments

Participants were first taught to tact “interested” and “uninterested” listener behavior based on facial expressions and body posture

Participants in Experiment 1 were next taught to respond to an uninterested listener by asking the listener a question, using Behavioral Skills Training

Participants in Experiment 2 were additionally taught to respond by changing the conversation topic

Conversation probes (up to 15 min):
- Experimenter initiated with an open-ended question (e.g., “What have you been up to?”)
- Experimenter engaged as an interested listener by asking and answering questions and commenting
- Experimenter behaved as an uninterested listener for up to 10 s at a time in response to certain participant behavior, for example
  - speaking for a long time without letting experimenter speak
  - providing excessive detail
  - reintroducing a topic already exhausted in the conversation
- Experimenter began to behave as interested again if participant responded appropriately to disinterest
- Ended after 5 opportunities to respond to uninterested listener
FIGURE

FIGURE
All participants acquired the target tacts, but this was not sufficient to alter their responses to a disinterested listener.

All participants successfully learned to respond to disinterest when this was directly taught.

In Experiment 3, four participants from Experiment 2 were successfully taught to switch to the alternative strategy (asking a question or changing the topic) if the first strategy failed to re-engage the listener.

Blind raters watched pre- and posttraining videos from conversation probes procedures and found differences in the quality of conversation.

Lepper et al. (2017) used lag reinforcement contingencies to shift two older children’s (11-12 years) conversation topics away from perseveration on circumscribed interests (CIs).

- A functional analysis demonstrated sensitivity of conversation to attention as a consequence.
- All participants had several CIs that dominated conversation with experimenter in baseline, when attention was provided at the end of every 10-s interval in which the participant talked.
- Attention was provided at the end of intervals in which the participant made statements related to a non-recent topic (Lag 1 or Lag 2 contingency), regardless of whether it was a CI topic or not.
- Both participants increased CI-unrelated and decreased CI-related talk.
Conallen and Reed (2017) successfully taught children to initiate conversation by describing their feelings about an activity or an event (e.g., “I like coloring”), using PECS.

Mason et al. (2015) taught one child and two adolescents with ASD to ask questions of previously unknown visitors and report information about the visitor back to another person who inquired about the visitor.

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### Other Studies

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### Studies Identified

*TOTAL OF 70 ARTICLES*

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The PEAK® Curriculum

Developed by Mark Dixon (see www.peakaba.com)

“The PEAK Relational Training System is an evaluation and curriculum guide for teaching basic and advanced language skills from a contemporary behavior analytic approach” (www.peakaba.com)

Four modules:
- Direct Training
- Generalization
- Equivalence
- Transformation

Recent research on the PEAK® curriculum


Recent research on the PEAK® curriculum


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**Dixon et al. (2017)**

PEAK-E curricular program 14B: “Equivalence: Categories with Lag”

- Participants were school-age children (8-9 years) diagnosed with ASD who did not perform correctly on this item in the PEAK-E assessment

Program involved teaching participants to

- match visual stimuli belonging to the same category (e.g., colors; math symbols; musical notes)
- respond as listener to each verbal category label (e.g., “Which is a math symbol?”) by selecting a category member (taught with only one member of each category)

Categorization probes assessed listener responses to category labels with all stimuli

Intraverbal probes assessed responses to questions about category members, such as “What is an example of a color?”
McKeel et al. (2015) conducted a randomized controlled trial with 27 participants (age, 5-19 years) to evaluate effects of instruction using the PEAK-DT module

- Treatment group received instruction on five programs from the PEAK-DT module, while control group received standard special education
- Treatment group showed significant pre-post gains on PEAK-DT assessment; control group did not improve
  - Gains were not influenced by pretest scores, or by standard language assessment scores
- Did not assess effect on other measures
Other Studies

Eight additional studies evaluated other programs in the PEAK curriculum and produced positive results.

Four studies obtained normative data or evaluated psychometric properties of the PEAK system.

A great resource you should know about. . .

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DISCUSSION/REVIEW ARTICLE


Sarah A. Lechago1 · Rachel E. Jackson1 · Fernanda S. Oda1
Other References Cited


Other References Cited


