Multiple Control

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Introductory Remarks

- Experimental analysis vs. application.
  - Science proceeds by isolating variables of interest and controlling everything else:
    - E.g., mass, velocity, angular momentum, & friction.
    - E.g., temporal contiguity, deprivation, & contingencies of reinforcement
  - In the “real world” all the variables come together again.
  - In applied settings, and in the interpretation of everyday behavior, we must consider the vast complexity, not only of many variables together, but the interactions among those variables.
  - As Newton himself remarked regarding gravitation, the complexity of relations among just a few objects in space can be staggering.
  - The complexity in behavior arising from multiple control is equally daunting. Skinner devoted much of his book on verbal behavior to the topic.

MacCorquodale on Chomsky

- [Chomsky’s] review completely ignored much that is central to an understanding, application and assessment of Skinner's position. Most importantly it failed to reflect Skinner's repeated insistence that the full adequacy of his explanatory apparatus for complex cases, including verbal behavior, cannot be assessed unless the possibilities for interaction among its several controlling variables acting concurrently were realized; this is what is different between the laboratory and the real world. In the laboratory, variables are made to act “one at a time”, for all practical purposes. The real world simply puts the environment back together again. Multiple causality is never mentioned in the review; it is mentioned throughout Verbal Behavior. (p. 98)

Thus the task of interpreting verbal behavior in everyday settings almost always requires that we look a the effects of many variables and their interactions.

Education often begins with elementary control but even in children with limited repertoires we need to examine the role of multiple variables in both speaking and listening.

[See Michael, Palmer, & Sundberg (2011) for an overview.]

Multiple Control

- Skinner’s analysis of multiple control (Verbal Behavior, Chapters 9-11) has important implications for language assessment and intervention for children with autism
- “Verbal behavior is usually the effect of multiple causes” (Skinner, 1957, p. 10)
- The same can be said for nonverbal behavior such as functional living skills (self-care, household chores) and vocational skills (e.g., busing a table, greeting a customer), and for social behavior
- The term “discrete trial training” suggests single antecedents
- Multiple control can be a friend or a foe
- Understanding and using multiple control is a key element for assessment, and for intervention programs for children with autism
- Seven examples of the application of multiple control to teaching children with autism and other special education needs will be presented
- Establishing early verbal behavior
- Teaching more advanced types of verbal behavior
- Nonverbal behavior
- Social behavior
- Language and learning barriers created by multiple control
- Multiple exemplar instruction
- Using multiple control to establish response variation
Two Types of Multiple Control

- Skinner:
  - “Two facts emerge from our survey of the basic functional relations in verbal behavior:
    - (1) the strength of a single response may be, and usually is, a function of more than one variable and
    - (2) a single variable usually affects more than one response.”
  (1957, p. 227; formatting ours)

Convergent & Divergent Multiple Control (Michael)

- The conditions where the strength of a single verbal response is a function more than one variable can be identified as “convergent multiple control.”
- The conditions where a single variable affects the strength of more than just one response can be identified as “divergent multiple control”

Multiple Control

- Convergent multiple control
  - SD
  - SD
  - SD
  - MO
  - R

- Divergent multiple control
  - R
  - R
  - SD/MO

Convergent Multiple Control: Discrimination and Generalization

- Reinforcement strengthens behavior in a context:
  - S₁
  - S₂
  - S₃
  - lever press → food
  - S₈

Result: Lever press more likely in presence of stimuli S₁ – S₈
That is, the sight of the lever, the smell of the chamber, the sound of the white noise generator, the feel of the cardboard liner below its feet, etc.
Discrimination Training

- Reinforcement restricted to a single element:
  \[ S_1, S_2, S_3, \ldots, S_N \] (red light) \( \rightarrow \) Lever press \( \rightarrow \) No food

Lever press more likely only in presence of red light. The rest of the stimuli in the chamber have been present for both reinforcement and extinction, and lose control relative to the red light.

In the absence of discrimination training a response tends to be multiply controlled.

- Examples:
  - Overgeneralization:
    - Young child calls all dogs *Rover*.
  - Appropriate generalization:
    - Child calls all dogs *dog*.
    - *Rover* controlled by size, color, snout length, location, hair length, etc.
  - Multiple control is apparent in both cases:
    - Natural categories tend to have many correlated features, all of which participate in controlling a response.
    - Even discrimination training usually leads to control by multiple features of a "concept" such as *dog, cat, house, friend, paper*.
  - "Single" control rare: *blue, do-re-mi, anise, etc.*

How to get someone to say “pencil” (Skinner, 1957)

To strengthen a [response] of this form, we could make sure that no pencil or writing instrument is available, then hand our subject a pad of paper appropriate to pencil sketching, and offer him a handsome reward for a recognizable picture of a cat … Simultaneously we could strengthen other responses of the same form by providing echoic stimuli (a phonograph in the background occasionally says pencil) and textual stimuli (signs on the wall read PENCIL). We scatter other verbal stimuli among these to produce intraverbal responses: the phonograph occasionally says pen and … and there are other signs reading PEN AND, … We set up an occasion for a tact with the form pencil by putting a very large or unusual pencil in an unusual place clearly in sight—say, half submerged in a large aquarium or floating freely in the air near the ceiling of the room. We indicate our own audience-character as an English-speaking person by the simple device of speaking English. Under such circumstances it is highly probable that our subject will say pencil. (pp. 253-254)

Convergent Multiple Control

- MO: reward offered for drawing
- Auditory verbal SD “pencil”
- Textual SD: PENCIL
- Auditory verbal SD–“pen and …”
- Conspicuous unusual pencil
- Speaker says “pencil”
- “pencil” strengthened by both stimuli.
- Other person speaking English

Interaction of Types of Control

- Suppose we point to a green croquet ball and ask a child, “What color is it?”
- The verbal stimulus color will tend to evoke a variety of intraverbal responses, such as blue, green, orange.
- The object will tend to evoke a variety of tacts, such as round, hard, ball, green.
- “Green” will be strengthened by both stimuli.
- (Here we speak of joint control.)

Origins of Divergent Multiple Control

A single object, event, or condition may enter into many contingencies:

We throw frisbees, balls and sticks for Rover; we feed him, pet him, call him, teach him to heel, take him for walks, etc. All of these contingencies call for different response topographies.
Convergence of intraverbal and tact differentially strengthens “green.”

Audience Control
- A nurse may refer to an injury as a “bruise” to a patient and as a “contusion” to a doctor.
- Even this simple case illustrates highly complex interactions of variables.

Audience Relation
- Nurse’s tact of discoloration on a child’s arm
- “bruise”
- remainder of nurse’s lay vocabulary
- “contusion”
- remainder of nurse’s medical vocabulary
- Convergent control–physician plus discoloration strengthens “contusion”
- Divergent control–physician as audience strengthens nurse’s entire medical vocabulary as well

Prompts and Probes, Formal and Thematic
- Skinner identified four types of procedures for strengthening weak behavior:
  - Formal prompts
  - Thematic prompts
  - Formal probes
  - Thematic probes
- They all illustrate multiple control and are effective because they do so.

Multiple Control
- Convergent multiple control can be observed in almost all instances of verbal and nonverbal behavior
- In convergent multiple control, more than one variable strengthens a response of a single topography
- Any type of antecedent event can participate
- verbal (e.g., mand, tact, intraverbal, autoclitic)
- nonverbal (e.g., visual, auditory, olfactory)
- public (e.g., verbal, nonverbal)
- private (e.g., pain, self-echoic, emotion, self-mand, imagery)
- S’ (verbal, nonverbal)
- MO (UMO, CMO, aversive, establishing, abative)
- US/CS (bright light, screeching sound, words)
- audience (professional, friends, strangers, non English speaking)
- contextual (settings, temperature, lights, décor)

Multiple Control: Applications to Intervention Programs
- Multiple sources of control can be additive
- A powerful tool for establishing new verbal and nonverbal skills
- Prompting, fading, & transfer of control
- Formal and thematic prompts have long been a staple of language intervention programs
- Formal: echoic, imitation, matching, copying a text
- Thematic: intraverbal, tact, motivating operations (MOs), textual
- Combinations and hierarchies
Multiple Control: Early Mand Training

Multiple Control: Early Intraverbal Training

Multiple Control: Applications to Nonverbal Behaviors
- Most functional living skills are (and often must be) multiply controlled, for example
  - self-care
  - dressing
  - eating
  - toileting
  - bathing
  - shopping
  - housekeeping and chores
  - meal preparation
  - laundry

Multiple Control: Transfer of Control Among the Verbal Operants
- Multiple control allows for any verbal operant to be used to establish a different verbal operant
- Tacts can be used to teach intraverbals
- Intraverbals can be used to teach tacts
- Mands can be used to teach tacts
- Tacts can be used to teach mands
- Textuals can be used to teach intraverbals
- And so on
- The emergence of “untrained” verbal operants is usually a function of multiple control (e.g., equivalence, naming, & relational frames)

Multiple Control: Applications to Social Behavior
- Most social behaviors are under multiple sources of control (e.g., greeting others, initiating a conversation, joint attention)
- There are many complicated behavioral repertoires that fall under the rubric of “social behavior” and most involve convergent and divergent multiple control
- Social behavior is comprised of at least three general repertoires:
  - Nonverbal repertoires
  - Verbal repertoires
  - Listener repertoires
- Social rules and etiquette are complex, vague, and constantly changing
- A functional analysis (in a Skinnerian sense) will almost always reveal multiple sources of control
Multiple Control: Applications to Social Behavior

- **Examples of Nonverbal Behaviors**
  - Each example usually involves multiple control
  - Proximity to others
  - Eye contact and visual tracking (gaze) of others
  - Dynamic speech properties (e.g., volume, tone, prosody)
  - Body posture, facial expressions, movement
  - Parallel play
  - Physical play
  - Cooperative play
  - Sharing and turn taking

- **Examples of Verbal Behaviors**
  - Mands to others
  - Initiation of interactions (mands, tacts)
  - Joint attention (mands)
  - Reciprocal conversations (mands, tacts, & intraverbals)
  - Mands for information
  - Tacting for the benefit of the listener
  - Intraverbal responding
  - Intraverbal content
  - Autoclitic mands and tacts
  - Appropriate self-editing

- **Examples of Listener Behaviors**
  - Attending to a speaker
  - Reinforcing speaker behavior (eye contact, head nods, smiles, shows empathy)
  - Responding to the mands of a speaker
  - Mediating reinforcement (bridging the speaker to the environment)
  - Serving as an audience for verbal behavior (someone who cares)
  - Minimal interruptions, disruptions, punishment, apathy, etc.
  - Personal MO/EOs controlled
  - Turn taking in the speaker/listener dyad

Multiple Control: Applications to Problematic Social Behavior

- Due to the complex nature of social behavior impairments are common for most people (even the extremely gregarious person may wear on social partners)
- It is critical to use an assessment tool that identifies the relevant multiple sources of control, and identifies barriers affecting the child
- Failing to initiate interactions
- Failing to make eye contact
- Failing to respond to the mands of peers
- Failing to make bids for joint attention
- Standing too close
- Changing the topic
- Implement an intervention program that establishes the relevant sources of control

Multiple Control: Applications to Social Behavior Using Multiple Exemplar Instruction

- Multiple Exemplar Instruction (MEI) is a type of multiple control (Greer & Ross, 2007). There are two general types
  - “The first type (also called general case teaching) is related to teaching...in which the irrelevant aspects of the stimulus or conglomerate of stimuli are rotated across positive exemplars....In addition, negative exemplars...are presented” (Convergent control)
  - “The second type involves...rotating different responses to a single stimulus” (Greer & Ross, 2007, p. 296). (Divergent control)
- MEI can be very effective in teaching a child “functionally correct” social skills
- And perhaps as important, when NOT to be social

Multiple Control: Applications to Social Behavior Using Multiple Exemplar Instruction

- For example, teaching a child about personal safety, a teacher may say, *Show me what you do when a stranger asks you to get in his car,* it is important that the target responses also be evoked by novel antecedent configurations of stimuli that might share fragments of the original antecedent conditions (Convergent control)
  - What if a stranger offers you money for a video game?
  - As well as other novel configurations (e.g., *hurt mother, fire at home*)
  - It is also important that the child be able to discriminate among situations that have NO particular threat (stranger walks by you)
  - The actual antecedent configuration that a child might encounter may contain a combination of novel variables along with the presence or absence of the primary source of control (i.e., a threat to safety).
Multiple Control: Applications to Social Behavior Using Multiple Exemplar Instruction

- Divergent multiple control is also a major component of establishing generative safety repertoires
- A single stimulus configuration should evoke different safety responses (e.g., saying no, screaming, running away, telling an adult)
- An actual threat to a child’s safety will also include additional sources of control that involve convergent and divergent control
- Respondent behaviors (increased heart rate)
- New reflexive EOs (an aversive stimulus has been created)
- Private events such as covert verbal behavior (e.g., self-mands to stay calm, tacts of the heart rate or situation, intraverbals regarding options)
- An intervention program that makes use of these types of multiple control can have a higher probability of being successful

Applications to Social Behavior: Summary

- Social behavior almost always involves multiple control
- Assessment and intervention programs must account for all the relevant sources of control
- Social behavior consists of a mixture of three complex behavioral repertoires: verbal, nonverbal, and listener
- Appropriate social skills can be difficult for typical children and adults
- Individuals with ASD have a particularly difficult time due to weakness in all three of the repertoires
- Specific and often complex training for the child is required
- However, too much adult driven training and an overdependence on adult interventions and antecedent and consequent control may impede the development of social behavior with peers

Divergent Multiple Control: Response Generalization

- Response variation
- Reinforce variation
- Prompt variation with multiple control
- Primary source the same, wide range of secondary sources
- Tact (nonverbal dog: Echoic “animal,” “Maggie,” “pet,” “puppy”)
- Mand (EO swing: Echoic “push,” “go,” “swing,” “zoom”)
- Listener (nonverbal banana: Verbal “eat,” “fruit” “yellow” “monkeys like”)
- Intraverbal (Verbal S0 “eat”: Nonverbal apple, banana, strawberry, hamburger)
- Fade secondary source of control
- Transfer control to the primary source (create response classes)

Stimulus Classes and Response Classes

- Verbal Antecedent: What has a tail?
- Array: Child touches the cat and says “cat”
- Response: “Cat”

The basic components of the intraverbal relation are present (“Tail” and “Cat”)
Simple task for transfer: 1) Fade out the picture of the cat
Target Intraverbal: “What has a tail?” → “Cat”
Multiple Control: Response Generalization

- Use other verbal operants as additional sources of control (prompts)
  - Tact & intraverbal (Nonverbal cat: Verbal “canine” “woof”) “Response priming”
  - Mand & tact (MO Hunger: Nonverbal golden arches, corner pizza person)
  - Mand & intraverbal (MO thirst: Verbal “Mountain Springs” “Silver Bullet”)
  - Intraverbal & tact (Verbal “eat”: Nonverbal apple, cookie, sandwich)
- Extinction can also produce response variation (extinction burst)
- Mand, tact, intraverbal, listener (scrolling)
  - (Show Sami video)

Multiple Verbal Stimuli with one Nonverbal Stimulus

- Multiple Ss
  - What is it?
  - What color is it?
  - What sound does it make?
  - What do you do with it?
  - What is it made out of?
  - What does it feel like?
  - Whose car is it?
  - Where is the car?
  - What size is the car?
  - Where do you park it?
  - How do you drive it?
  - Who drives this car?
- Single Nonverbal Stimulus
  - A Toy Car

Multiple Control as a Foe: Barriers to Analyze and Overcome

- Verbal and nonverbal problems can result from the unwanted presence of multiple control, AND the failure to establish the necessary types of multiple control
- Prompt dependency can occur with every verbal and nonverbal skill
  - position, eyes, lips, gesture, movement, audience, etc. (Derek video)
  - echoic (vocal S) (perhaps most common)
  - imitation (visual verbal S) (same as echoic for signers)
  - tact (nonverbal S) (e.g., manding for items that are present)
  - intraverbal (visual verbal S) (e.g., multiple choice test)
  - textual (written verbal S) (e.g., the current presentation)
- “we must be sure to take into account all relevant variables in making a prediction or in controlling behavior” (Skinner, 1957, p. 228)

Multiple Control as a Foe: Barriers to Analyze and Overcome

- Failing to establish the required sources of multiple control
- Most verbal and nonverbal behaviors are multiply controlled
  - Nonverbal
  - Most functional living skills are multiply controlled behaviors (e.g., dressing, eating, toileting, bathing, shopping)
- Relevance to assessment and intervention
  - Failing to account for multiple sources of control can produce inaccurate assessments, rote repertoires, and unforeseen problems
  - shoes off at the right time
  - eating your own food
  - dressing at the right time and in the right place
  - running water at the right time

Multiple Control as a Foe: Barriers to Analyze and Overcome

- Most advanced forms of verbal behavior require multiple control
- A common problem for a number of children with autism is answering questions about things, but the answer contains a noun that is inappropriately modified by a verb, adjective, preposition, etc. (although the form is correct) (e.g., “White airplane” “Wash hair” “In car”)
- Requires tact and intraverbal multiple sources of control
- What is tacted depends on what question is asked
- Conditional discrimination: “When the nature or extent of operant control by a stimulus condition depends on some other stimulus condition” (Michael, 1993, p. 14)
- One antecedent with multiple parts where one part alters another

Conditional Discrimination in Listener Skills

Verbal $S^i_1$ + Array ($S^j_a$) Nonverbal Response

- “Touch ball” + $S^A$ $S^D$ $S^A$ Select Ball
Multiple Control as a Foe: Barriers to Analyze and Overcome

- What is it?
- What color is it?
- What shape is it?
- What do you do with it?

Another common problem faced by children with autism is acquiring conversational skills and other skills involving intraverbal behavior.

Almost all intraverbal behavior involves convergent and divergent multiple control.

For example, answering the question, “Who did you see yesterday?” involves several different sources of control.

Can you identify them?

Some of these are verbal conditional discriminations.

Verbal Conditional Discriminations (VC\(D\)s)

- What constitutes a verbal conditional discrimination and an intraverbal response?
- Two components of a verbal stimulus where one verbal stimulus alters the evocative effect of the second verbal stimulus, and collectively they evoke a differential intraverbal response.
  - Antecedent: Big animal, Little animal, Big vehicle, Little vehicle
  - Verbal S\(D\)_1 + Verbal S\(D\)_2: Lion, Mouse, Boeing 747, A toy car
  - Intraverbal Response: "What grows on your head?" ... "Shoulders"
  - "What helps a flower grow?" ... "Up"
  - "Where do you eat?" ... "Food"
  - "What do you smell with?" ... "Poopies"
  - "What’s under a house?" ... "roof"
  - "What grows outside" ... "Sand"
  - "What shape are wheels?" ... "Triangle"

Implication for Intraverbal Intervention Programs

- Establish the individual words as intraverbals prior to combining them in a VC\(D\)s task (e.g., "grows" “head” “garden” “outside”).
- Don’t move from the nonverbal context (multiple control) too quickly.
- Always analyze errors and the sources of control. Back down the curriculum sequence if necessary.
- Be aware that a (rote) correct answer to a question may occur when the VC\(D\)s element is removed (e.g., all “What color” questions, or all “What shape” questions, or all “Where” questions). Mixed and rotated VB trials can solve that problem.
- Typically developing 3-year-olds emit 100s of intraverbal responses a day, thus there needs to be many trials for language delayed children.
Extensions to Complex Behavior

- Priming effects.
- Additivity of stimulus control
- Algebraic summation
- Exploitation in problem solving and recall
- Multiple control in humor, poetry, and literature.

The Additivity of Response Strength

- [It is likely that] any sample of verbal behavior will be a function of many variables operating at the same time. Any response under the control of one variable has a fair chance of being related to other variables also present. Now, it is a well-established principle in nonverbal behavior that separate sources of strength are additive. (Since some variables reduce the strength of verbal behavior, the addition must be algebraic.)

(Skinner, 1957, p. 228.)

Experimental Evidence from the Animal Lab

- Reflexes: (Sherrington, 1906)
- Conditioned reflexes (Pavlov, 1927)
- Operant behavior (Wolf, 1963)

Experimental Evidence from the Human Lab

Does a verbal stimulus alter the probability of an intraverbal response if that intraverbal response is not actually emitted? Surprisingly, the answer may be "Yes!"

Consider the following research on priming.

The "Semantic Priming" Procedure

- Two words are flashed on a screen in close succession.
- How fast we respond to the second is the dependent variable.
- Typical finding: If the words are intraverbally related, response latencies are reduced. That is, we respond more quickly.

A Typical Experimental Protocol

1) * * * * * (360 ms)
2) (360 ms)
3) (warning tone) (140 ms)
4) BREAD (250 ms)
5) dark (50 ms)
6) BUTTER (indefinite)
7) "0" or "1" (end of trial)
Typical Findings

- Response latencies to related words are lower than to unrelated words.
  - Bread, Butter
  - Lion, Tiger
  - Glove, Hat
  - Fruit, Pear

- But also: Category-Exemplar effects:
  - Fruit, Peach
  - Fruit, Banana
  - Fruit, Orange
  - Fruit, Apple

The first set of results demonstrates the additivity expected in convergent multiple control.
- Intraverbal control and textual control combine to yield a stronger response. That is, a faster response.

The second set of results illustrates divergent multiple control
- A single stimulus item increases the strength of a variety of different responses.
- Since the subject has no way of knowing which word is going to appear next, the effect must be simultaneous.

Implications of Priming

Since the decrease in latency is a measure of a change in response probability, the priming procedure seems to offer a way to indirectly evaluate the effect of a stimulus on the probability, not just of covert behavior, but of behavior that is not even emitted.

The Intraverbal Game

- State
- Mountain
- False teeth
- President
- Cherry tree
- Martha

Notice that no clue by itself is likely to evoke the response “Washington,” but the combined effect is very strong.

This illustrated the additivity of response strength.

Multiple Causation in Problem Solving and Recall:

Exploiting the Additivity of Response Strength

- We have a problem when a response in our repertoire is scheduled for reinforcement, but that response is not currently strong enough to be emitted.
- Problem solving: an acquired strategy of bringing additional variables to bear on the target response until the additive effect is sufficient to evoke the response.
- Analogous “strategies” are used to recall something.
A question posed to a graduate student, and her response:

Q: “The square root of 841 is an integer. What is it?”
A: “Well, it's less than 100.

50 times 50 is . . . 2500: It must be smaller than 50.
10 times 10 is 100, so it's bigger than 10.
20 times 20 . . . 400. Too small.
30 times 30 is 900. Oh!
It's between 20 and 30,
20-something, but twenty-what?
21? It might be 21.
22 . . . 23 . . . 24 . . . 25 . . .
It's close to 900, so it must be in the high 20s.
28 or 29?
28 times 28 would end in 4.
29 times 29 would end in 1.
It must be 29.”

Each prompt selectively strengthened the target response, while weakening others. The cumulative effect was to make the target response the strongest response in her repertoire at the moment, and it was emitted.

The following diagrams illustrate the process in a graphical way. With each successive prompt, the strength of the constellation of responses changes.

The “bottleneck” is a metaphor and should not be taken literally. It represents the fact that many responses are incompatible. Only one response at a time can be emitted (within the same response system).
Recall

Where were you on Sept. 21, 2011?

Well, let’s see, according to the calendar, the 21st was a Wednesday. I was teaching behavior analysis and statistics that day. Let me consult my syllabus . . . we did a pigeon lab. Ok, that was the semester I ran one lab in the morning, one in the evening. I must have been running a lab that night. Who was in that class? According to my class list, Sonia and Helen were in that class. I remember Sonia working alone with her bird on a chaining task one night. Could that have been the 19th? No, the 19th is too close to the beginning of the semester; she wouldn’t have got to chaining yet. She had excellent luck with that bird. What would she have done before the chaining experiment? Wait, that would only have been the second session of the semester. They were still working on shaping. Yes, I remember the night they worked on shaping. One group shaped their birds up in one session, but most of them didn’t.

Effects of Multiple Control on the Listener or Reader

- The effects of multiple control on the listener or reader typically play a role in our enjoyment of esthetic or humorous aspects of verbal behavior.
- Skillful writers and speakers, as well as comedians, exploit multiple control to create various effects.
- Usually in such cases we can distinguish an obvious primary source of control and one or more secondary sources of control that are usually subtle or hidden.

Multiple Control in Humor

- The humor of an utterance is typically determined by competing response tendencies evoked by the main and secondary sources of control and perhaps also by differences in latencies of the competing responses.
- In a “good” pun, the secondary source of control is strong in the context but does not exert discriminative control over the behavior of the listener until the pun is uttered.
- Ben Jonson is said to have offered to make a pun on any subject. When someone suggested the King, Jonson replied, “The King is not a subject!”

Multiple Control in Literature

The elegance and “depth” of a piece of writing, depends, at least in part, on interacting multiple sources of control:

- “Now is the winter of our discontent, made glorious summer by this sun of York.”
- “Golden lads and girls all must, As chimney-sweepers, come to dust.”

A Page from Shakespeare’s Notebook:

- We all end up dead sooner or later.
- Live it up kids, you’re gonna be worms’ meat some day.
- Blond boys and girls are going to die too, just like brunettes. Not to mention chimney-sweepers.
- Objective consideration of actuarial evidence compels the conclusion that homo sapiens of every age, no matter what the state of vigor at the time of baseline observation, inevitably reach a state at which all metabolic function ceases (JEAB draft, 1611).
Multiple Sources of Control in the Couplet

• Formal control:
  – Meter (iambic tetrameter)
  – Rhyme (must, dust)

• Thematic control:
  – Intraverbal:
    • lads - girls
    • gold – dust
    • Chimney-sweepers – dust
    • Chimney-sweepers – death
    • Chimney-sweepers – coming (to one’s house) to dust
  – Antithesis:
    • Golden – come to dust
    • Golden lads and girls – chimney-sweepers
    • Youth – death
  – Metaphor
    • The dandelion, fresh and gone to seed

Golden lads and girls all must,
As chimney-sweepers, come to dust.

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Applications of Multiple Control: Take-Away Points

• 1) Human behavior is rarely under a single source of control, especially in the natural environment
• 2) The practice of “discrete trial training” may focus too much on establishing single sources of control
• 3) Multiple control is a valuable teaching tool for establishing early verbal behavior
  a) additional sources of control are often additive or even algebraic
  b) a strong source of control can be used to transfer control to a weaker, but essential, source of control (echoic to mand)
• 4) Most VB skills are multiply controlled
• 5) Multiple control is required for most complex verbal behavior (e.g., intraverbal behavior and VC³s)

Applications of Multiple Control: Take-Away Points

• 6) Most life skills are multiply controlled
• 7) Most social behaviors are multiply controlled
• 8) The failure to appreciate multiple control can create language and learning barriers
• 9) Multiple exemplar training is a powerful teaching technology strategy based on multiple control
• 10) Divergent control and response generalization — variation in responding — techniques using multiple control

More Take-Away Points

• 11) S⁵s have effects on response probability, even for responses that are not emitted.
• 12) The effects of multiple S⁵s are additive (+/-).
• 13) We exploit additivity in problem solving and recall.
• 14) Multiple control is central to humor.
• 15) Writers and poets often achieve special effects through the skillful use of multiple control. (Artists and musicians too?)
• 16) Pure verbal operants are rare outside of the laboratory or therapeutic settings.

Conclusions

• Skinner (1957) points out that….
• “The formulation is inherently practical and suggests immediate technological applications at almost every step” (1957, p. 12)
• His 3 Chapters on multiple control are filled with applications ripe for developing interventions and generating research
• One advantage of Skinner’s functional analysis is that by its very nature different sources of control are highlighted vs. the traditional receptive-expressive framework of language where the different functions are blended together
Conclusions

- “Verbal Behavior...will, I believe, prove to be my most important work” (Skinner, 1978, p. 122)