



## The Functional Analysis of Problem Behaviors: Practice and Research

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### Overview

- History of the development of a “function-based” approach to treating problem behaviors
- Functional assessments
- Description of experimental functional analysis
- Efficacy of FA
- Functional analysis criticisms
- Functional analysis modifications



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### Take Home Point

Functional analysis is a *safe & flexible* tool, which is *integral* to the treatment development process



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## FUNCTIONS OF PROBLEM BEHAVIOR

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### Question

O. Ivar Lovaas is most famous for popularizing ABA as a method of treating behaviors of children with autism. What contributions did he make to treating SIB?



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### Learned Functions of Problem Behavior

Lovaas, Freitag, Gold,  
& Kassorla (1965)



Lovaas & Simmons (1969)

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1969, 2, 143-157 NUMBER 3 (FALL 1969)

MANIPULATION OF SELF-DESTRUCTION IN  
THREE RETARDED CHILDREN\*

O. IVAR LOVAAS AND JAMES Q. SIMMONS, MD

UNIVERSITY OF CALIFORNIA, LOS ANGELES

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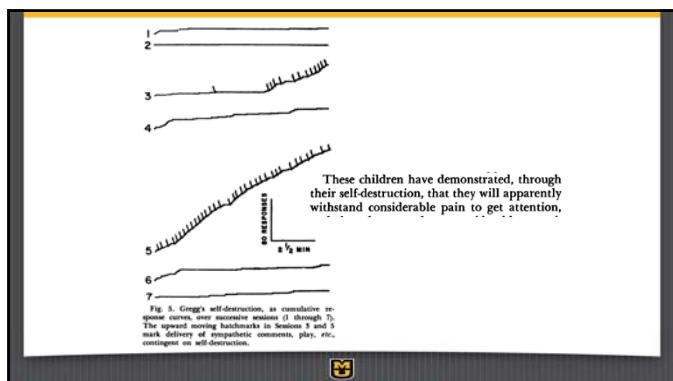
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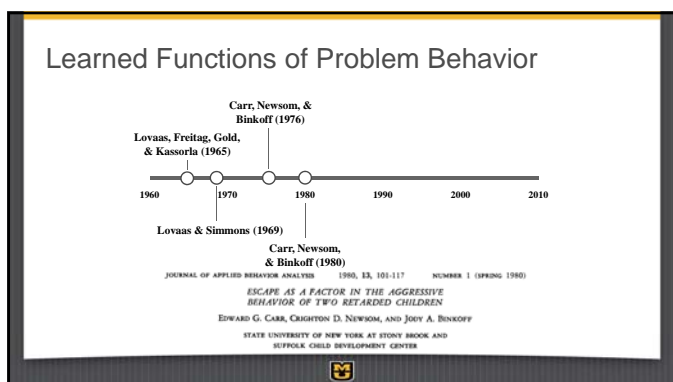
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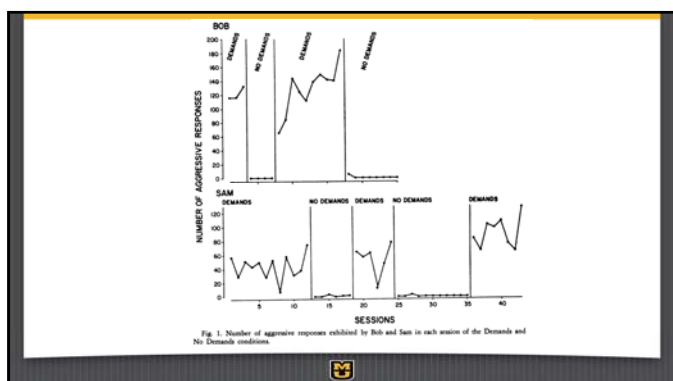
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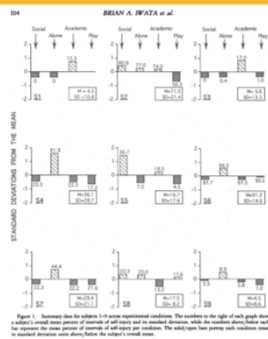
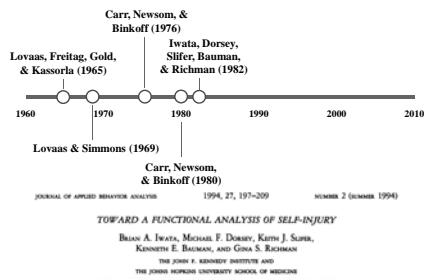
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## Learned Functions of Problem Behavior



## Reinforcement Contingencies

- Positive Reinforcement
  - Attention
  - Access to tangible items
- Negative Reinforcement
  - Escape from demands
- Automatic Reinforcement
  - Sensory reinforcement

## Common Behavioral Functions

- **Escape from demands** – problem behaviors results in a break from instructional activity
- **Attention from caregivers** – problem behavior produces verbal reprimands or concern
- **Access to tangible reinforcers** – problem behaviors result in access to preferred items, often as a form of redirection
- **Automatic (sensory) reinforcement** – behavior produces it own sensory reinforcement



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## Question

Idiosyncratic function?



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## Less Common Behavioral Functions

- **Escape from environmental features** (e.g., noise, medical procedures, etc.) – problem behavior occurs to produce removal from aversive environments
- **Social avoidance** – problem behavior produces escape from social interactions
- **“Control” function** – behavior increases the probability that a request will be met



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## Less Common Behavioral Functions

- **Maintenance of rituals** – behavior keeps others from interrupting important rituals
- **Access to stereotypy materials**– behaviors provide materials to be used in stereotypic responses (e.g. tearing curtains for string)
- **Access to preferred activities** - behavior keeps others from blocking activities that would otherwise be prevented



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## Less Common Behavioral Functions

- **Automatic negative reinforcement** – problem behavior removes private aversive stimulation
- **Divided attention** – attention maintained problem behavior is more likely to occur if the caregiver is diverting their attention elsewhere



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## Multiply-Controlled Behavior

- A single form of behavior may have multiple functions (e.g., hand-to-head SIB maintained by both escape and attention)
- Multiple responses can have the same function (e.g., both aggression and self-injury may be maintained by attention)



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## FUNCTIONAL (BEHAVIORAL) ASSESSMENT VS. FUNCTIONAL ANALYSIS

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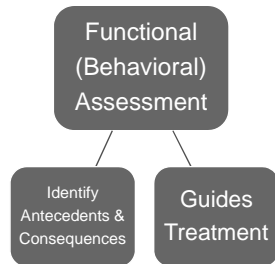
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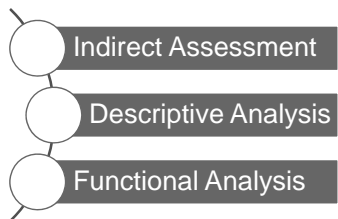
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#### A FUNCTIONAL ANALYSIS

The external variables of which behavior is a function provide for what may be called a causal or functional analysis. We undertake to predict and control the behavior of the individual organism. This is our "dependent variable"—the effect for which we are to find the cause. Our "independent variables"—the causes of behavior—are the external conditions of which behavior is a function. Relations between the two—the "cause-and-effect relationships" in behavior—are the laws of a science.

Skinner (1953)

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## INDIRECT ASSESSMENT

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### Question

What indirect assessment do you use?

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## Indirect Assessment

- Informant based
- Assessment instrument
  - Asks questions about target behavior and circumstances surrounding behavior
  - Provide decision rules for deriving hypothesis about function
- Several instruments
  - MAS
  - QABF
  - FAST



## Indirect Assessment

- Advantage
  - Simplicity
  - Minimal time and training
- Disadvantage
  - Least precise
  - Questionable reliability

Table 3  
Percentage Agreement Scores for Individual FAST Items

Item	Agreement	Item	Agreement
1	70.8	9	77.4
2	78.6	10	71.1

Table 4

Table 5

Summary of Agreements Between FAST and FA Outcomes

FA outcome	Cases	Matches to FAST	Percentage
Comparison based on all pairs of FASTs			
Social-positive reinforcement	18	14	77.8
Social-negative reinforcement	25	14	56
Automatic-positive reinforcement	26	16	61.5
Total	69	44	63.8
Comparison based on FASTs for which there was agreement on function			
Social-positive reinforcement	7	7	100
Social-negative reinforcement	11	6	54.5
Automatic-positive reinforcement	6	4	66.7
Total	24	17	70.8

## DESCRIPTIVE ANALYSIS

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## Descriptive Analysis

- Naturalistic observation
- Direct observation of individual's behavior
  - Identify antecedent events and consequences
  - Determine degree of correspondence (or correlation) between behavior and environmental events
  - Hypotheses about function based on high correlation between behavior and environmental event
- Results in conditional probabilities - given that the behavior occurred, what was most probable to occur before and after the behavior

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## Descriptive Analysis

- Common Forms:
- ABC
  - Structured ABC
  - Scatterplot analysis

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
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# Open-Ended ABC

- Includes columns for antecedents, behaviors, and consequences (at minimum)
- Each time the behavior occurs, observers write in the relevant antecedent and consequence
- Prone to information that is not very useful (e.g., most likely antecedent is "Got upset.")



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[illegible]

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# Structured ABC

- Data collection sheet is pre-coded with suspected relevant antecedents and consequences
- Each time the response occurs, observers record the code for the antecedent that preceded the response and the consequence that followed the response
- Can include "other" for unlisted events



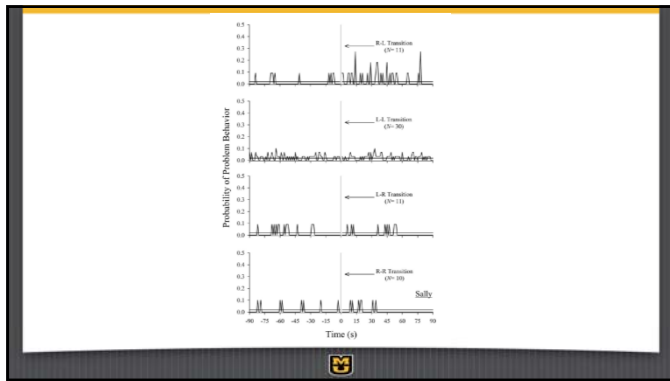
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NAME \_\_\_\_\_ Date \_\_\_\_\_

ABC Data Sheet

For each instance of SB, ASD, DS, and dropping record the antecedent, description of the situation, the number of behaviors total or target behaviors, the behavior(s) that occurred, and the consequence applied. Use the codes below - circle the code that best fits the situation and explain the situation in detail. Circle all codes that apply.

TIME	ANTECEDENT	DESCRIPTION OF SITUATION	FREQ	BEHAVIOR(S)	CODE	CA Name
12:15.0				SB	ASD	12:15
12:15.5				Drop	DS	
12:16.0				SB	ASD	12:16
12:16.5				Drop	DS	
12:17.0				SB	ASD	12:17
12:17.5				Drop	DS	
12:18.0				SB	ASD	12:18
12:18.5				Drop	DS	
12:19.0				SB	ASD	12:19
12:19.5				Drop	DS	
12:20.0				SB	ASD	12:20
12:20.5				Drop	DS	
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## Descriptive Analysis

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- Data analysis
  - Conditional probabilities
    - Probability of behavior given antecedent
    - Probability of antecedent given behavior
    - Probability of behavior followed by consequence
    - Probability consequence preceded by behavior
- Advantages
  - Ecological validity (naturalistic setting)
  - Examine fuller range of antecedents and consequences
- Disadvantages
  - Not the most precise (Thompson & Iwata, 2007)
  - False positive
  - Open formats may provide useless information
- Recommendation – augment other assessments

Table 1.  
Correspondence between results of descriptive assessment and functional analysis

Correspondence	N	Percentage
Overall	71	50%
Yes	27	38%
No	44	62%

RACHET, J.C.

Condition	Number of studies	Percentage
Complete	18 studies/18 participants	25%
Partial	5	7%
No	12	17%

ABC Narrative Assessment

Condition	Number of studies	Percentage
Complete	2	100%
Partial	0	0%
No	0	0%

Subplot Assessment

Condition	Number of studies	Percentage
Complete	15	67%
Partial	2	13%
No	3	20%

Structural Assessment

Condition	Number of studies	Percentage
Complete	15	67%
Partial	2	13%
No	3	20%

Conditional Probabilities

Condition	Number of studies	Percentage
Complete	25	49%
Partial	12	24%
No	14	27%

Note: Data are presented in terms of number of participants (N) and categorized by type of descriptive assessment. Yes = results of descriptive assessment (DA) correspond to results of functional analysis (FA). Partial = for behaviors maintained by multiple variables, results of DA and FA corresponded for one function but not others. No = results of DA and FA did not correspond.

\*Conditional probabilities refers to the probability of a specific consequence event given a specific problem behavior.

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## FUNCTIONAL ANALYSIS

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## Functional Analysis

- Manipulation and replication of controlling variables
  - Set of conditions designed to identify controlling variables by manipulating antecedent and consequent events
- Brief sessions (10-15 min), five conditions
  - Alone
  - Attention
  - Demand
  - Tangible
  - Play (control)
- Data analysis – compare rates of behavior during test conditions to control condition



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JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1994, 27, 197-209 NUMBER 2 (SUMMER 1994)

### TOWARD A FUNCTIONAL ANALYSIS OF SELF-INJURY

BRIAN A. IWATA, MICHAEL F. DORSEY, KEITH J. SLIPP,  
KENNETH E. BAUMAN, AND GINA S. REICHMAN

THE JOHN H. MONROE INSTITUTE AND  
THE JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

This study describes the use of an operant methodology to assess functional relationships between self-injury and specific environmental events. The self-injurious behaviors of nine developmentally disabled subjects were observed during periods of brief, repeated exposure to a series of analogue conditions. Each condition differed along one or more of the following dimensions: (1) play materials (present vs. absent), (2) experimenter demands (high vs. low), and (3) social attention (alone vs. noncontingent vs. contingent). Results showed a great deal of both between and within-subject variability. However, in six of the nine subjects, higher levels of self-injury were consistently associated with a specific stimulus condition, suggesting that within-subject variability was a function of discrete features of the social and/or physical environment. These data are discussed in light of previously suggested hypotheses for the maintenance of self-injury, with particular emphasis on their implications for the selection of suitable treatments.



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## Iwata et al. (1982/1994)

- Alone – individual alone; test for automatic reinforcement
- Attention – therapist engaged in another activity; test for social positive reinforcement
  - Problem behavior → brief attention (e.g., reprimand)
  - Appropriate behavior → ignored
- Demand – therapist presents demand; test for social negative reinforcement
  - Problem behavior → brief escape from demand
  - Appropriate behavior → praise
- Tangible – therapist removes preferred stimulus; test for social positive reinforcement
  - Problem behavior → access to preferred stimulus
  - Appropriate behavior → ignored
- Play (control)



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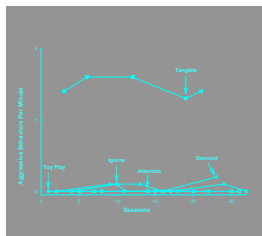
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## Data Analysis

### Visual Inspection

- compare rates of behavior during test conditions to control condition



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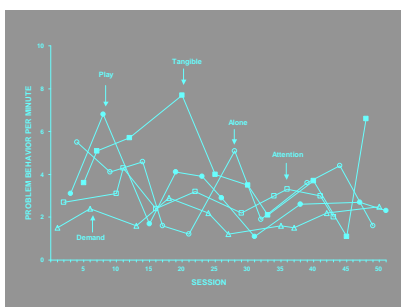
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## Functional Analysis

- Advantages
  - Experimental rather than correlational in nature; greater assurance of cause and effect
- Limitations
  - Failure to identify the full range of the controlling variables
  - Potential for false positive
  - Requires specialized training?

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## UTILITY OF FUNCTIONAL ANALYSIS




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JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1994, 27, 215-240 NUMBER 2 (SUMMER 1994)

### THE FUNCTIONS OF SELF-INJURIOUS BEHAVIOR: AN EXPERIMENTAL-EPIDEMIOLOGICAL ANALYSIS

BRUCE A. IWATA, GARY M. PAUL, MICHAEL F. DODDY,  
JENNIFER K. ZARCON, TIMOTHY B. VOLANSKY, RICHARD G. SMITH,  
TERESA A. RIOSORIA, DOROTHY C. LEMANN, BRIGGETT A. SHORE,  
JOHN L. MAGALONE, HAN-LIANG CHEN, GUYMON EDWARDS GONZALEZ,  
MICHAEL J. KALISHA, KAY C. MCCOON, and KIMBERLY D. WELLS  
THE UNIVERSITY OF FLORIDA AND THE KENNEDY KRIEGER INSTITUTE,  
JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

Data are summarized from 152 single-subject analyses of the maintaining functions of self-injurious behavior (SIB). Individuals with developmental disabilities referred for assessment and/or treatment over a 11-year period were exposed to a series of conditions in which the effects of antecedents and consequent events on SIB were examined systematically by way of extinction, reversal, or combined designs. Data were collected during approximately 4,000 experimental sessions (1,000 h), with the length of sessions for individuals ranging from 8 to 60 sessions ( $M = 26.2$ ) conducted over 1 to 16.5 hr ( $M = 6.5$ ). Differential or uniformly high responding was observed in 145 (95.4%) of the cases. Social-negative reinforcement (escape from task demands or other sources of aversive stimulation) accounted for 70 cases, which was the largest proportion of the sample (46.1%). Social-positive reinforcement (either attention or access to food or materials) accounted for 40 (26.3%) of the cases, automatic (sensory) reinforcement accounted for 19 (12.5%), and multiple controlling variables accounted for 8 (5.3%). Seven sets of data (4.6%) showed either cyclical or inconsistent patterns of responding that were uninterpretable. Overall results indicated that functional analysis methodologies are generally effective in identifying the environmental determinants of SIB on an individual basis and, subsequently, in guiding the process of treatment selection. Furthermore, an accumulation of assessment data from such analyses across a large number of individuals provides perhaps the most rigorous approach to an epidemiological study of behavioral function.

**INDEXING TERMS:** epidemiology, functional analysis, self-injurious behavior




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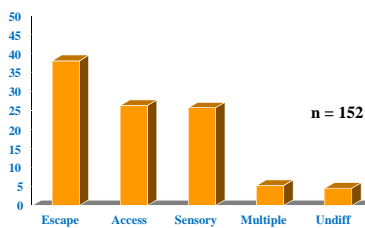
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## Functional Analysis Outcome



Iwata et al. (1994)




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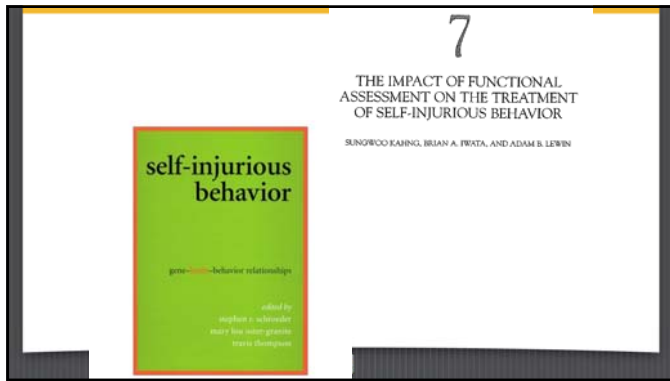
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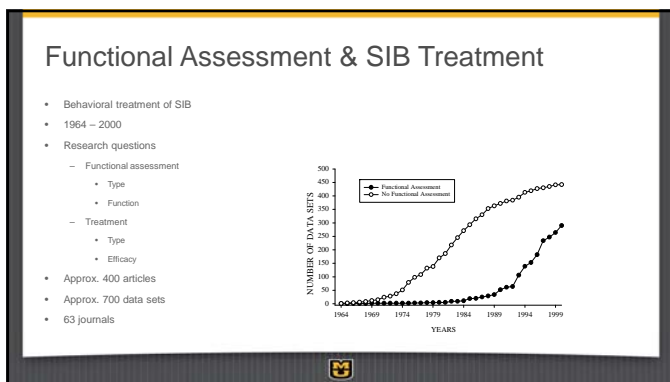
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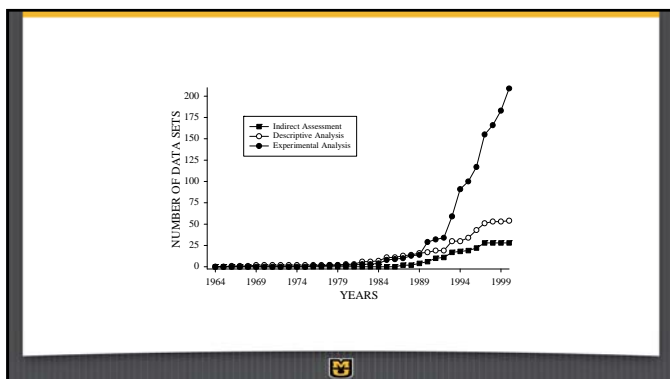
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## Treatment Efficacy

	Antecedent		Extinction		Reinforcement		Punishment		Response Block		Mechanical Restraint	
Functional Assessment	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Antecedent	76.5% (n=25)	88.1% (n=19)										
Extinction			47.0% (n=2)	86.0% (n=24)	47.0% (n=5)	82.3% (n=31)						
Reinforcement					61.6% (n=92)	83.5% (n=103)	82.4% (n=75)	89.5% (n=17)	57.3% (n=3)	81.8% (n=5)		
Punishment							84.9% (n=121)	67.8% (n=29)				
Response Block												
Mechanical Restraint											87.5% (n=14)	94.2% (n=19)




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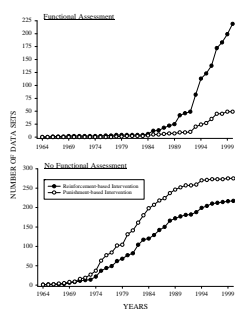
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## Question

Why are functional assessments (analyses) beneficial?




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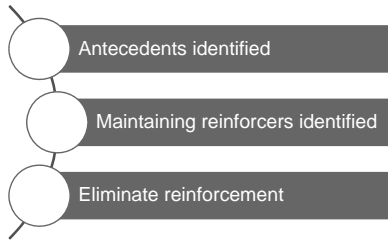
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## Why are FAs Beneficial?



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## Function-Based Treatment

- Consequence for problem behavior
  - Extinction
    - Positive versus negative reinforcement
  - Punishment
    - Positive versus negative reinforcement
  - Avoid “mismatched” function
- Reinforcement-based interventions
  - DRO
  - DRA (FC)
  - NCR

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*Journal of*  
Applied Behavior Analysis

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2015, 48, 817–829

NUMBER 4 (WINTER)

A SURVEY OF FUNCTIONAL BEHAVIOR ASSESSMENT METHODS  
USED BY BEHAVIOR ANALYSTS IN PRACTICE

ANTHONY C. OLIVER, LEIGH A. PRATT, AND MATTHEW P. NORMAND  
UNIVERSITY OF THE PACIFIC

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Most respondents (86.5%) also indicated that they believed conducting functional analyses was a necessary component of being a behavior analyst.  whereas 36% indicated "almost always" or "always" using functional analyses.

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## Question

Concerns about functional analyses?

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## FUNCTIONAL ANALYSIS CRITICISMS

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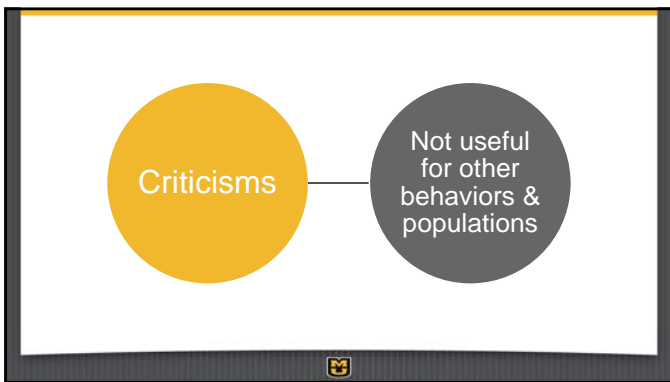
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THE INFLUENCE OF ANTECEDENTS AND  
CONSEQUENCES ON THE OCCURRENCE OF BIZARRE  
SPEECH IN INDIVIDUALS WITH DEMENTIA

Maranda A. Trahan<sup>1,2\*</sup>, Jeanne M. Donaldson<sup>3,4,5</sup>, Matthew K. McNabney<sup>1</sup>  
and SungWoo Kahng<sup>6,7\*</sup>

<sup>1</sup>Division of Geriatric Medicine and Gerontology, Johns Hopkins University School of Medicine, Baltimore, MD, USA  
<sup>2</sup>Trahan Behavioral Services, Breard County, FL, USA  
<sup>3</sup>Department of Educational Psychology and Leadership, Texas Tech University, Lubbock, TX, USA  
<sup>4</sup>Department of Pediatrics, Johns Hopkins University School of Medicine, Baltimore, MD, USA  
<sup>5</sup>Department of Behavioral Psychology, Kennedy Krieger Institute, Baltimore, MD, USA  
<sup>6</sup>Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, USA  
<sup>7</sup>Department of Health Psychology, Thompson Center for Autism and Neurodevelopmental Disorders, University of Missouri, Columbia, MO, USA

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## Purpose

Is bizarre speech sensitive  
to same contingencies?

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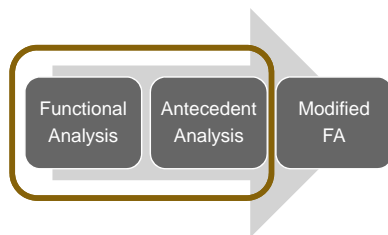
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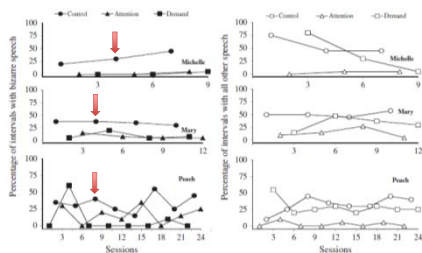
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## Functional Analysis



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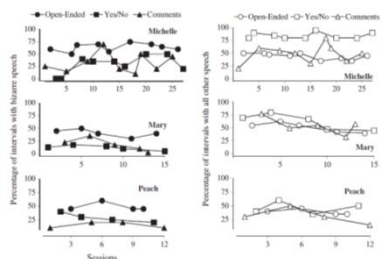
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## Antecedent Analysis



Criticisms

Safety

*Journal of  
Applied Behavior Analysis*

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2015, 48, 107-114

NUMBER 1 (SPRING)

### THE SAFETY OF FUNCTIONAL ANALYSES OF SELF-INJURIOUS BEHAVIOR

SUNGWOO KANG

KENNEDY KRIEGER INSTITUTE AND THE JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

NICOLE L. HAUMAN AND ALYSSA B. FISHER

KENNEDY KRIEGER INSTITUTE

JEANNE M. DONALDSON

TEXAS TECH UNIVERSITY

JESSICA R. COX AND MONICA LOGO

KENNEDY KRIEGER INSTITUTE

AND

KATIE M. WISOW

TEXAS TECH UNIVERSITY

Purpose

How safe are functional analyses of self-injurious behavior?

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Results

Table 6  
Average Injury Reports per Hour Both During and Outside the FA for All Participants and for Participants with at Least One Injury Report

	Average injury reports per hour	
	During FA	Outside FA
All participants ( $N = 99$ )	0.098	0.011
Participants with at least one injury report ( $n = 42$ )	0.230	0.027

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Results

Table 4  
Severity Index Scores (Adapted from Iwata et al., 1990)

Severity index	Severity of injury within a report
0	No injury
1	All severity scores 1s
2	At least one score of 2; no 3s
3	≥ Two scores of 2; no 3s
4	No more than one score of 3
5	≥ Two scores of 3s

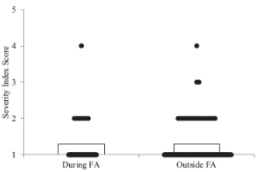


Figure 2. Severity scores for all injury reports during the functional analysis ( $n = 34$ ) and outside the functional analysis ( $n = 79$ ). Bars represent the average severity score for all injury reports. Each point represents the severity score for a single injury report.

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**ACTUAL FUNCTIONAL ANALYSIS CONCERNS**

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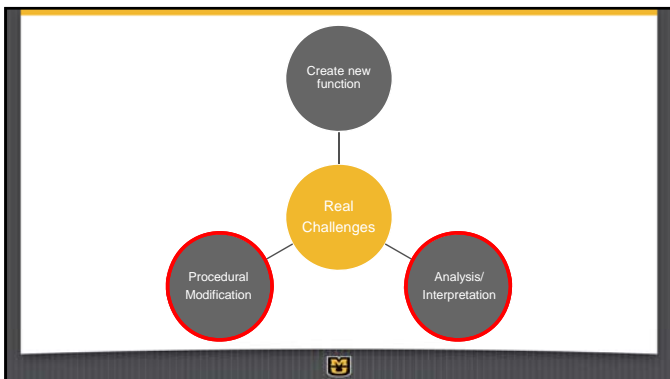
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INITIAL FUNCTIONAL ANALYSIS OUTCOMES AND  
MODIFICATIONS IN PURSUIT OF DIFFERENTIATION:  
A SUMMARY OF 176 INPATIENT CASES

LOUIS P. HAGOPIAN, GRIFFIN W. ROOPER, JOSHUA JESSEL, AND ISEK G. DiLEON  
KENNEDY KRIEGER INSTITUTE AND JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE




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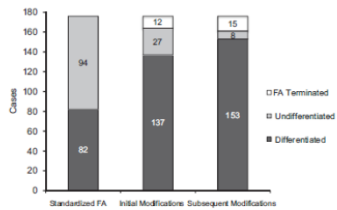


Figure 1. Summary of FA results.




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Modifications important, how do you  
know *when* and *what* to modify?




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Journal of  
Applied Behavior Analysis

JOURNAL OF APPLIED BEHAVIOR ANALYSIS2017, 9999, n/a-n/a

NUMBER 9999 ()

EFFECTS OF COMPUTER-BASED TRAINING ON PROCEDURAL  
MODIFICATIONS TO STANDARD FUNCTIONAL ANALYSES

LAUREN K. SCHNELL, TINA M. SEDNER, RUTH M. DeBAR AND  
JASON C. VLADISCU  
CALDWELL UNIVERSITY

AND  
SUNGWOO KANG  
THE UNIVERSITY OF MICHIGAN

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Brief FA

Differentiated

Treatment

Undifferentiated

Multi-Element FA

Differentiated

Treatment

Undifferentiated

Extended Alone Condition

Persistence

Treatment

Decrease in Responding

Pairwise FA

Differentiated

Treatment

Adapted from Vollmer, Marcus, Ringbahl, & Roane (1995)

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FUNCTIONAL ANALYSIS VARIATIONS

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## Design Variations

- Brief FA - Northup et al. (1991)
  - 2 phases
    - Analogue assessment
      - 5-10 min
    - Contingency reversal
      - Consequence for appropriate behavior
  - Good when time limited
  - Limitation – insufficient data?

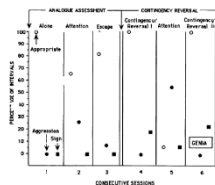


Figure 3. Performance of Genia across conditions during the analogue and contingency phases of assessment.

## Design Variations

- Pair-wise analysis – Iwata et al. (1994)
  - Compare 1 test to 1 control (2:1 ratio)
  - Good when difficulty discriminating
  - Limitation?

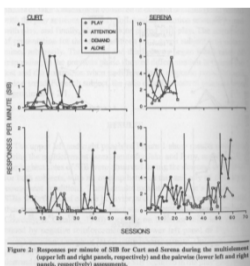


Figure 2. Responses per minute of SIB for Curt and Sierra during the multi-element upper left and right panels, respectively, and the pairwise (lower left and right panels, respectively) assessments.

## Design Variations

- Screening procedures
  - Comprehensive model - Vollmer et al. (1995)
    - Progression from Brief FA to Reversal
  - Good "roadmap"
  - Limitation – too much time?

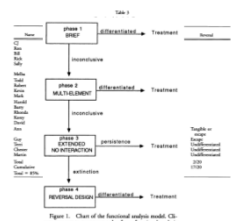


Figure 1. Chart of the functional analysis model. CH- one program in session only after a functional analysis (CH- one program in session only after a functional analysis).

## Design Variations

- Screening procedures
  - Automatic reinforcement - Querim et al. (2013)
  - 3, 5-min alone session
  - Good for (potentially) saving time
  - Limitation?

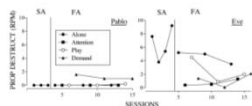


Figure 5. Response per minute of property detection across the SA and FA conditions.

## Design Variations

- Precursor - Dracoby & Smith (2012)
  - Multiple phases
    - DA to identify precursor
    - FA of precursor
    - Function-based treatment of precursor
  - Good for (potentially) preventing problem behavior
  - Limitation – same response class?

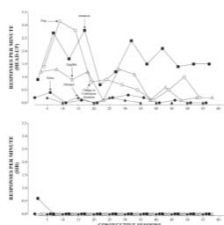


Figure 6. Results of the precursor treatment analysis. Data are plotted as response per minute for all sessions. The first panel shows data for baseline. The second panel shows data for DA, which was maintained for testing and only.

## Design Variations

- Latency-based measure – Thomason-Sassi et al. (2011)
  - Latency to 1<sup>st</sup> response
  - Good for time limited and safety concern
  - Limitation – correspondence?

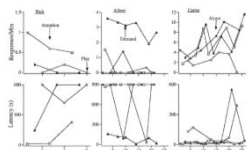


Figure 7. Rate and latency graphs depicting examples of correspondence from Experiment 1 for problem behavior maintained by positive reinforcement (left), negative reinforcement (middle), and automatic reinforcement (right). Top panels show rate data, and bottom panels show latency data.

## Design Variations

- Extended FA – Davis et al. (2014)
  - Each day = different condition
  - Good for low-rate behavior

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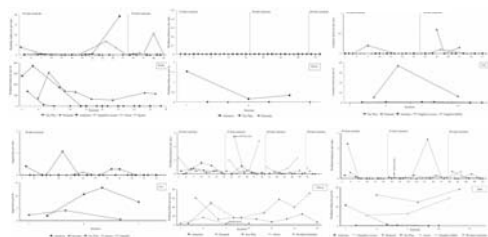
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## Antecedent Event Variations

- EO manipulations - Smith et al. (1995)
  - Examined multiple potential EOs
    - Task novelty
    - Session duration
    - Rate of task presentations

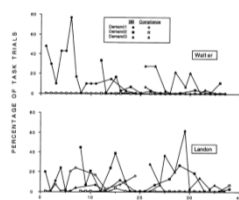


Figure 1. Results of Study 1 for Water and Lemon. Thick symbols represent percentage of task trials with SO, and open symbols represent percentage of task trials with longlatency.

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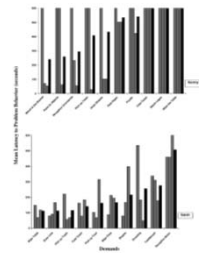
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## Antecedent Event Variations

- Demand assessment – Call et al. (2009)
  - Identify specific demands likely to evoke behavior
  - Good for more precise FA
  - Limitation – time?




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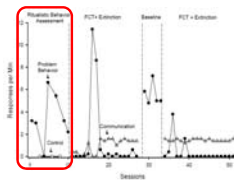
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## Consequent Events Variation

- Idiosyncratic variables – Hausman et al. (2009)
  - Ritualistic behavior
  - Good for less common functions
  - Limitations – time?




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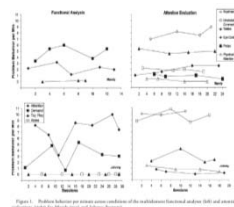
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## Consequent Events Variation

- Types of attention -Kodak et al. (2007)
  - Evaluating different forms of attention
  - Good for more precise FA
  - Limitation – time?




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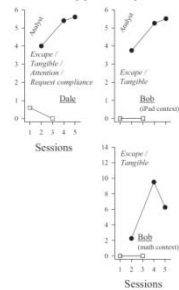
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## Interview Informed Synthesized Contingency Analysis (IISCA)

- Hanley, Jin, Vaneslow, & Hanratty (2014)
- Synthesize test condition based on informant report
- “Kitchen sink”



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### Take Home Point

Functional analysis is a *safe & flexible* tool, which is *integral* to the treatment development process



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### Contact info.

SungWoo Kahng, Ph.D., BCBA-D  
E-mail: [S.Kahng@Rutgers.edu](mailto:S.Kahng@Rutgers.edu)



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