From Angry Birds to Learning Words:
Applying Features of Game Design to Semantic Intervention

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A bit about me

• Atari and Sega, late 1970s into 1990s
• M.A. at University of Kansas
• 5 years as a clinical SLP
  • Boys Town National Research Hospital
  • Children’s Therapuetic Learning Center
• Ph.D. at University of Kansas

Schedule
• Video Game Design & Clinical Practice
• The Full Experience of Semantics
• Discovery & Risk Taking in Development
• Generalization from Treatment
• Unlocking Future Rewards

Video Games Motivate

• People invest money in video games
  – Games grossed $10.5 billion in 2009
• People willingly invest time and effort in video games
  – The average gamer spends eight hours per week playing video games
• People concentrate on video games and stay on task for long periods of time

Reference:
http://www.esrb.org/about/images/vidGames04.png

Video Games Motivate

• A wide variety of people play video games
  – 67% of U.S. households play video games
  – 40% of gamers are female
  – average age of gamers is 34
  – 48% of games are rated “E for Everyone”

Reference: http://www.esrb.org/about/images/vidGames04.png
## The Appeal of Video Games is Not Accidental

- Games of all sorts have been refined through the years.
- Game designers are motivated to make games more engaging.
- Principles of game design have been studied extensively in both industry and academia.

## Five Principles of Video Game Design

1. **Full Experience Principle**
   - Many games address **epic themes**
     - allocation of limited resources
     - decision making in ambiguous contexts.
   - Every aspect of the game contributes to the epic themes
   - Example Game: *Penumbra*

2. **Risk Taking Principle**
   - Tasks are designed to be challenging but not impossible.
     - Goldilocks / Zone of Proximal Development
   - Player innovation and creativity are encouraged
     - Failure has only small penalties and is expected
   - Example Game: *Braid*
3. Discovery Principle

- Players learn by exploration and experimentation
- “How to” instruction is kept to a minimum
  - no manuals
  - online player supports available

Example Game: *World of Goo*

4. Generalization Principle

- New knowledge is put to work right away
- Skills learned early should transfer and be useful later

Example Game: *Epic Mickey*

5. Rewards System Principle

- Reinforcements are given frequently and in a variety of ways
  - points
  - new tools / weapons
  - additional information
  - unlocking extra levels

Example Game: *Pokémon*
Pokémon

Groups

• Get together with 4 or 5 people
• Pick a principle
• Discuss how it might relate to client learning
  — How does your current clinical practice reflect this principle?
  — What might be new ways to incorporate this principle into practice?

Groups will report out in 10/15 minutes.

Recap of the Five Principles of Video Game Design

1. Full Experience Principle
2. Risk Taking Principle
3. Discovery Principle
4. Generalization Principle
5. Rewards System Principle

Group Reports

• Each group reports
• General Discussion, questions, and observations

Focus on Semantics

• Continue using the video game principles
  — but now applying them to
  • what we do as clinicians
  • how children learn semantics

The Full Experience of Semantics

• Semantics has an image problem
  — Semantics = Vocabulary
The Full Experience of Semantics

• Semantics has an image problem
  — Semantics $\neq$ Vocabulary

• Semantics $>$ Vocabulary
  — vocabulary is one aspect of semantics

The Full Experience of Semantics

• Problems with a Semantic = Vocabulary focus
  — Vocabulary items need to be
    • Complete
    • Interconnected
  — Semantics deals with both of these issues and more

The Full Experience of Semantics:
Completeness

• What is a word (or vocabulary item)?
  — a unit of language, consisting of one or more spoken sounds or their written representation, that functions as a principal carrier of meaning.
  (www.dictionary.com)
  — a phonological form paired with a meaning

The Full Experience of Semantics:
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  $/d\alpha k/$
  duck

The Full Experience of Semantics:
Completeness

— The form and meaning(s) should be shared across people
  • kooba

— The meanings should be complete, but don’t have to be
  • pervert
  • sacapuntas
The Full Experience of Semantics: Completeness

• What are the parts of a dictionary's definition?

Vocabulary entries should include all of these parts.

The Full Experience of Semantics: Interconnectedness

• A dictionary's definition is a good metaphor for vocabulary completeness

• But, a dictionary is not a good metaphor for the lexicon
  • each individual’s “mental library” of word knowledge

The Full Experience of Semantics: Interconnectedness

– 5 people have target words.
– We want to connect these words
  • What combinations of other single words will achieve this?
  – think six degrees of separation
  – We need a data keeper

Discovery & Risk Taking: Semantic Development

• Learning first words is a slow, laborious process
  – mostly dependent on adult models and repetition

• But it starts to take off during the second year of life
  – because of experiential learning and application
    • finding a pattern and using it to increase learning
      – a process of discovery and risk taking
Discovery & Risk Taking: Semantic Development

- Experiential Learning and Application Examples
  - Infant phonological sensitivities
  - semantic principles
  - word’s semantic and phonological properties

- Between 18 months and 18 years of age
  - children learn an average of 9 to 10 words a day
  - Fast Mapping
    - initial connection between a new phonological form and a referent
  - Slow Mapping
    - refinement of a fast mapped lexical entry over time and experience
    - and perhaps integration with known items

- Effective and efficient lexicons are organized
  - Entries are interconnected in multiple ways
    - Taxonomic categories
    - Thematic categories
    - Synonyms / antonyms
    - Phonological structure

- Abstract semantics develop across the elementary school years

- Reduced input
  - hearing loss, autism, poverty
  - cannot build a large vocabulary or interconnected lexicon

- Low vocabularies
  - late talkers

- Word finding deficits
  - vocabulary may be within normal limits
  - underdeveloped meanings
    - especially with with abstract concepts
  - specific language impairments

Generalization to Better Semantics: Assessment

- What do you do to assess semantics?
  - Brackenbury & Pye (2005)
  - Standardized tests are mostly focused on vocabulary
  - A few look at other aspects

- Preschool Language Scales
- Test of Semantic Skills
  Ages 9 – 13
Generalization to Better Semantics:
Assessment

– Language sample analysis
  • limited information
  • may need to verify with other tasks
– Nonword repetition tasks
  • measure of phonological short-term memory
– Clinician developed tasks
  • good for evaluating interconnectedness

Generalization to Better Semantics:
Case Examples

• Lara, 3 years, 7 months
  – first expressive words ~ 18 months
  – receptive and expressive vocabulary scores < 10th percentile
  – sorts and labels common vocabulary scores into categories
  – vocabulary during language sample focused on
    • objects in the environment
    • attribute words
    • prototypical action words for those objects

Generalization to Better Semantics:
Case Examples

• Luigi, 9 years, 8 months
  – receptive and expressive vocabulary scores at 18th and 14th percentile, respectively
  – accurate but slow word naming
  – definitions imprecise
  – averages 65% accuracy with classroom vocabulary
  – categorizes by common groups and functions
    • low accuracy for classroom vocabulary

Generalization to Better Semantics:
Case Examples

• In groups of 4 or 5, spend 10 minutes discussing
  – your targets for Lara
  – how you would address them
  – write down your responses to be collected later
    • no names needed

Generalization to Better Semantics:
Intervention for Low Vocabularies

• Interactive Modeling
  – embed lexical models in everyday contexts
  – facilitate their use through focused stimulation techniques

I. Parent Training Models
  – training parents/caregivers as agents of change
Generalization to Better Semantics: Intervention for Low Vocabularies

— The Hanen Program
  ● parents are taught techniques that promote language learning through daily interactions
    — Observe, Wait, Listen
    — Say less, Stress, Go Slow, Show
  ● adults model target vocabulary, but do not require a response

— Research Evidence
  ● Positive effects on parent language facilitation
    — Girolametto, Pearce, and Weitzman (1996)
  ● Increases in children learning target words
    — Girolametto, Pearce, and Weitzman (1996)
    — Whitehurst et al. (1991)
  ● Variable results for generalization to other word learning
    — Significant results by Girolametto, Pearce, and Weitzman (1996)
    — Non-significant results from Whitehurst et al. (1991)

Generalization to Better Semantics: Intervention for Low Vocabularies

II. Clinician-based models
  ● Positive effects with SLP focused stimulation
    — Kouri (2005)
    — Classroom + supplemental work

Generalization to Better Semantics: Intervention for Low Vocabularies

• Positive effects with parents across naturalistic environments
  — Home: Girolametto, Pearce, and Weitzman (1996); Whitehurst et al. (1991)
  — Clinic group: Lederer (2001)
  — Classroom: Wilcox, Kouri, and Caswell (1991)

• Positive effects with other adult conversational partners
  — Rustan & Schwanefugel (2010)

Generalization to Better Semantics: Intervention for Low Vocabularies

• Positive effects when targeting semantic and phonological features of new words
  — Motsch and Ulrich (2012)

• Explicit vocabulary instruction helps
  — Coyne, McCoach, and Kapp (2007)

Generalization to Better Semantics: Case Examples

• Given what we’ve just discussed
  — How would you alter your intervention for Lara?

  — draw a horizontal line on your original sheet
  — write your changes below the line
Generalization to Better Semantics: Case Examples

• What we did...
  – Hanen model + clinician focused stimulation
  – Sessions targeted prior and new technique
    • parent use previous technique
    • introduce new technique
    • clinician use of technique
    • parent trial of technique
    • discuss parent performance and words to target
  – Later sessions highlighted semantic & phonological features

Generalization to Better Semantics: Intervention for Word Finding

Storage of words + Retrieval of words = WFD

Generalization to Better Semantics: Intervention for Word Finding

Storage of words

Semantics

Phonology

Emphasizes:

Increasing knowledge within lexical entries

Improving connections between entries

Generalization to Better Semantics: Intervention for Word Finding

• Research Evidence
  – Semantic Storage
    • Marks and Stokes (2009)
      – Narrative-based intervention, targeting words through
        » definitional sentences
        » contextual sentences
        » exposure, imitation, and retelling
        – Significant increases in target words
        – Non-significant for control words

Generalization to Better Semantics: Intervention for Word Finding

• Hodgepodge of intervention models
  – single feature
    • semantic storage
  – multiple features
    • semantic vs. phonological
  – multiple features across modes
    • semantic vs. phonological storage vs. both
Generalization to Better Semantics: Intervention for Word Finding

— Phonology Retrieval
  • German (2002)
    — Identified and practiced phonological cues of
      > syllable counting
      > phonological neighbors
      > verbal rehearsing
    — Significant increases in target words
    — Non-significant for control words

— Semantic vs. Phonology
  • Wing (1990)
    — Semantic features
      > definition
t      > categorization
      > picture association
    — Phonological features
      > rhyming
      > syllable count
      > imagery
      > phoneme count
    — Phonological group > semantic group on trained and untrained words

— Semantic vs. Phonology
  • Wright, Gorrie, Haynes, and Shipman (1993)
    — Semantic features
      > category
      > function
      > content
      > description
      > similarity
      > association
    — Phonological features
      > length
      > rhyme
      > rhythm
      > initial sound
      > other sounds
    — Semantic group > phonological group on untrained words

— Semantic vs. Phonology vs. Both
    — Semantic features
      > category
      > attributes
      > functions
    — Phonological features
      > rhyming
      > initial sound
      > syllable counting
    — Words trained under Both conditions were learned the best

Intervention = ↓ # WFD

Improvement = Storage + Retrieval

Improvement = Semantic + Phonology

↓ WFD = TEACHING > TESTING
Generalization to Better Semantics: Case Examples

• Given what we’ve just discussed
  – How would you alter your intervention for Luigi?
  – draw a horizontal line on your original sheet
  – write your changes below the line

Generalization to Better Semantics: Case Examples

• What we did...
  – Teach semantic and phonological features for common words
    • sorting and grouping activities
    • identifying
  – Identify the features in low frequency words
  – Identify the features in target vocabulary words
    • within contexts

Unlocking Future Rewards

• What might the future hold???
  – Selecting groups of words based on semantic and phonological neighbors

Unlocking Future Rewards

• What about your future???
  – What questions and comments do you have?
  – How might you change your practice as a result of this conference?

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Core References

Video Game Principles

Full Experience of Semantics

Discovery & Risk Taking In Semantic Development

Core References


Research Evidence: Low Vocabularies

Core References


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Research Evidence: Low Vocabularies
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