Reading: Effort, Choice, Vocabulary, and Reinforcement

Christopher H. Skinner

The University of Tennessee

Delivered at the Ohio School Psychology Associate Annual Conference: October, 2018

Start out with my mistakes… again

Why do I do that?

Actually, not sure.

As a behavioral scientist, I am always not sure – I never want to give you the idea that I think I have all the answers, or any complete answers.

We all have lots of work to do.

My Brief History with Brief Reading Rate Measures

Read Deno and Mirkin – 1977 manual on CBM

Taught 10th grade EBD and poor readers were assessed 1 or 2 times per week using CBM.

Teachers (we) made probes or passage from curricula. Student read them aloud and we measure oral reading fluency (WCPM).

Teachers assigned parts of curricula and went through our grade level text and picked out passages.

My Brief History with Brief Reading Rate Measures

Getting passages from text was a challenge because we needed:

1. enough words on a page (so there was no page turning)
2. No pictures
3. No poems, songs, etc.
4. Few unusual proper names

Note – may be harder with young children because now material often contains unusual (e.g., foreign) proper nouns. Most common form of multi-cultural education – little research.

My Brief History with Brief Reading Rate Measures

Today, we download passages and collect ORF data.

Why did we insist on getting passages from the curricula?

Text-test overlap studies looked a standardized reading test and popular curricula. Check for common words (i.e., overlap).

If high text-test overlap: students scored high on reading achievement test. If lower text-test overlap they scored lower.

Idea – test what is taught – but down to the level of word overlap?

My Brief History with Brief Reading Rate Measures

As research continued, we determined that with ORF, probe (i.e., test) – text overlap was not all that important. Now, we can download our probes (test) from various sources – so much easier, so many different probes. Also, it's no longer a curriculum based measurement.

Thus, I tend to say Brief Reading Rate Measures.

Dr. Reschly (Dan) suggested that this concern over test-text overlap delayed the large scale application of ORF measures (e.g., RtI) by 15 years.

Teaser Question to Come Back To? Why did text-test overlap matter for standardized reading achievement tests back in the day, but not for ORF?

My Brief History with Brief Reading Rate Measures

Some Personal Stories:

I hung folders on a bulletin board. In the folders were progress graphs (e.g., WCPM across the school year) that were measuring each student's (who was behind) growth.

Would plot and the student could lift their folder and see the graph of their growth.

One day I was giving CBM instruction and a student said wait, took a deep breath, pointed at me, and I said "begin." He began spew reading (no porosity), but WCPM were really high.

Like a knucklehead, I plotted his point. An administrator came in my room, lifted his graph, and fussed over the student for his strong reading improvement.

Now, my other students did the same. I instructed them not to do that and eventually they (students with EBD) stopped.

My Brief History with Brief Reading Rate Measures

OK – back to CBM, they do not have to be from the curricula.

But what about measuring ORF or words correct per minute from intact grade-level passages?

Criticism – just measuring word calling or WORD BARKING.

My Brief History with Brief Reading Rate Measures

Word Barking – don't you love it?

Behaviorist – I like direct measures of functional skills.

Reading aloud rapidly and accurately – Functional for who?

- Radio and TV personalities.

But often TV personalities should comprehend what they are reading!
If not, they read a tragic stories with a happy smile on their face.

Another Mistake I Made

Even 30 years ago they could compress speech.

So, I was doing LWR studies and a colleague thought we should measure comprehension from radio commercials and manipulate reading speed.

We did it. I hated it and had to read all this material that was not related to my areas of interest.

I struggle to keep up with *my own* topics – with my limited abilities, I did not and do not need to make more work for myself reading radio commercial studies.

My Brief History with Brief Reading Rate Measures

Back to Word Barking

Behaviorist – I like direct measures of functional skills.

The purpose or function of reading is almost always comprehension.

When we read for comprehension, we read silently.

There is evidence that silent reading is different from aloud.

My big idea – Change the numerator in words correct per minute.

My Big Idea: Measure Reading Comprehension Rate

ORF measured using WCPM: words read correctly/time spent reading

MAZE- correctly selected words/time spent reading

My big Idea:

Reading Comprehension Rate (RCR) –

% comprehension questions correct/time spent reading.

Note: while we use different numerators, all measures include a measure of reading speed.

My Big Idea: Measure Reading Comprehension Rate

I began measuring reading comprehension rate (RCR).

Spargo timed reading series: each passage had 400 words and 10 comprehension questions: 5 factual and 5 inferential.

Get 8 correct: 80% in numerator, 4 minute (240 s in denominator)

Ralph comprehended 20% of the story for every minute spent reading.

Could do it silently.

Wow, I thought I was onto something,

My Big Idea: Measure Reading Comprehension Rate

I thought I was onto something. Called it RCR. Now I am really getting somewhere – I even have a 3 letter acronym – it must be good!

Soon realized (working with EBD) that students had to read it aloud.

EBD students – as I moved through with repeated measures during SS design studies:

Students started scanning the test and guessing from the three options.

They scored high because their denominator (seconds to read) went very low, impossibly low – but they got some really high RCR scores.

1) First problem with RCR measure – could not read silently.

My Big Idea: Measure Reading Comprehension Rate

Other problems with RCR when measured with students reading aloud:

1. Need equivalent passages for oral reading speed (really hard).
2. Also need equivalent comprehension questions
3. Also need comprehension questions that are not dependent on prior learning
4. Need open-ended questions or more options on multiple choice
5. Need more questions to get a big enough range of scores in numerator – (word correct per minute – range from 0 to 150).
6. Need longer passages – now takes more time. More questions – takes more time.

NOW NOT SUCH BRIEF MEASURSES

My Big Idea: Measure Reading Comprehension Rate

Final problem – not consistently better than WCPM, even for older students.

Regardless, we did run some studies which showed that RCR correlated strongly with standardized reading achievement measures.

While this sounds good, we did more than try to support my big idea, we in fact tested it and found that the measure of reading speed embedded with the RCR measure accounted for almost all of the relationship. I KILLED MY OWN BIG IDEA!

My Big Idea: Measure Reading Comprehension Rate

		Fourth Grade	Fourth Grade	Fifth Grade	Fifth Grade	Tenth Grade	Tenth Grade
Predictor Variables	Criterion Variable	Reading Speed	Reading Rate	Reading Speed	Reading Rate	Reading Speed	Reading Rate
Words Correct	WJ-III BRC	.788 (.621)	.842 (.709)	.808 (.653)	.896 (.803)	.751 (.564)	.761 (.579)
Words Correct	TCAP	.620 (.384)	.633 (.401)	.592 (.350)	.742 (.551)		
% Comp Correct	WJ-III BRC	.795 (.632)	.905 (.819)	.773 (.537)	.834 (.695)	.751 (.564)	.712 (.507)
HP Correct	TCAP	.621 (.386)	.605 (.366)	.619 (.383)	.732 (.536)		

My Big Idea: Measure Reading Comprehension Rate

What does this table mean? It means that the numerator is not all that important, but reading speed predicts much of general reading skill development.

Almost all brief reading rate measures have a reading speed measure embedded within them.

See highlighted punctuation correct per minute.

Cloze, Maze, RCR, HPC/M are all going to be good GOMs because reading speed is embedded, but are they good measures.

Also, it means my RCR measure was not all that and a bag of chips.

Oh well, at least I am in pitching - and **it does directly measure a functional skill.**

My Big Idea: Measure Reading Comprehension Rate

I still hope we can develop direct measures of functional reading skills.

The problems I indicated may not be insurmountable.

However, WCPM (word barking speed) does predict general reading skills very well (gets weaker as we age).

GOM – general outcome measure

RCR measure does directly measure a functional skill.

WC/M does not - Are there ways to enhance WC/M without enhancing reading skills?

Concept of Reading Comprehension Rate

All was not lost – all this working on RCR made me appreciate the importance of reading speed and reading comprehension rates.

Two important points to consider:

Point 1:

1. Teaser Question to Come Back To? Why did text-test overlap matter for standardized reading achievement tests back in the day, but not for ORF?

I think it is because older reading achievement tests measured accuracy, not speed. When only measuring accuracy, word overlap is important.

However, our brief reading rate measures and now our reading achievement tests have measures of reading speed embedded within.

Note: I do not know this or have data to support it – just a hunch.

Concept of Reading Comprehension Rate

All was not lost – all this working on RCR made me appreciate the importance of reading speed and reading comprehension rates.

Second important point to consider:

Conceptually – still a very good idea to enhance RCR.

To understand this we need to understand:

1. a different measure – chuckles per minute (C/M),
2. basic research on choice
3. spirals and the Mathew Effect

Choosing to Read, Reading Speed, and Spirals

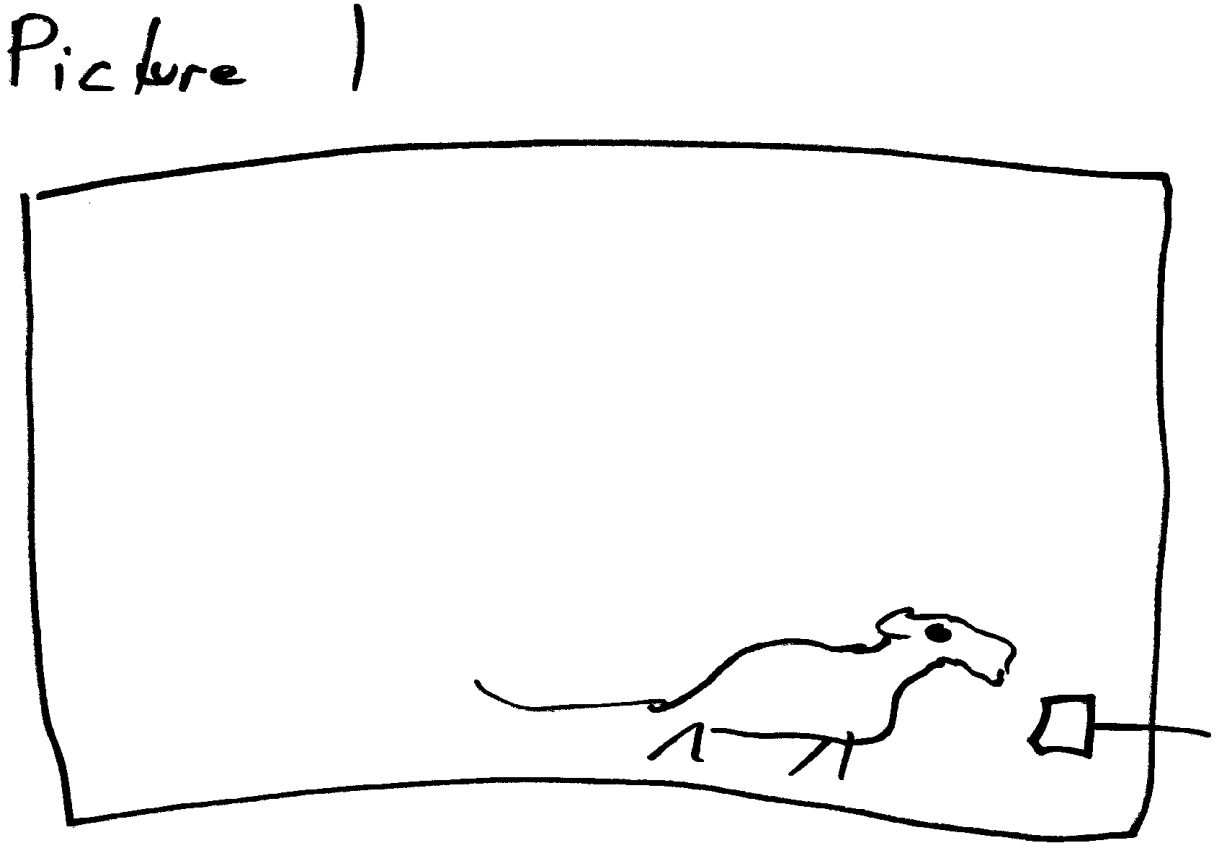
Choice

Getting student to choose to read is critical

CHOICE: A Brief History

B.F. Skinner - **R+ Rates effects bar pressing**

CHOICE: Picture 1



CHOICE: A Brief History

B.F. Skinner

Re-conceptualize - Press the bar or *not* (choice).

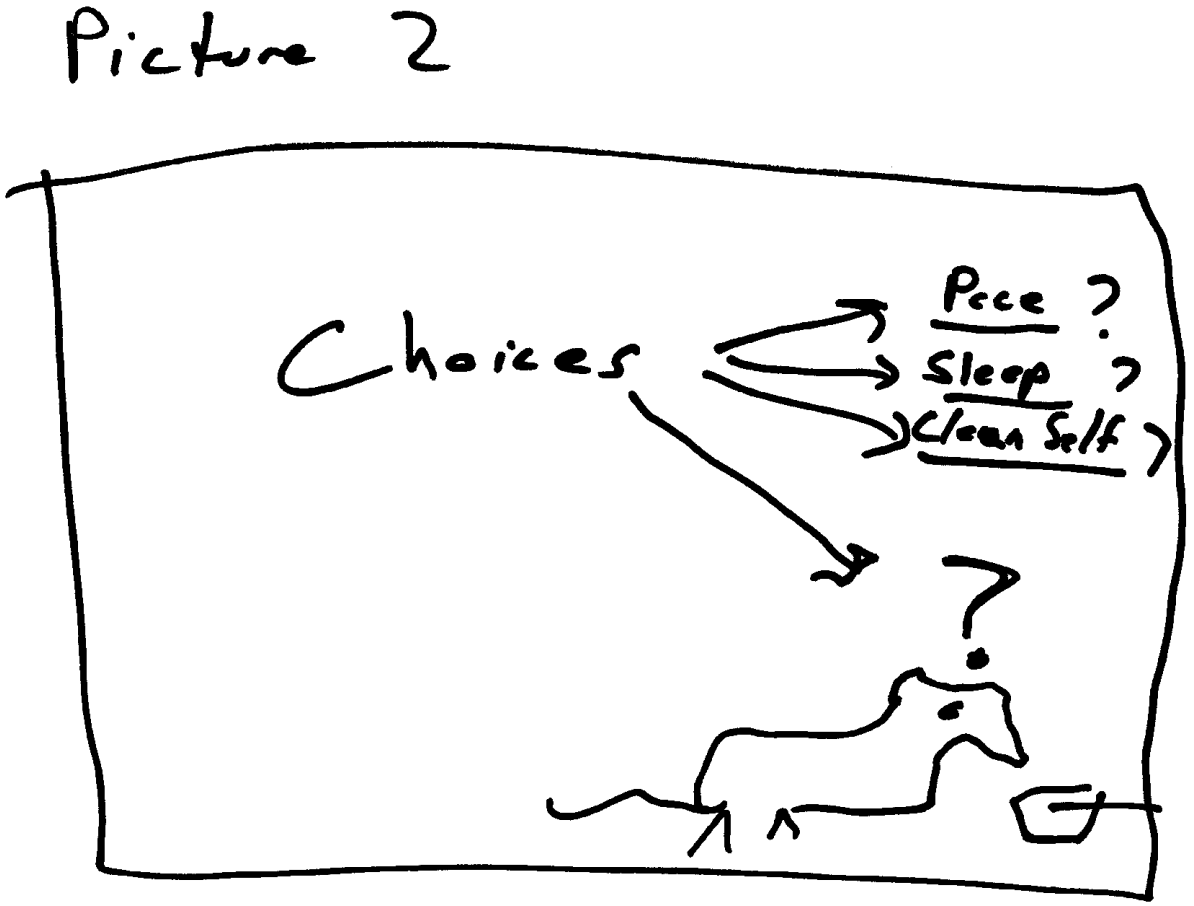
What do organisms choose to do when they choose **not** to engage in target behavior?

- Unless they're dead, they have to be doing something.

Rat may pace, sleep, clean self, or go to bathroom.

Choice is not always conscious.

CHOICE: A Brief History



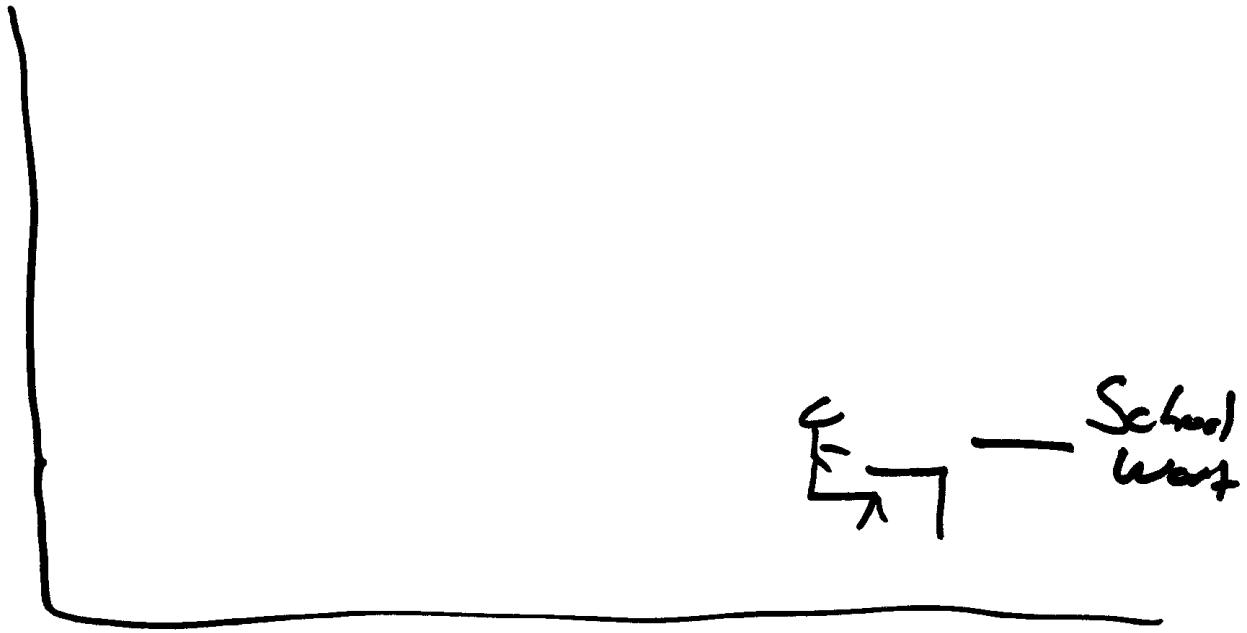
CHOICE: A Brief History

Students in cages?

- Some report feeling that way.

Regardless, reinforcement rates can increase the probability of students choosing to do the school work.

Picture 3



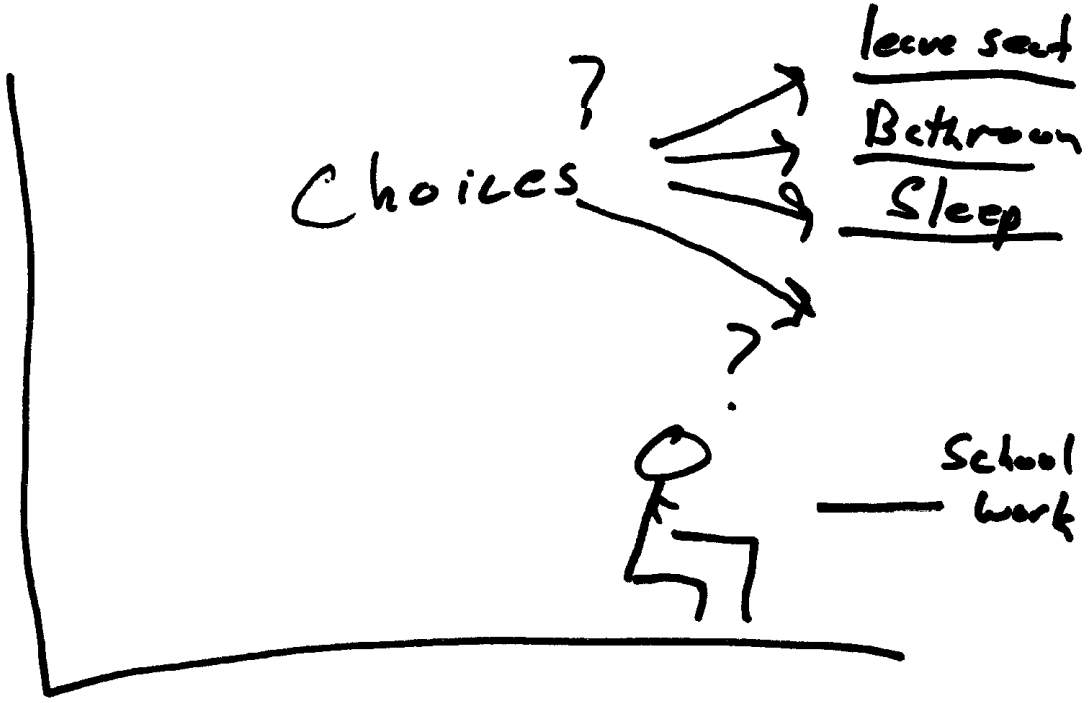
CHOICE: A Brief History

The choice model is more appropriate because at any given in moment in time, students can choose to engage in target behaviors (school work) or an infinite number of alternative behaviors.

What do students choose to do when they choose not to engage in target behavior?

CHOICE: A Brief History

Picture 4



CHOICE: A Brief History

What do students choose to do when they choose not to engage in target behavior?

Schoolwork or an infinite number of alternative behaviors

- Students – choice is sometimes passive (sleep).
- Sometimes disruptive behaviors
  - Pace - leave seat
  - Clean self- go the bathroom
  - Others?

CHOICE: A Brief History

Student Choices: We focus on big choices with clear and often immediate negative consequences - looking both ways before crossing the street, unprotected sex, drug use, etc.

Our ability to influence students' everyday, moment-to-moment choices – specifically choosing to do school work – is critical for their success and contribution to society and their children's (parents' SES predicts) – if choose to do the work, do better in school, raise your own SES, and pass it on to children.

Note: choices are often unconscious.

CHOICE: A Brief History

Richard Herrnstein:

*Added another bar to the operant chamber

*Now 2 bars and can choose what to press

This model of studying choice is superior

CHOICE: A Brief History

Picture 5

CHOICE: A Brief History

Richard Herrnstein:

Found: choice is *relative* and mathematically *predictable*.

Relative: Which bar they CHOOSE to press can be precisely predicted based on RELATIVE (not absolute) rates of reinforcement.

Example:

Reinforced VI 10 minutes for pressing bar A.

Reinforced VI 5 minutes for pressing bar B.

Will press Bar B at TWICE the rate as bar A(5-10) .

Predictable: It is known as the Matching Law.

CHOICE: A Brief History

Other research by Herrnstein, Mace, Skinner (**C.H. me!**) showed that students' choice is based on relative:

1. Rate of reinforcement
2. Quality of reinforcement
3. Immediacy of reinforcement
4. Response effort (INVERSE)

CHOICE AND READING SPEED

Earlier, I made the point that we read for comprehension.

Now, I will explain why fluent readers are more likely to choose to read.

Consider two students – Fred Fluent and Sam Slow.

Each given the same 1500 word material to read. It is funny, Mark Twain material.

Fred reads it in 10 minute (150 word read per minute)

Sam reads it in 20 minutes (75 words read per minute

CHOICE AND READING SPEED

While reading, Fred's comprehension is high and he chuckles 10 times.

While reading, Sam's comprehension is high and he chuckles 10 times.

Fred finishes in 10 minutes and as he finishes the last line he breaks out into a belly laugh.

Sam finishes in 20 minutes and as he finishes the last line he breaks out into a belly laugh.

Equal Comprehension!

CHOICE AND READING SPEED

Consider that a chuckle denotes a low quality reinforcer and a belly laugh, a high quality reinforcers. Who is more likely to choose to read?

Rate of low quality reinforcement or Chuckles per Minute (CPM). It is three letters – Perhaps I am on to something.

Fred – 1 chuckle per minute

Sam – 1 chuckle per 2 minutes

Fred is more likely to choose to read – thicker schedule of reinforcement.

CHOICE AND READING SPEED

Consider that a belly laugh represents a high quality reinforcer for reading. Who is more likely to choose to read?

Fred – 1 belly laugh following 10 minutes of reading (more immediate high quality R+)

Sam – I belly laugh following 20 minutes or reading (more delayed high quality reinforce).

Fred is more likely to choose to read – high quality R+ is less delayed or more immediate.

CHOICE AND READING SPEED

Now, let's consider effort.

Who expends more effort to get the chuckles and belly laugh?

Effort is hard to measure, but generally we consider that when something requires more time, it requires more effort (human factors engineer at MSU told me they often measure effort with time).

Fred requires less effort to read material than Sam.

Fred is more likely to choose to read because it required less effort to obtain 10 chuckles and one belly laugh.

CHOICE AND READING SPEED

Now, let's consider some research from cognitive psychologists –

- Those who read faster – comprehend more.

We have limited cognitive resources, attentions, and information held in short term or working memory…

Fluent readers spend fewer of those resources on activities like decoding – thus have more to apply to comprehension.

Thus, Fred is more likely to have all 10 chuckles and the Belly laugh.

Sam – may not get all 10 chuckles or the belly laugh because his comprehension is weakened by his disfluent reading.

SPIRALS OR THE MATHEW EFFECT

The Law of Effort and the Matching Law both suggest that when given a choice to read or to engage in another behavior, *fluent* readers are more likely to choose to read because:

a. lower effort

b. higher rates of R+

c. more immediate R+

SPIRALS OR THE MATHEW EFFECT

How do we enhance fluency?

Practice or by engaging in high rates of active, accurate, and academic responding (AAA responding).

Who is more likely to choose to read, thereby enhancing fluency (and many other thinks like vocabulary)?

Fluent reader.

Thus, the Fluent reader becomes more and more fluent as he chooses to read- **Upward Spiral**

The Disfluent reader falls further and further behind as he repeatedly chooses not to read, because the effort is not worth the reward.

Getting Students to Choose to Read

Earlier, I discussed getting students to choose and apply effort to doing math by giving them a chance to earn external reinforcement via the application of interdependent group bonus rewards.

How does it work with reading?

Note, my data is not as strong, but let's discuss if we could do it better than these two studies.

Academic Targets: Accelerate Readers Sharp & Skinner, ...

Study 1: AR

Students: 13 second-grade African-American Students

They have an *Accelerated Reader* program which includes:

1. Hundreds of chapter books at various grade levels for students to read
2. For each book, comprehension questions on computer
3. When finished reading they take computer test – give points based on difficulty and percent correct
4. Record, who took what, when

Accelerated Reader:
Enhancing sustained silent reading

Cool program – *only works if students choose to read.*

Encouraged to check out chapter books, read them, take quizzes, even get extra credit.

Time allotted each day to read chapter books – 30 minute of sustained silent reading time

Problem- students are not doing it.

Accelerated Reader:
Enhancing sustained silent reading

Target behavior: number of chapter book quizzes passed (60% was considered passing)

<u>Criteria – Two contingencies</u>

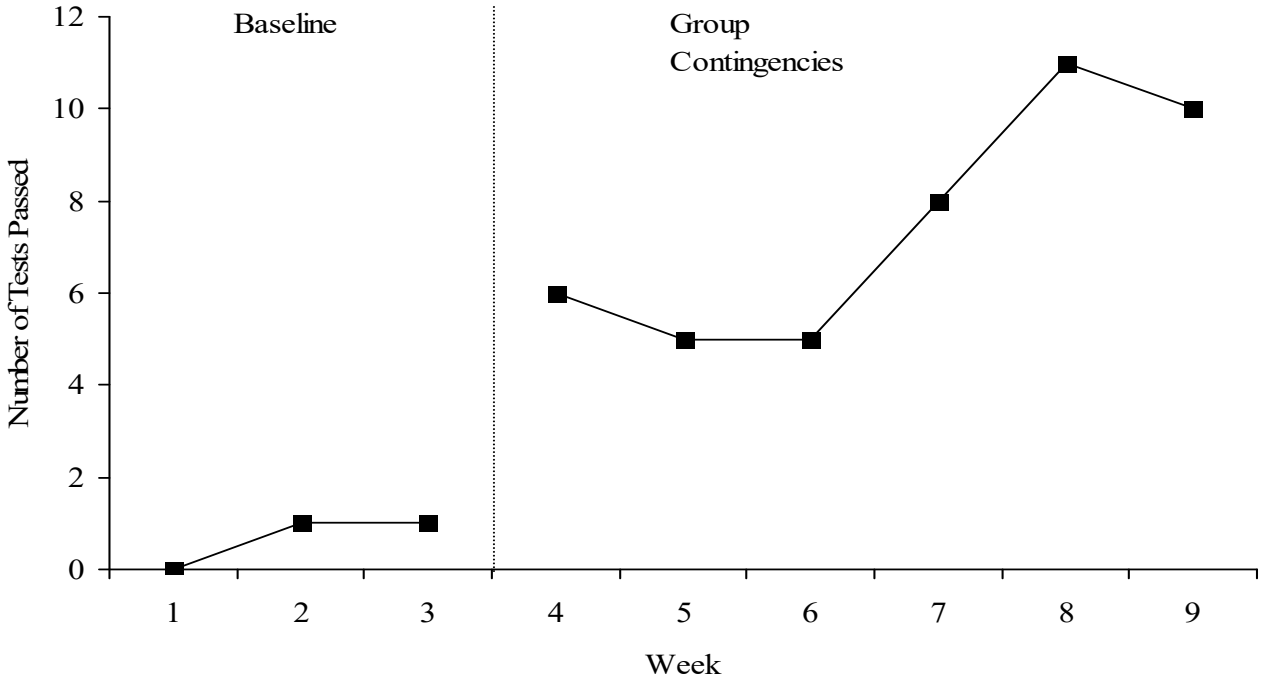
1. Each child that passes 1 quiz in 6 weeks will get ice cream
2. Each week, a randomly selected number passed gets free time

*Criteria were 1-13

Accelerated Reader:
Enhancing Sustained Silent Reading

Procedures :

- Explained to students
- Paired students for paired readings, take turns reading pages from same book until all pass
- Paired with similar level reader, except weakest reader was paired with strong reading friend
- After each pair passes a test, they can choose to read alone.
  - (more than half stayed in pairs)
- Rigged first week – all slips said 6.
- Show the data


Baseline
Group
Contingencies
Number of Tests Passed
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
Week

Accelerated Reader: Individual Student Data

14 students	**Baseline**	**Intervention**
• 4 Students	0	1
• 1 Student	0	2
• 2 Students	0	3
• 4 Students	2	5
• 1 Student	0	6
• 1 Student	0	7
Class/Wk	0.70/wk	7.5/wk

Alphie Kohn would he have them continue not reading?

Academic Targets: Accelerate Readers Pappas & Skinner, ...

Study 2: AR

Students: from three 4th grade classrooms.

All participated, but did not receive permission to collect data on 19 students, so graphs are a bit wonky.

They have an *Accelerated Reader* program.

Academic Targets: Accelerate Readers Pappas & Skinner, ...

Study 2: AR

TCP: each teacher provided 30 mins for independent reading – encouraged reading AR books then and when independent seat work was complete.

Students encouraged to take quiz as soon as possible.

Had trinket that students were given occasionally for passing quiz.

Problem – not taking or passing quizzes, not reading!

Academic Targets: Accelerate Readers Pappas & Skinner, ...

<u>Study 2: AR</u>

Intervention: Randomly selected criteria and rewards.

Student could suggest rewards.

Criteria was based on total AR quizzes passed per week.

Rigged first week, so they barely won – if they read 10, then we selected 9.

- *Priming the Pump*

Academic Targets: Accelerate Readers Pappas & Skinner, ...

Study 2: AR

Teacher A and B agreed upon rewards (a) ice cream party, (b) popcorn party, (c) lunch in the classroom, (d) music during seatwork, (e) board game day, (f) pajama day, (g) treat day (i.e., candy bars or cookies), (h) computer time, (i) free pencils, (j) extra free time, and (k) arts and crafts day. Randomly selected criteria and rewards.

Teacher C had her own list of high quality rewards.

Rewards delivered some time the next week!

Academic Targets: Accelerate Readers Pappas & Skinner, ...

<u>Study 2: AR</u>

Only 1 reward was suggested throughout the study and it was rejected by teacher.

Note: if they met or exceeded randomly selected criteria, a reward was randomly selected.

If not – then we did not **pull a Wheel of Fortune** (*a technical behavioral term*) and selected one and show them what they could have won.

Academic Targets: Accelerate Readers Pappas & Skinner, ...

Study 2: AR

School attendance ranged from 87% to 92%.

If attendance was ever below 75%, we would have excluded data.

This is because it was cumulative quizzes passed.

Academic Targets: Accelerate Readers Pappas & Skinner, ...

Study 2: AR

Four day weeks were a limitation:

- Week 4 (baseline)
- Weeks 5,7,8, 9, 12 (intervention phase)

Quizzes Passed

Figure 1. Average daily quizzes passed by class.

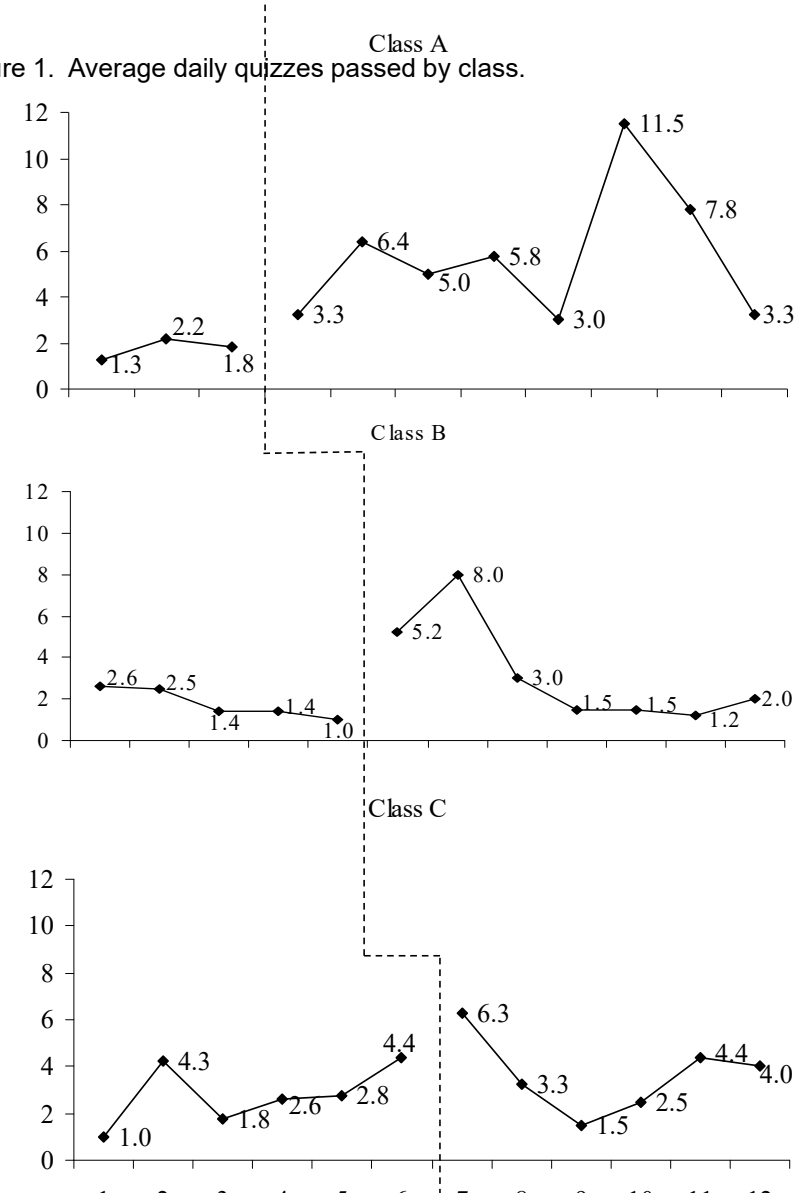


Table 3
Quizzes Passed, Means, Standard Deviations, and Effect Sizes (*N* = 32)

Cohens ES

Group	N	Baseline Mean	Baseline standard deviation	Intervention mean	Effect Size
Class A	9	1.50	0.73	4.71	4.42 Large
Class B	10	1.74	0.81	3.06	1.63 Large
Class C	13	2.29	1.26	2.78	0.39 S to Mod
Total Sample	32	0.95	0.82	1.87	1.14 Large

Results – Quizzes passed

ES data makes intervention appear better than visual analysis of graph.

Strongest with class A: Averaged about 1.7 in baseline, increased all the way to 11.5 one day, no overlapping data points – variable intervention phase performance. Decreasing trend last two sessions.

Class B showed immediate increase and then worked back down to baseline levels after 3rd week. Again a decreasing trend.

Class C – not much evidence of effect – highest during baseline of the three classes.

No decreasing trend though?

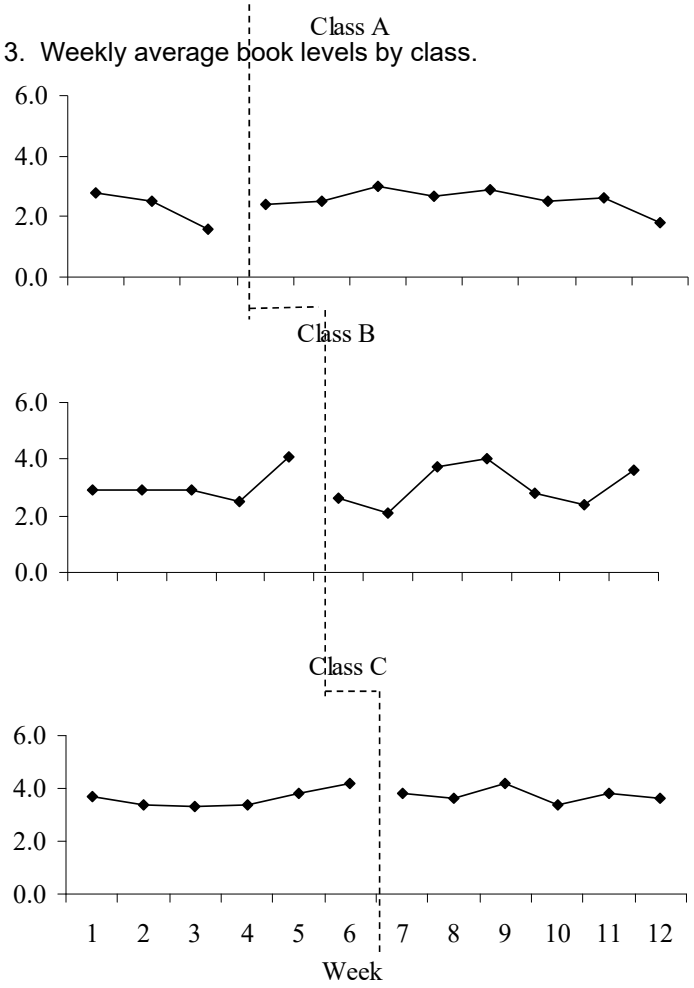
Quizzes Taken? Look almost exactly like quizzes passed. They were not taking quizzes without reading – might as well try. Little failing quizzes.

Choose to read easier material

Both Kohn and Law of Effort suggest that they should choose to read easier material.

What did we find regarding reading levels of quizzes attempted?

Figure 3. Weekly average book levels by class.



Average Book Level, Means, Standard Deviations, and Effect Sizes (*N* = 32)

ES Average Book Level – not much diff

Group	N	Baseline Mean	Baseline standard deviation	Intervention mean	Effect Size
Class A	9	2.30	1.49	2.55	0.17
Class B	10	3.06	0.61	3.03	-0.05
Class C	13	3.62	0.34	3.73	0.34

Reading Easier Books - Nope

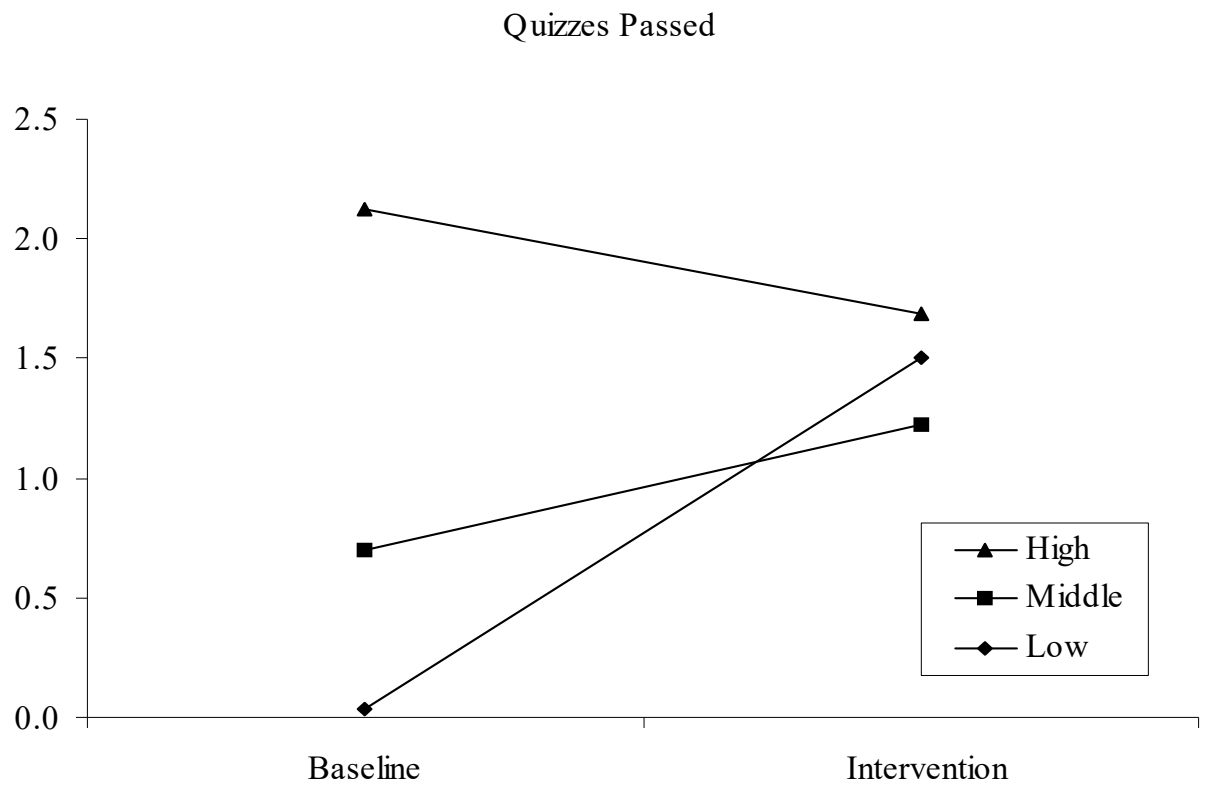
Not much difference in grade level material

Perhaps most students and people want to read material at their grade level.

Students choosing a lot of 3rd grade level material. This is probably about the average level at this school (behind in reading).

Note: children do not want to read little kid books. Also, belly laughs hard to come by with little kid books (material not R+).

Quizzes Passed by Students Group by Baseline



Groups

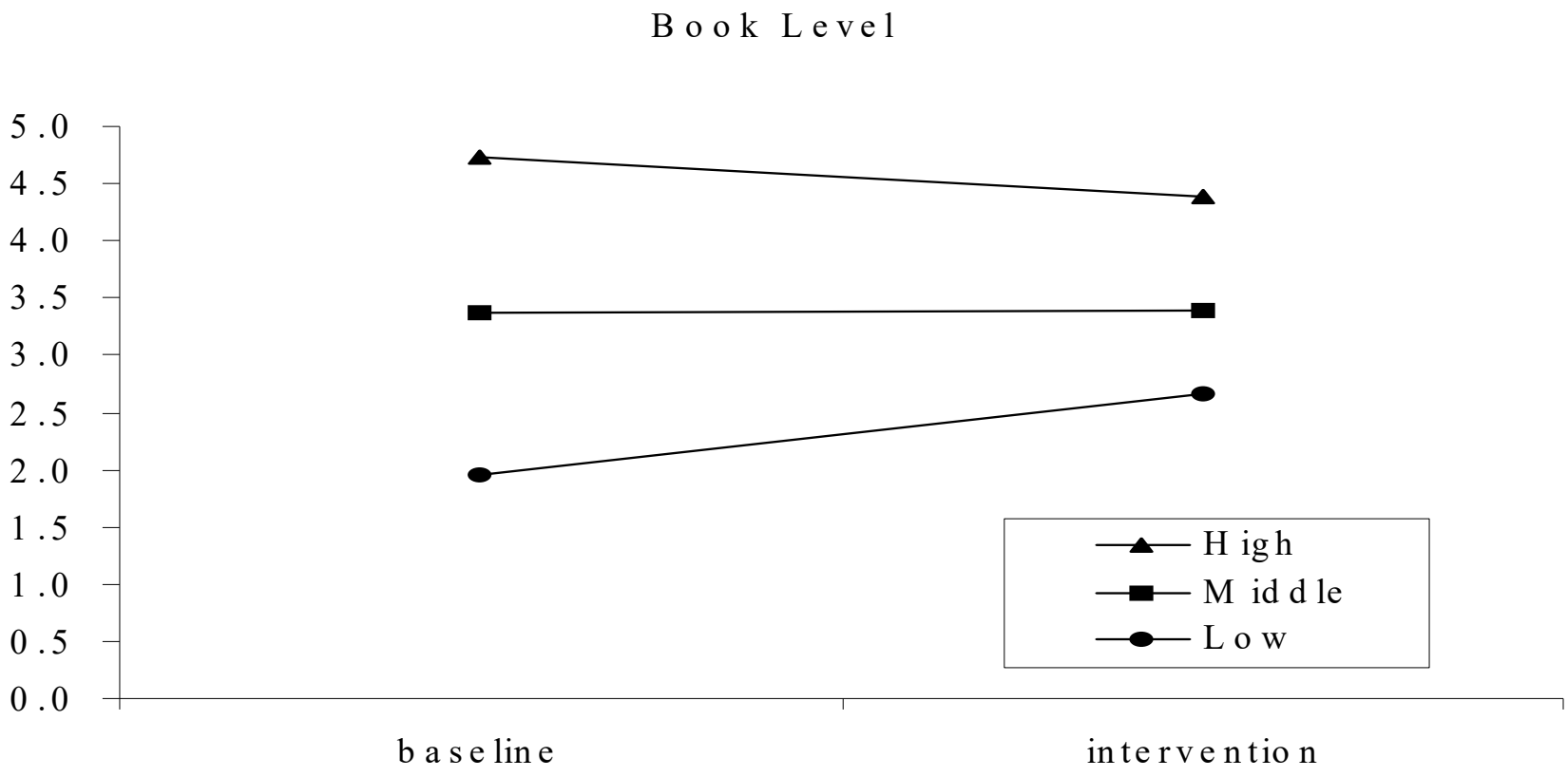
Strong baseline performers went down a bit.

Moderate went up a bit more than strong went down.

Non-participants (0 quizzes passed) shot way up –

They could do it, just need R+

Choose easier books



Limitation

Weakest readers read and passed more quizzes. Also, read higher level material, but still below the moderate and high performers.

Those reading more and high material went down a bit in both (small, but not what we want to see).

Moderate- read more and same level material.

Acceptability Measures

Note: both teachers and students liked it. Teacher C liked it least (4.75 on 6 point scale).

Students really like it: 3.3 – 3.6 on 4 point scale.

What should we do different?

Let's talk about what we could do different to enhance effectiveness.

Problem 1 – reinforcers really delayed. Immediacy matters. Even older kids will take a couple marshmallows now over a bag later.

Solutions:

1. smaller, more immediate rewards (daily?).
2. If determine criteria on Friday – give reward on Friday
3. Publicly post to provide feedback on progress or stimuli that suggest reinforcement is closer in time and more likely

What should we do different?

Problem: The rewards are pretty unique (scarce). However, I am concerned that students did not suggest any.

Solutions:

1. Provide cues to students about types of rewards give examples of things, activities, edibles etc.

2. Perhaps rig it – you drop one in and pretend it was a student?

Challenge

No one to share with?

Reading clubs.

Ran a student ART of reading and found that previewing procedures (e.g., Scan material, write questions that you have that may be answered by material) only helped when we asked them to discuss their questions and what they found with their elbow partner who read the same material???

II. Big shift to hard words and vocabulary

My student, Kala Taylor, read some articles which suggested funny hard-to-read fonts would enhance reading comprehension.

We thought it would distract and slow down, thereby decreasing comprehension.

Here are the three studies Kala ran for her dissertation!

Effects of Difficult-to-Read Material on Learning

Kala L. H. Taylor, M.s.
Christopher H. Skinner, Ph.D., Advisor
University of Tennessee

Overview

- Simple educational materials reduce cognitive load and learning and comprehension (Allington, 2009; National Reading Panel, 2000).
- Difficult-to-read materials that increase cognitive processing (cause cognitive disfluency) learning (Alter, 2013; Bjork, 1994; McDaniel & Butler, 2010).
- **Purpose:** Evaluate potential applications of cognitive disfluency which have not been previously studied: isolated word acquisition during constant time delay; unfamiliar diverse names in children's texts.

Review of Literature

Cognitive Load

- Learning information that requires increased cognitive effort burdens the information processing system (Sweller, 1988; Sweller & Chandler, 1994).
    - Used to explain differences between experts and novices.

Cognitive Disfluency

- Levels-of-processing framework (Craik & Lockhart, 1972).
- Disfluency causes deeper processing (Alter, 2013; Bjork, 1994).
    - Reduces confidence in understanding the material, signaling the learning to pay close attention (Alter, 2013; Alter et al., 2007).

Review of Literature

Perceptual Fluency

- The subjective ease of cognitively processing text (Katzir, Hershko, & Halamish, 2013).
- Perceptual fluency manipulations make text difficult to read: missing letters (Maki et al., 1990), hard-to-read fonts (Diemand-Yaumana et al., 2011), inverted text (Sungkhasettee et al., 2011), small letters (Rhodes & Castel, 2011), blurred text (Yue et al., 2013).
  - Some found difficult-to-read materials increased recall and comprehension (e.g., Diemand-Yaumana et al., 2011).
  - Others found decreased learning or no effects (e.g., Yue et al., 2013)

Review of Literature

Aptitude-Treatment Interactions

- Perceptual fluency manipulations may hurt novice readers but help skilled readers.
- Evidence is mixed:
  - Katzir et al. (2013): Disfluency reduced reading comprehension of second-grade sample but increasing reading comprehension of fifth-grade sample.
  - French et al. (2013): Disfluency increased performance on a multiple-choice comprehension test, for 9^{th}-11^{th} grade students across ability levels, especially those with Dyslexia.

  (*Monotype Corsiva* vs Arial font).

Review of Literature

Possible Implications of Cognitive Disfluency for Multicultural Education

- Majority of US student population will be students of color in less than a decade (U.S. Department of Education, 2016).
- Multicultural education reduces racial attitudes (Okoye-Johnson, 2011) and improves critical thinking (Gurin et al., 2002; Zirkel, 2008).
- The most widely implemented and least studied element of multicultural education is the inclusion of multicultural content in the curriculum (Zirkel, 2008).

Review of Literature

Multicultural Literature

- Increases understanding of diverse cultures and can be used to start conversations about changing oppressive situations (Souto-Manning, 2011).
- Includes diverse names.
  - Help children strengthen their identities (Peterson et al., 2015)
  - Often phonetically unfamiliar (phonetic features and rules differ across languages).
    - May slow students down (reduce fluency and comprehension), increase response effort (reduce response frequency)
    - Young students may lack problem solving schemas to address the names.

Summary and Purpose

Summary

- Learning is generally thought to be best supported with simple materials that avoid high cognitive load (Allington, 2009; National Reading Panel, 2000), but some have suggested increasing cognitive effort by introducing disfluency can improve learning (Alter, 2013; Alter et al., 2007).

Purpose

- Evaluate new applications where difficult-to-read materials may cause cognitive disfluency: isolated word acquisition during constant time delay; unfamiliar diverse names in children's texts.

Research Questions

- **Study 1.** Do difficult-to-read fonts hinder sight word acquisition in students with intellectual disability?
- **Study 2.** Do difficult-to-read diverse names hinder elementary student's reading comprehension and reading comprehension rate?
- **Study 3.** Can reading difficulties presented by diverse names (impaired reading comprehension and rate) be effectively mediated with a simple intervention (computerized flashcard reading paired with a brief introduction to characters)?

Overview of Study I

- Purpose: Extend perceptual fluency research to S-R-S flashcard learning trials.
  - We used an adapted alternating treatments design to evaluate and compare sight word learning when flashcards were presented in fluent and disfluent fonts.
- Participants
  - Three college students with intellectual disability who attended a post-secondary education program
- Design: Adapted alternating treatments (Sindelar, Rosenberg, & Wilson, 1985).

- Primary dependent variable: Number of words acquired
- Results: All students acquired and maintained fluent and disfluent words. Two learned more fluent words.

Figure 1.1. Cumulative number of words Sadie acquired across conditions.

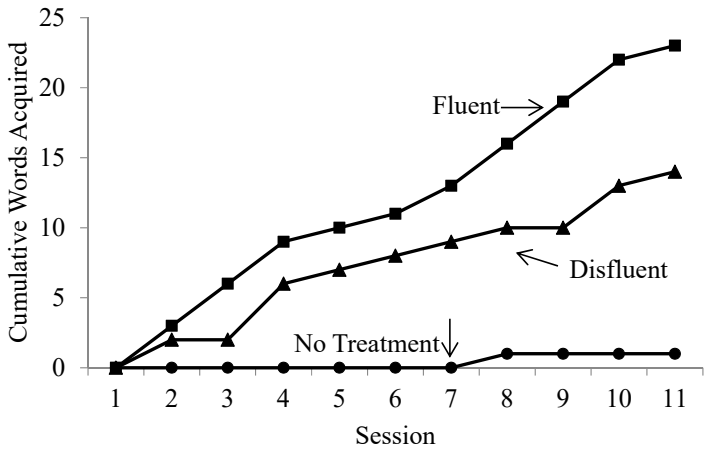


Figure 1.2. Cumulative number of words Emily acquired across conditions.

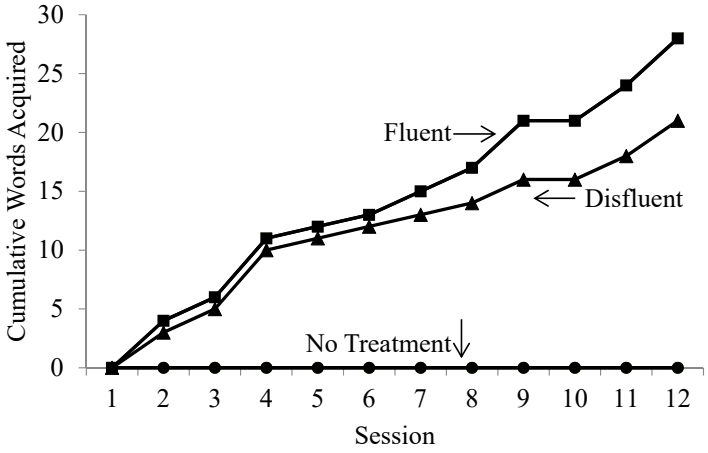


Figure 1.3. Cumulative number of words Tom acquired across conditions.

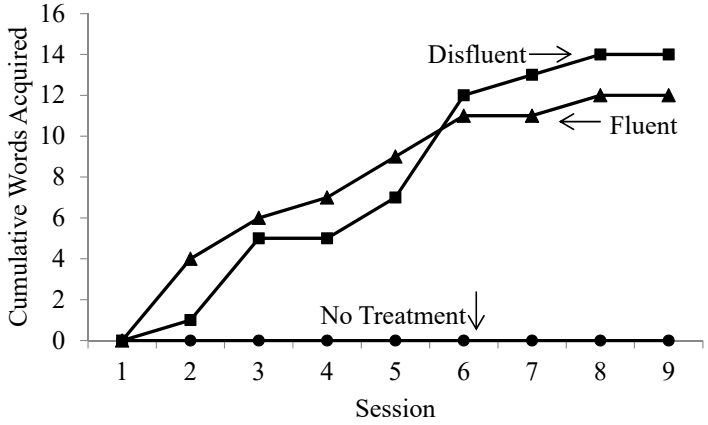


Table 1.1
Total Acquired Read Correctly During Each Maintenance Session

	Fluent		Disfluent		No Treatment	
Student	Session 1	Session 2	Session 1	Session 2	Session 1	Session 2
Sadie	14 (61%)	15 (65%)	7 (50%)	7 (50%)	1 (100%)	1 (100%)
Emily	24 (86%)	26 (93%)	16 (76%)	18 (86%)	0 (0%)	0 (0%)
Tom	10 (71%)	10 (71%)	9 (75%)	8 (67%)	0 (0%)	0 (0%)

Overview of Study II

- Purpose: Determine whether the presence of unfamiliar diverse names in grade-level reading passages effects reading comprehension and rate.
- Participants: 74 first-third grade students from a rural southeastern elementary school.
- Design: Mixed-factors experimental design. Each student read one passage including simple, common names and one passage including unfamiliar diverse names.
- Results: The students' reading comprehension and comprehension rate were both significantly higher on the standard passages than the experimental passages. Effect sizes were moderate.
  - Reading comprehension: $F(1,70) = 9.35$, $p = .00$, $d = .52$
  - Reading comprehension rate: $F(1,70) = 37.12$, $p = .00$, $d = .77$

Table Descriptive statistics for students' scores by standard passage

Condition	Speed	Accuracy			Rate	
		WRC	WRC-N	% Comp Correct	WCPM	%QCPM
Standard	168.48 s	193.15	196.12	71.84%	81.25	33.03%
Experimental	220.55 s	174.22	195.85	60.43%	52.85	20.31%

Note. WRC = words read correctly; WRC-N = words read correctly excluding name errors; % Comp Correct = percent comprehension questions answered correctly. WCPM = words correct per minute spent reading; %QCPM = percentage of comprehension answered correctly per minute of reading time.

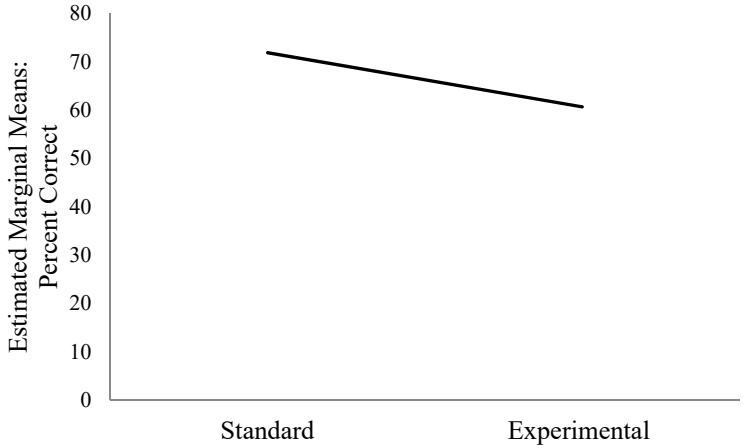


Figure 2.1 Main effect of passage type in reading comprehension scores

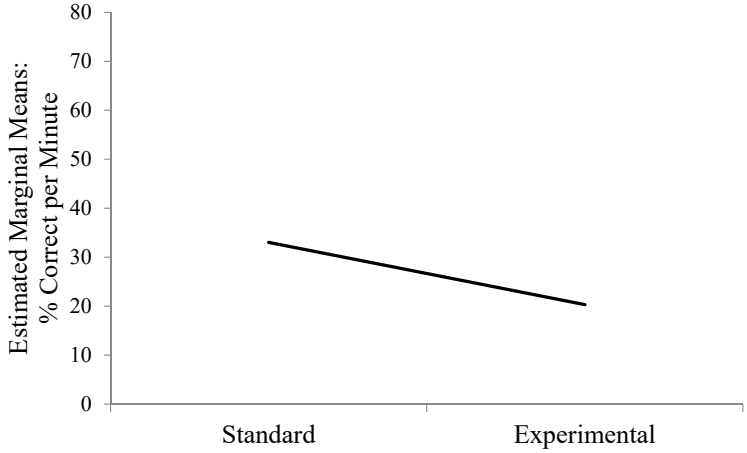


Figure 2.2 Main effect of passage type in reading comprehension rate scores

Study III

Purpose: Evaluate a possible remedy to the reading problems we found to be presented by diverse names by applying a simple evidence-based intervention paired with a brief description and pictures to teach students diverse names before they read them embedded in text.

Study III: Design and Dependent Variables

- Between-subjects design
- Dependent Variables
  - Reading comprehension (percent correct)
  - Reading comprehension rate (percent correct per minute)
- Independent Variable = Pre-teaching intervention
  - Constant time delay presented via computerized flashcards, paired with a description and pictures of the characters in the passage
  - ½ of participants (randomly assigned) received the intervention before reading the passage

Study III: Participants, Setting, Materials

- Participants: 67 second-grade students enrolled in two rural southeastern elementary schools
- Setting: quiet rooms in the elementary schools
- Materials:
  - “New Friend” experimental passage and comprehension questions.
  - Computer with CFR intervention targeting 3 diverse names.
    - Constant time delay
      - Simultaneous prompting: Name appears as it is read aloud by the computer, student repeats name. Five trials per name (15 simultaneous prompting trials)
      - Fixed 3-s response interval: Name appears, 3-s interval for student to read name, computer reads name aloud, student repeats name again. Five trials per name (15 fixed interval trials)
    - Total of 30 learning trials
  - Clipart pictures of each of the three characters in the passage.

Study III: General Procedures

- Participants worked individually with experimenters.
- Performance was audio recorded for interrater.
- All participants read the same “New Friend” passage and answered the comprehension questions.
- Half of the participants (randomly assigned) received the pre-teaching intervention right before they read the passage.

Study III: Pre-teaching Procedures

- CFR time delay trials
  1. Student receives simultaneous prompting instructions:

     This computer is going to teach you the names of the characters in a story you are about to read. It will show you each name and read it aloud to you; then, you will repeat the name.
  2. Student completes simultaneous prompting trials on the computer.
  3. Student receives 3-s delay instructions:

     Now the computer is going to show you the names again. This time, try to read the name before the computer says it. Then, after the computer says the name, you will say the name again.
  4. Student completes fixed 3-s response interval trials on the computer
- Description and flashcards with pictures
  5. Experimenter states:

     Now I'm going to show you pictures of the characters in the story.

     Lidochka is a girl in the story (shows picture of first character).

     Katenka is a woman in the story (shows picture of second character).

     Annushka is a girl in the story (shows picture of third character).

Lidochka

Annushka

Katenka

Study III: Procedures for Passage and Questions

- Experimenter delivered instructions for reading the passage:

  Please read this story out loud. The title of the story is New Friend. If you get stuck, I will tell you the word so you can keep reading. When you finish, I will ask you questions about what you read, so do your best reading. Start here (experimenter points to the first word of the passage). *Begin.*

  - Standard oral reading fluency procedures were used to score participants' reading performance.
  - A rubric was used to score responses to comprehension questions.

New Friend

In the summer, Annushka and Katenka moved to Texas. Annushka was sad. She left all of her friends behind and she did not know how she would find new ones. Katenka told Annushka to look out the window to see if there were any children playing outside, but she did not see anyone. It was so hot that all the kids stayed inside.

One day, Katenka said, “Let’s go to the park. I hear there is water to play in. You can run through the spray and there are buckets that dump water on your head.”

Annushka went with Katenka to the park. When they got there, Katenka told Annushka to go play. Annushka saw lots of kids running and splashing in the water. They were smiling and having a great time. Annushka and Katenka sat on a bench. The sun was beating down on Annushka’s head. She felt hot, but she did not go play.

A girl Annushka’s age ran past and splashed Annushka.

“I’m sorry!” said the girl. “Hey, you’re new here. What’s your name?”

“Annushka.”

“I’m Lidochka. Come on, let’s go play in the water,” said the girl.

“Okay, Lidochka!” said Annushka

Annushka followed Lidochka out into the water. Annushka and Lidochka ran, splashed, and giggled. At the end of the afternoon, Annushka and Lidochka made a plan. Annushka would meet Lidochka at the park the next day.

Comprehension Questions

- Where did Annushka move to? (*Texas.)*
- Where did Annushka and Katenka go? (*The park.)*
- According to the story, how was Annushka feeling about moving? (*Sad.)*
- At the beginning of the story, why was Annushka sad? (*She left her friends behind. She didn’t know how she would make new friends.)*
- What did Katenka say they could do at the park? (*Play in the water. Run in the spray. Get water dumped on your head.)*
- What plan did Annushka and Lidochka make at the end of the afternoon? (*To meet at the park the next day.)*
- When Annushka first got to the park, why didn’t she go and play? (*She was shy. She didn’t know anyone. She didn’t have any friends. She had just moved so she didn’t know the kids.)*
- How did Lidochka know that Annushka was new? (*Lidochka had never seen Annushka there before. Lidochka didn’t recognize Annushka.)*
- How do you know that Annushka and Lidochka became friends? (*They played together. They made plans to meet up the next day.)*

Study III: Interscorer and Treatment Integrity

- A secondary experimenter scored procedural integrity, seconds spent reading, words read correctly, and comprehension accuracy across 30% of participants (10 sessions from each condition, 20 of 67 sessions total).
- Pearson product-moment correlations:

Measure	Pre-Teaching Condition	No Pre-Teaching Condition
Seconds spent reading	$r = 1.00$	$r = 1.00$
Words read correctly	$r = .99$	$r = .95$
Reading comprehension	$r = .96$	$r = .97$

- Procedural integrity checklist indicated each experimenter administered each condition correctly 100% of the time.

Study III: Descriptive Statistics

Table 3.1

Descriptive Statistics for Reading Scores by Condition

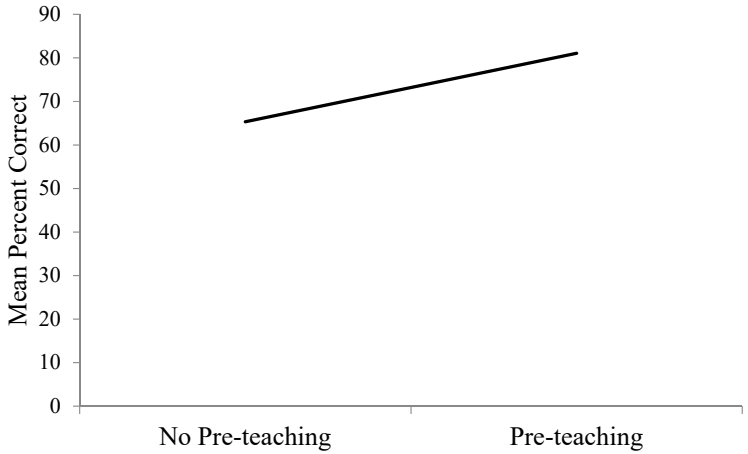
Measure	Condition	Minimum	Maximum	Mean	SD
Speed in Seconds	P	108.00	494.00	237.15	97.81
	NP	112.00	519.00	234.15	95.77
Reading Rate	P	24.41	125.56	61.94	25.79
(words correct per minute)	NP	15.72	109.82	58.78	23.51
Words Read Correctly	P	179.00	231.00	209.09	13.24
	NP	136.00	217.00	197.09	15.56
Words Read Correctly	P	198.00	233.00	223.21	7.47
Excluding Name Errors[a]	NP	163.00	231.00	220.94	13.35
Reading Comprehension	P	56.00	100.00	81.05	12.69
(percent correct)	NP	22.00	100.00	65.32	20.93
Reading Comprehension Rate	P	7.00	56.00	24.19	11.29
(percent correct per minute)	NP	4.00	42.00	19.85	10.76

Note. P = pre-teaching; NP = no pre-teaching.

[a]Words read correctly excluding name errors is calculated by subtracting total errors from total words read, and then adding total name errors.

Study III: Reading Comprehension

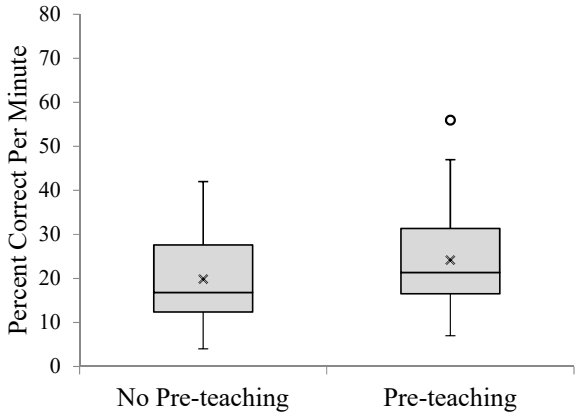
- No pre-teaching *M* = 65%, *SD = 21%*
- Pre-teaching *M* = 81%, *SD* = 13%
- Assumption of homogeneity of variances was violated (Levene's test *p* = .021)
- Equal variances not assumed, *t*(52.445) = 3.71, *p* = .001, *d* = .91



- *Figure 3.2.* Significant effect of condition in reading comprehension scores

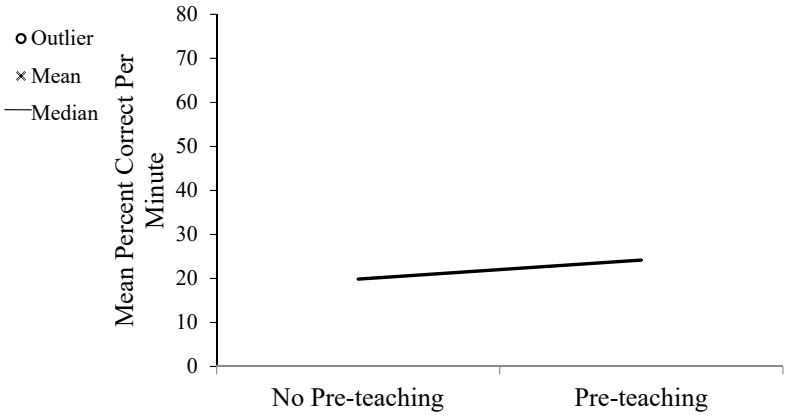
Study III: Reading Comprehension Rate

- There was one genuine outlier, which we included in our analysis.



- *Figure 3.1.* Box plot of reading comprehension rate scores by condition

- No pre-teaching group, *M* = 20%, *SD* = 11%.
- Pre-teaching condition, *M* = 24%, *SD* = 11%.
- Not significant, *t*(65) = 1.61, *p* = .113



- *Figure 3.3.* Reading comprehension rate scores by condition

Study III: Discussion

- Pre-teaching produced significant and meaningful improvements in reading comprehension but not reading comprehension rate.
- Why was pre-teaching effective for reading comp?
  - Enhanced fluency? Descriptive states indicate mean differences between conditions for reading speed (3 s) and rate (3 wcpm) were small
  - Reduced cognitive load?
- Could evaluate whether additional opportunities to respond, more learning trials, or self-determined response trials would improve learning rates

Study III: Discussion

- Limitations
  - Diverse names but not diverse passages
  - Russian names only
  - No common name conditions

Descriptive Statistics across Studies for Equivalent Conditions of the "New Friend" Passage with Diverse Names

Study	Accuracy			Speed	Rates	
	WRC	WRC-NE	%QC		WCPM	% QCPM
II	200.79	225.21	61.90	242.43	55.05	17.38
III	197.09	220.94	65.32	234.15	58.78	19.85

Note. The "New Friend" passage including diverse names was delivered with identical procedures in Study II (i.e., experimental condition) and Study III (i.e., no pre-teaching condition). Speed is measured in seconds. WRC = words read correctly; WRC-NE = words read correctly excluding errors made on names; % QC = reading comprehension; % QCPM = reading comprehension rate.

Descriptive Statistics for Second-Grade Reading Scores Across Studies

Study	Condition	Passage	N	WCPM		%QC		%QCPM	
				M	SD	M	SD	M	SD
II	Standard	All	28	90.43	37.83	73.81	22.67	31.45	15.67
		Spring Break	14	91.23	25.00	74.60	25.20	32.00	14.54
		New Friend	14	89.64	48.43	73.02	20.77	30.89	17.26
	Experimental	All	28	55.26	23.19	59.13	20.74	17.47	10.24
		Spring Break	14	55.47	27.52	56.35	21.56	17.56	11.47
		New Friend	14	55.05	18.96	61.90	20.31	17.38	9.27
III	No Pre-Teaching	New Friend	33	58.78	23.51	65.32	20.93	19.85	10.76
	Pre-Teaching	New Friend	34	61.94	25.79	81.05	12.69	24.19	11.29

Note. Experimental condition in Study II was equivalent to the no pre-teaching condition in Study III. WRC = words read correctly; WRC-NE = words read correctly excluding errors made on names; % QC = reading comprehension; % QCPM = reading comprehension rate.

Study III: Discussion

- Practical value for improving reading comp
  - Effect size was large
  - Average participant who received the intervention earned a B (i.e., 81%) in reading comprehension
  - Average participant who did not receive the intervention earned a D (i.e., 65%) in reading comprehension
- Possible tool for sparking conversations about diversity
- More research is needed
  - Evaluating effects of diverse names and terms across subjects
  - Validating interventions

General Discussion

- Study I: Difficult-to-read font had no affect or impaired learning in 3 adult students with intellectual disability
- Study II: Difficult-to-read diverse names impaired reading comprehension and comprehension rate in 1st-3rd grade students
- Study III: Pre-teaching diverse names improved reading comprehension but not comprehension rate in 2nd grade students

General Discussion: Implications

- Learner characteristics could moderate responses to cognitive disfluency
  - Causal Mechanisms and moderators associated with cognitive disfluency are not understood
  - Study I and II suggest difficult-to-read materials can hinder learning and comprehension in unskilled readers
  - French et al. found difficult-to-read materials can improve comprehension in students with dyslexia
- Unfamiliar diverse names can hinder reading
  - Multicultural education is important, and so is reading
  - Effects should be evaluated across subjects
  - If phonetically unfamiliar words cause learning problems, interventions should be developed and validated
- Pre-teaching names can meaningfully improve reading comprehension

General Discussion: Limitations and Future Research

- Sample characteristics and dependent variables
  - Textual disfluency manipulations could be investigated with larger sample sizes, students with different disabilities, more functional dependent variables
  - Effects of unfamiliar diverse names should be evaluated with diverse samples
    - Possible cultural moderators
- Study III intervention was effective but delivered one-on-one
  - Evaluate class-wide interventions
- Names were diverse but passages were not
  - Evaluate effects when using authentic multicultural literature

References

Allington, R. (2009). What really matters in fluency: Research-based practices across the curriculum. Boston: Allyn & Bacon.

Alter, A. L. (2013). The benefits of cognitive disfluency. *Current Directions in Psychological Science, 22*, 437-442.

Alter, A. L., Oppenheimer, D. M., Epley, N., & Eyre, R. N. (2007). Overcoming intuition: Metacognitive difficulty activates analytic reasoning. *Journal of Experimental Psychology: General, 136,* 569-576.

Browder, D., Ahlgrim-Delzell, L., Spooner, F., Mims, P. J., & Baker, J. N. (2009). Using time delay to teach literacy to students with severe developmental disabilities. *Council for Exceptional Children, 75,* 343-364.

Bjork, R. A. (1994). Memory and metamemory considerations in the training of human beings. In J. Metcalfe & A. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 185–205). Cambridge, MA: MIT Press.

Cazzell, S., Skinner, C., Ciancio, D., Aspiranti, K., Watson, T., Taylor, K.,…Skinner, A. (2016). Evaluating a computer flashcard sight-word recognition intervention with self-determined response intervals in elementary students with intellectual disability. *School Psychology Quarterly*. Advance online publication. http://dx.doi.org/10.1037/spq0000172

Cazzell, S., Taylor, K., Skinner, C., McCurdy, M., Skinner, A., Ciancio, D.,…Cihak, D. (2017). Evaluating a computer flashcard reading intervention with self-determined response intervals in a post-secondary student with intellectual disability. *Journal of Evidence-Based Practice in the Schools*, *16*(1), 74-94.

Chavous, T. M., Bernat, D. H., Schmeelk-Cone, K., Caldwell, C. H., Kohn-Wood, L., & Zimmerman, M. A. (2003). Racial identity and academic attainment among African American adolescents. *Child Development, 74*, 1076-1090.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of verbal learning and verbal behavior, 11,* 671-684.

Diemand-Yaumana, C., Oppenheimer, D. M., & Vaughan, E. B. (2011). Fortune favors the bold (and the italicized): Effects of disfluency on educational outcomes. *Cognition, 118*(1), 111-115.

French, M. M. J., Blood, A., Bright, N. D., Futak, D., Grohmann, M. J. Hasthorpe, A.,…Tabor, J. (2013). Changing fonts in education: How the benefits vary with ability and dyslexia. *Journal of Educational Research, 106*, 301-304.

References, cont.

Gurin, P., Day, E. L., Hurtado, S., & Gurin, G. (2002). Diversity and higher education: Theory and impact on educational outcomes. *Harvard Educational Review, 72*(3), 330-366.

Katzir, T., Hershko, S., & Halamish, V. (2013). The effect of font size on reading comprehension on second and fifth grade children: Bigger is not always better. *PLoS ONE, 8*(9): e74061.

LaBerge, D., & Samuels, S. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology, 6*, 293-323.

Maki, R. H., Foley, J. M., Kajer, W. K., Thompron, R. C., & Willert, M. G. (1990). Increased processing enhances calibration of comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16*, 609-616.

McDaniel, M. A., & Butler, A. C. (2010). A contextual framework for understanding when difficulties are desirable. In A. S. Benjamin (Ed.), *Successful remembering and successful forgetting: Essays in honor of Robert A. Bjork* (pp. 175-199). New York: Psychology Press.

National Reading Panel. (2000). Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implication for reading instruction (NIH Publication No. 00-4754). Washington, DC: U.S. National Institute of Health.

Okoye-Johnson, O. (2011). Does multicultural education improve students' racial attitudes? Implications for closing the achievement gap. *Journal of Black Studies, 42*, 1252-1274.

Perfetti, C. A. (1985). *Reading ability.* New York: Oxford University Press.

Peterson, B., Gunn, A. M., Brice, A., & Alley, K. (2015). Exploring names and identity through multicultural literature in K-8 classrooms. *Multicultural Perspectives, 17*(1), 39-45.

Reschly, A. L., Busch, T. W., Betts, J., Deno, S. L., & Long, J. D. (2009). Curriculum-based measurement oral reading as an indicator of reading achievement: A meta-analysis of the correlational evidence. *Journal of School Psychology, 47*, 427-469.

Rhodes, M. G. & Castel, A. D. (2008). Memory predictions are influenced by perceptual information: Evidence for metacognitive illusions. *Journal of Experimental Psychology, 137*, 615-625.

References, cont.

Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An adapted alternating treatments design for instructional research. *Education and Treatment of Children, 8*, 67–76.

Souto-Manning, M. (2011). Challenging the text and context of (re)naming immigrant children: Children's literature as tools for change. In B. S. Fennimore & L. N. Goodwin (Eds.), *Promoting social justice for young children* (pp. 111– 124). New York, NY: Springer.

Sungkhasettee, V. W., Friedman, M. C., & Castel, A. D. (2011). Memory and metamemory for inverted words: Illusions of competency and desirable difficulties. *Psychonomic Bulletin & Review, 18*(5), 973-978.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12,* 257-285.

Sweller, J., & Chandler, P. (1994).Why some material is difficult to learn. *Cognition and Instruction, 12*, 185–233.

Texas Education Agency (2010). *Technical Report: TPRI 2010-2014 Edition.* Retrieved from

http://tpri.org/resources/documents/20102014TechnicalReport.pdf

Thompson, V. A., Turner, J. A. P., Pennycook, G., Ball, L. J., Brack, H., Ophir, Y., & Ackerman, R. (2013). The role of answer fluency and perceptual fluency as metacognitive cues for initiating analytic thinking. *Cognition, 128,* 237-251.

U.S. Department of Education, Office of Planning, Evaluation and Policy Development, Policy and Program Studies Service. (2016). *The state of racial diversity in the educator workforce.* Retrieved March 10, 2017 from https://www2.ed.gov/rschstat/eval/highered/racial-diversity/state-racial-diversity-workforce.pdf

Yue, C. L., Castel, A. D., & Bjork, R. A. (2013). When disfluency is—And is not—A desirable difficulty: The influence of typeface clarity on metacognitive judgments and memory. *Memory and Cognition, 41*, 229-241.

Zirkel, S. (2008). The influence of multicultural educational practices on student outcomes and intergroup relations. *Teachers College Record, 110*, 1147-1181.

Big shift to Sight Word Learning Rates

Another area I have been working on is Learning Rates.

Much of this work has involved teaching whole words to students with disabilities.

Why? One reason is in consultation we work with teach referrals.

Teachers have student in grade 4-6. They are teaching them phonemics, RtI is phonemics, and special ed is phonemics. Been going on their entire education.

Why? National Reading Panel- schools focusing on only phonic instruction.

Sight Word Learning Rates

So the teacher tells my student – the student only has about 10-15 min.

Could you teach him some simple high frequency words?

With all these years, and extra time allotted (e.g., RtI, Reading first schools), some students still can't read commonly used pre-k and grade 1 words.

Other reasons include some earlier research I did on modeling reading speed and working with a computer science measure who said –

"I can make you a comp. program, but you have to tell me exactly what you want before I start. Can't change after begin."

I did not know exactly what I wanted!

A Little History

So much of what I have researched has comes from:

1. ClassWide Peer Tutoring (group contingencies) – Greenwood et al.
2. Tim McLaughlin – Taped words Cover, Copy, and Compare.
3. Teaching EBD students (color wheel – Scala Dendist, Lentz)
4. Working with my students as they consult

A Little History

5. My professors – Ed Shapiro, Ed Lentz, Tim Turco, Bob Suppa, Bud Mace, Kirby Brown.
6. My fellow grad students – Phil Belfiore, Barry McCurdy, Joe Lalli.
7. Mom, Wife

Thanks to you all

Special thanks to the educators who have let us enter their classroom and work with their students on real problems.

Learning Rates – 1st Paper

- Special Issue – EBD and Academic Interventions
- Used to teach EBD and was doing research at a lab school at Alabama

So I had stuff – was writing and responded to the call for papers for special issue

Learning Rates – 1st Paper

Was working on Tape words interventions

Freeman & McLaughlin (1984) Tape words intervention – read word lists along with tape which presented them very fast, 80 words per minute.

Mom had to make my tapes, I can't read that fast, got expelled for special speech.

Theoretical issues: works because

a) students model rapid reading,

b) prompts rapid reading - neurological impress

c) practice embedded within the intervention (opps to respond – Greenwood and CWPT)

Learning Rates – 1st Paper

Skinner et al., (1995). The influence of rate of presentation during taped-words interventions on reading performance. *Journal of Emotional and Behavioral Disorders, 3*, 214-223.

Manipulate speed of the tapes - words presented every s or every 5-s.

Student instructed to read words with tape.

Theoretical questions – do students model reading speed or does neurological impress occur which enhance reading speed?

Learning Rates – 1st Paper

Relative effectiveness studies-

Comparative Effectiveness Studies –

Not What Works, but What Works Best

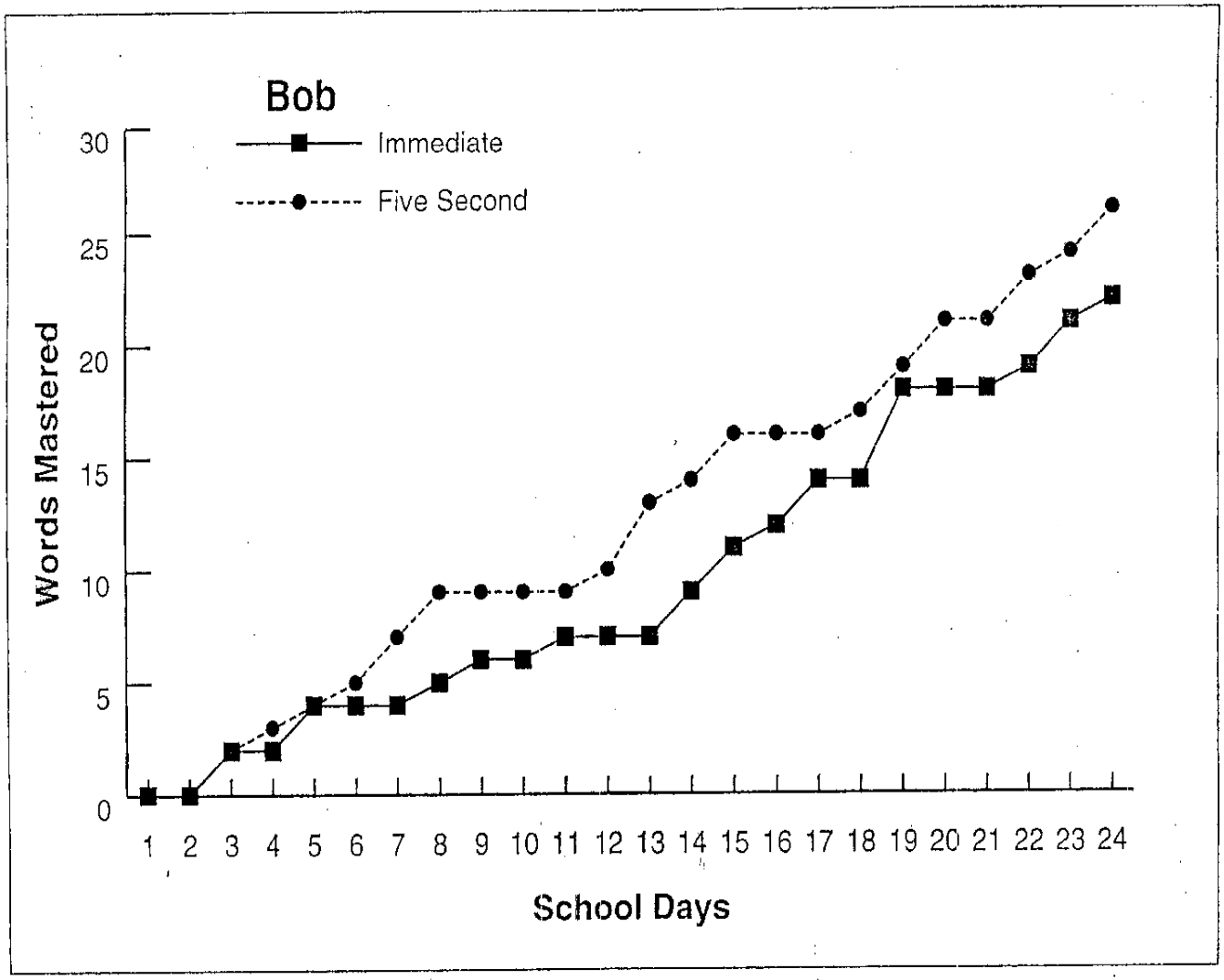


Figure 3. Number of words Bob mastered per school day.

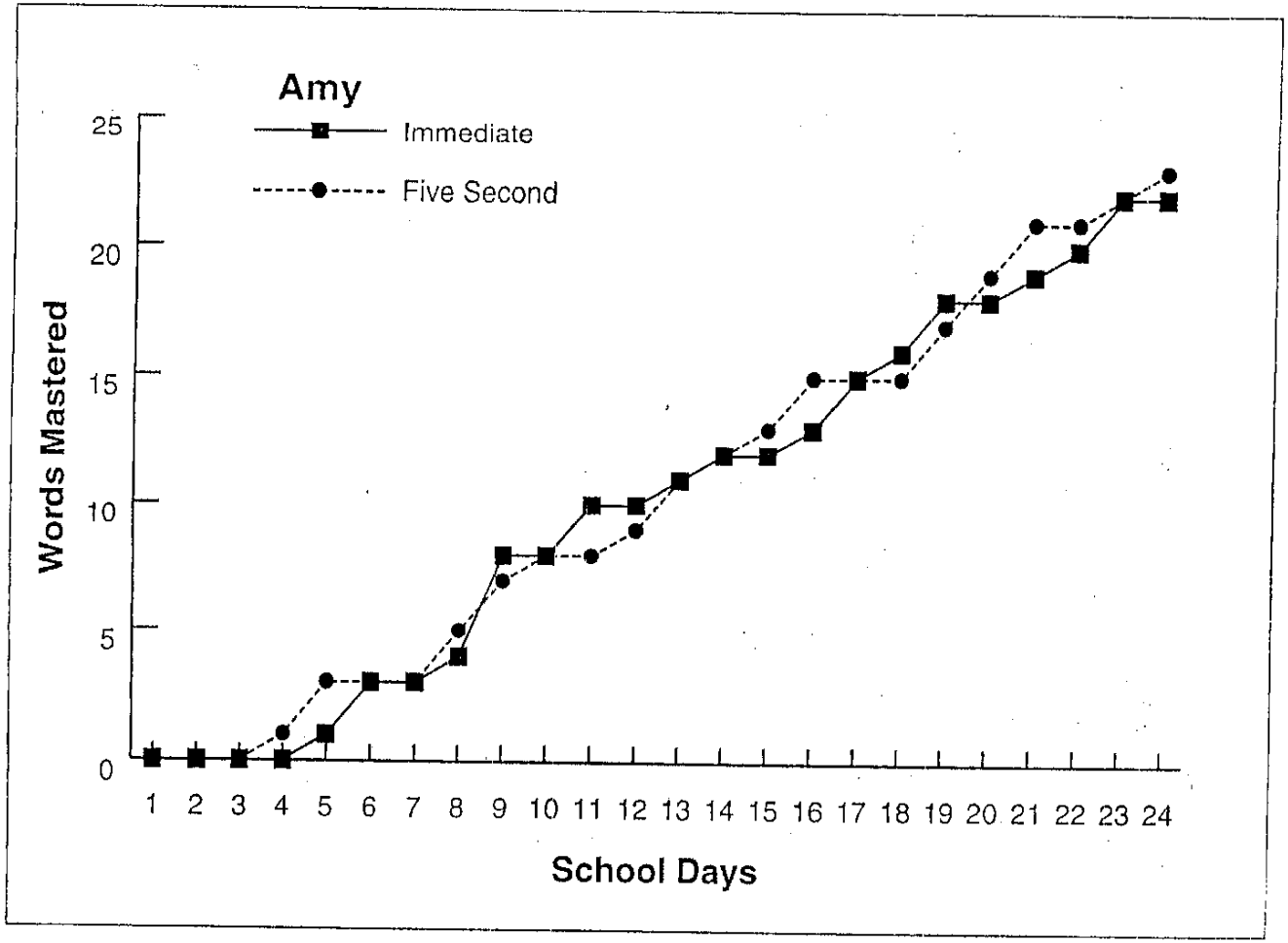


Figure 1. Number of words Amy mastered per school day.

Learning per session

Conclude – interventions equally effective – Thus, little evidence of modeling rates or neurological impress.

I can not run faster by watch Michael Johnson run faster.

May have been spillover or history (correct this latter with AAT-Design)

This theoretical conclusion is what this study was designed for.

Applied conclusion: For Bob and Amy it does not matter which you use.

This conclusion changed when we changed our measurement scale.

Learning Rates – 2nd Paper

After the first article was accepted, I tried to “stop the press” but it did not work –

My concern was that results would mislead practitioners who want to know which procedure works best. I concluded that it did not matter which you used.

Discovered – can’t stop the press - Wrote new article

Skinner, C. H., Belfiore, P. B., & Watson, T. S. (1995/2002). Assessing the relative effects of interventions in students with mild disabilities: Assessing instructional time. *Assessment in Rehabilitation and Exceptionality, 2*, 207-220. Reprinted (2002) in *Journal of Psychoeducational Assessment, 20*, 345-356.

Learning Rates – 2nd Paper

Wrote the second paper to correct the first –

Did not want people thinking it did not matter (for Amy, Bob, or their parents, teachers and others concerned with their well being) what intervention they applied.

It does matter and I have come to talk about these studies as focusing on crude and fine measure of Cumulative Instructional Time.

Learning Rates – 2nd Paper

Second paper – presented the same data in two formats – learning or behavior change by school day (session) and learning by instructional seconds.

In other words, I changed the scale of our measure of time (cumulative instructional time) on our *time*-series graphs from days to seconds.

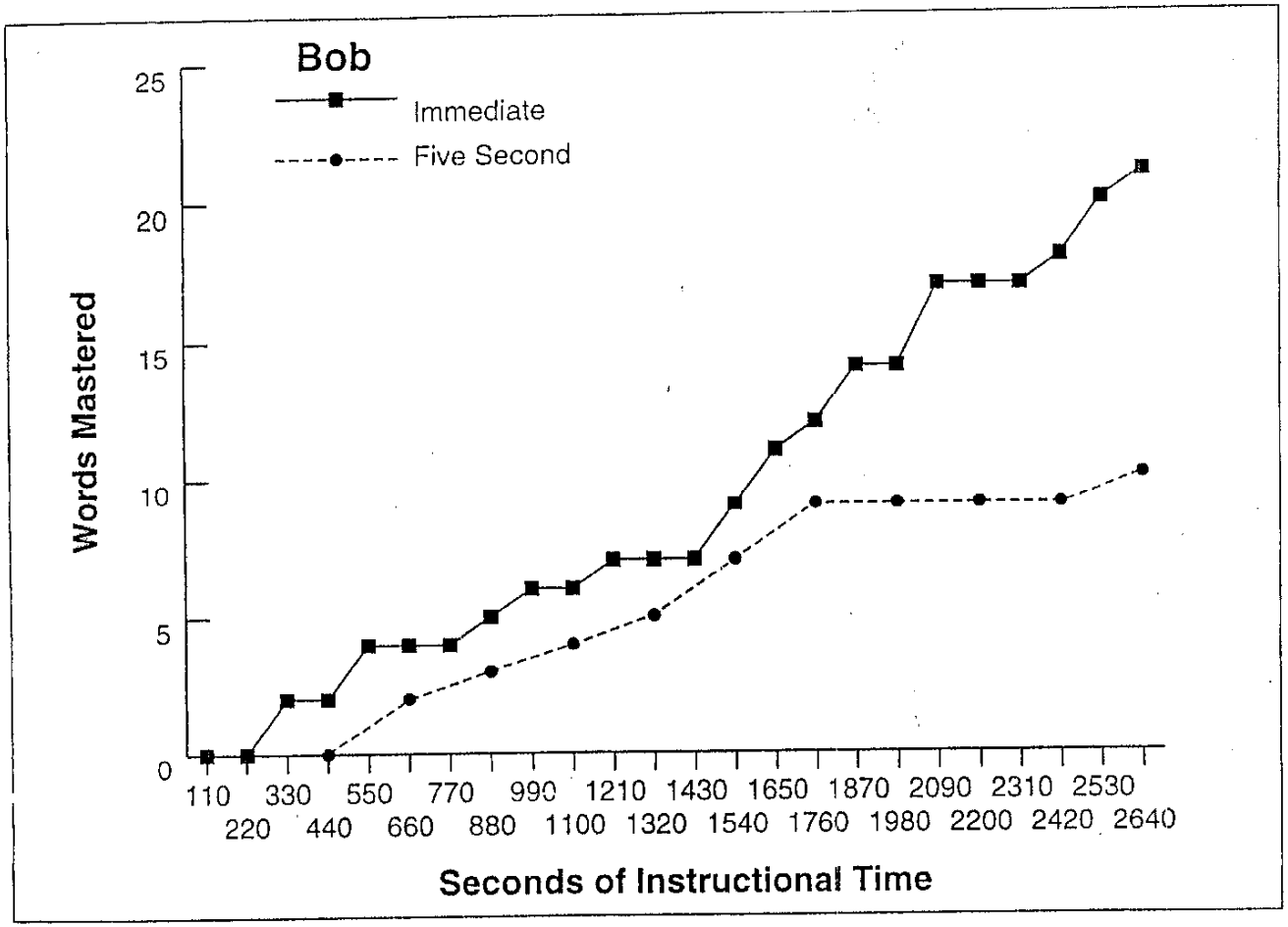


Figure 4. Number of words Bob mastered per 110 instructional seconds.

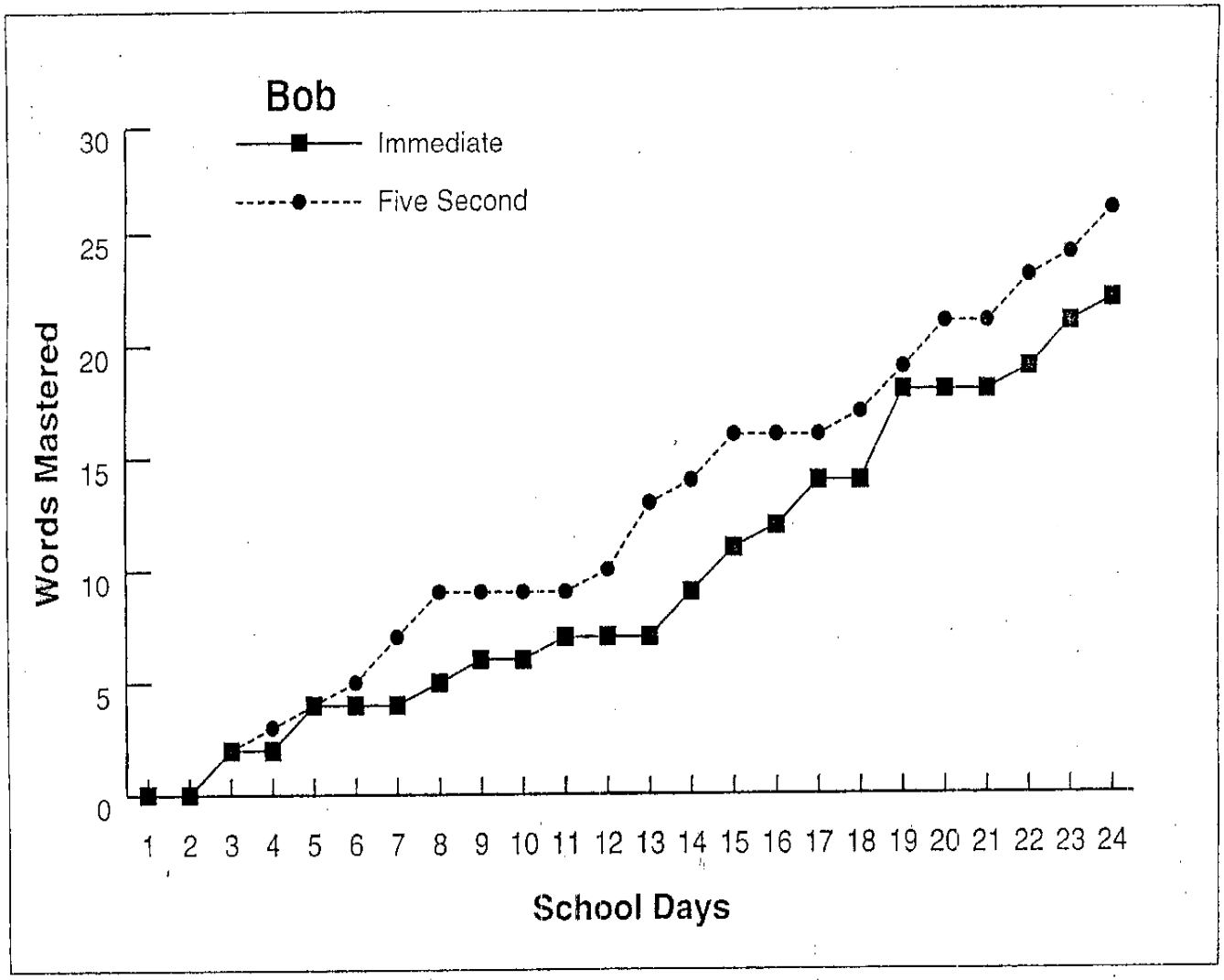


Figure 3. Number of words Bob mastered per school day.

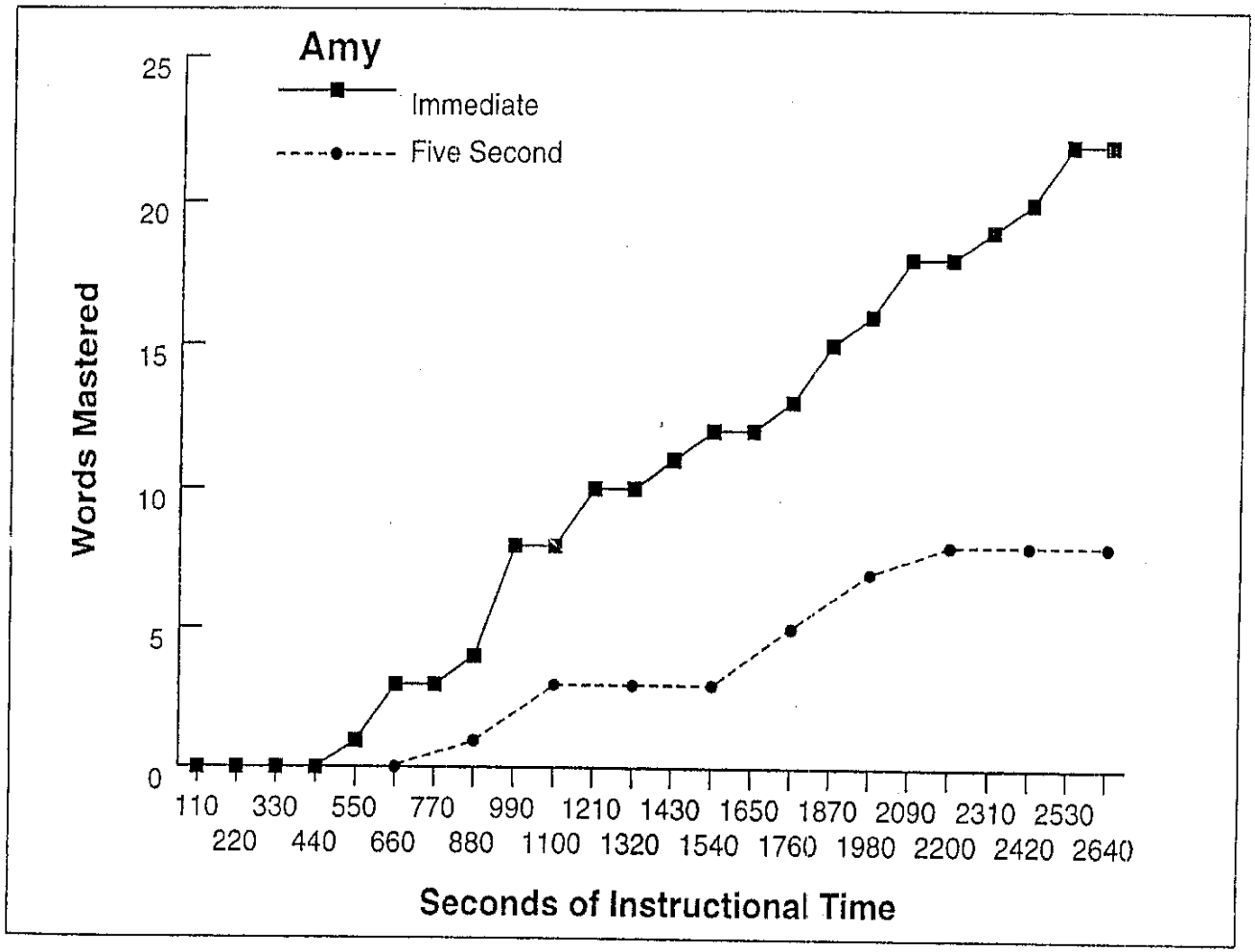


Figure 2. Number of words Amy mastered per 110 instructional seconds.

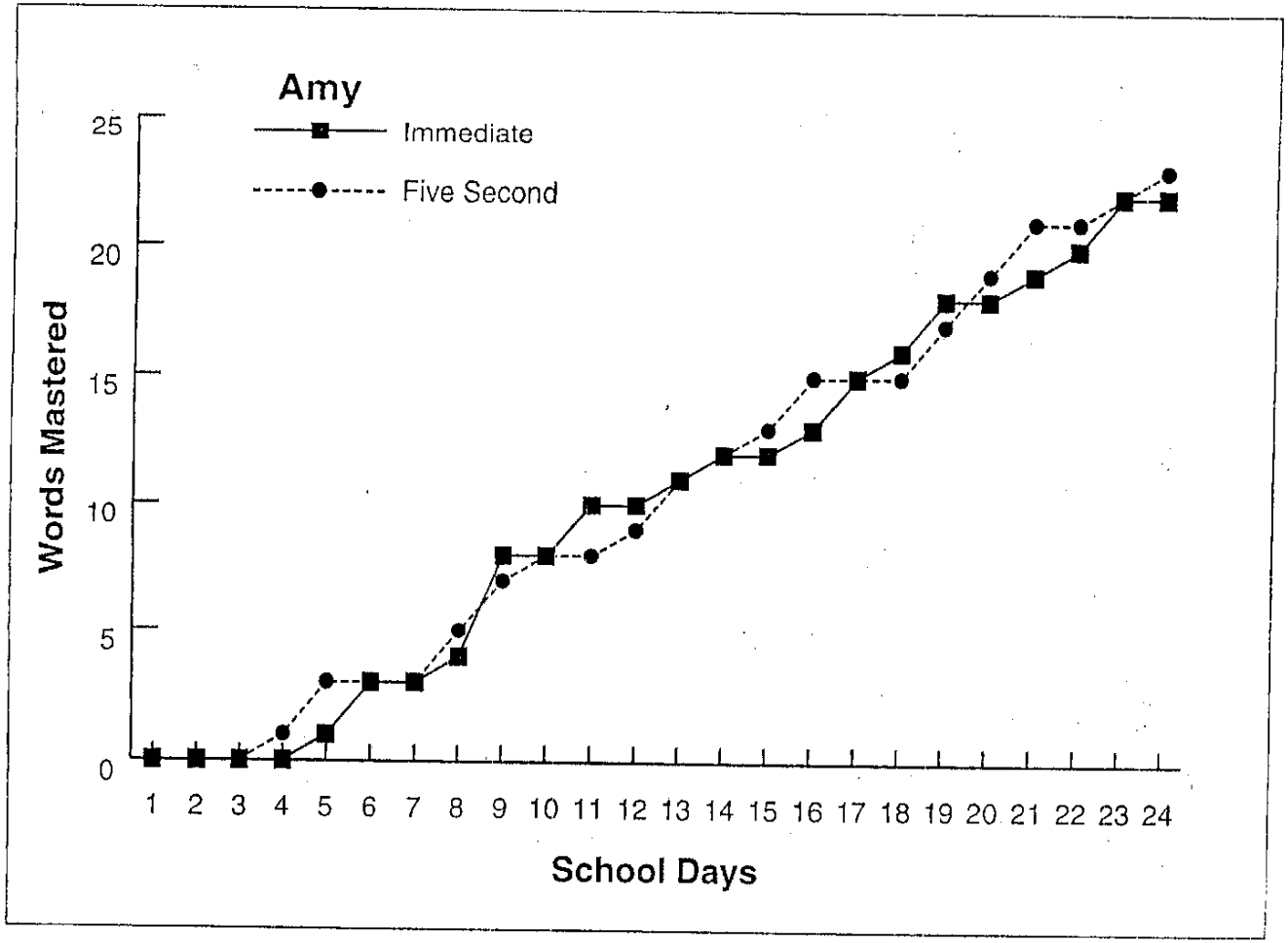


Figure 1. Number of words Amy mastered per school day.

Learning Rates – 2nd Paper

Applied conclusion: For Bob and Amy, it does matter which you use.

1-s allow for more rapid remediation.

Why Focusing on Learning Rate?

Basic Reason 1 – learning defined

Learning – relatively permanent change in behavior (behavior potential) brought about by experience. All experience takes time, so time is a variable in all learning.

Note: exceptions took little time – (e.g., change in behavior caused by getting hit by truck).

Note: also a focus on 1-trial learning (real rapid learning, few cumulative instructional minutes)

LEARNING RATE IS REDUNDANT.

Should not have to say rate, but should attend to our measures of instructional or learning time at bit more.

Why Focusing on Learning Rates?

Basic Reason 2 – Scale matters

Chaos theory: Measure at different scale and draw different conclusions

Smooth coast line or very jagged.

Physics of planets (astro-physics) versus very small things (quantum mechanics).

Why Focusing on Learning Rates?

Scale matters – as we change our scale we find different patterns in our data – patterns appear and then disappear

Which is correct? Wrong question (Baum).

Are the patterns useful? Right question! So, look at applied reasons for more precise measures of instructional time.

Why Focusing on Learning Rates?

Applied Reason 1 –

Learning Problem: rarely failure to learn, but not learning rapidly enough (falling behind)

Solution: Allot more time

1) summer school, 2) pre-school, 3) longer school day, 4) graduate school (how many years to be a school psych?)

Why Focusing on Learning Rates?

Within the school day re-allocate time from recess, physical education, music, art –

Activity	Learn
Recess	Social Skills
Phys Ed.	Healthy habit, social skills
Music/Art	Appreciation, if not skills.

Lately, even taking time from math/social studies

Why Focusing on Learning Rates?

RtI – many systems started with reading – ID who is behind and give them .5 more hours per day.

Move to 1 hour per day if that does not work.

Some caught up:

Then added RtI for math – now have children flipping in and out of RtI – first reading then math (where is time coming from - science)

Need – procedure that enhance learning rates or learning speed

Instead of adding more time, we would be better off identifying procedures that enhance learning rates, or amount learned per unit of time.

We ignore time at our own risk – another example:

Computer flashcard sight-word reading

Started getting referrals: Help my 3rd-7th grade students learn to read high frequency words.

Many had disabilities and were getting a lot of extra reading instruction which was based on phonemic awareness of phonic.

Teachers felt they could not switch to whole-word instruction.

Computer flashcard sight-word reading

Catch to the referral – you only get about 10 mins per day because they felt that they could not infringe on phonics instruction.

Many teachers across many districts felt that they had to apply phonics because NRP, curricula specialists, and other pressures.

When do we try another way?

Computer flashcard sight-word reading

Used PowerPoint to build computer flashcard reading program.

Generally what we did –

Pre-test and got unknown Dolce Words (none read correctly across 3 trials).

Then, we selected the lowest level words and in each intervention targeted 10 unknown words (NO KNOWN WORDS).

Intervention involved 30 S-R-S-R trials. Each words targeted 3 times.

Computer flashcard sight-word reading

Child would click on screen to open his intervention and click on start.

S-R-S-R interval would then run automatically

* Stimulus 1-- word appears on screen and stays there.
- Response – student has a fixed amount of time to respond (e.g., read the word allowed)
  - 1s, 3s, or 5s were our response intervals.

* Stimulus 2 – after the response interval, recording of the word being read is played (i.e., they hear the word)
- Response 2 – they repeat the word no matter how they responded during the first response interval (no response, correct response, or incorrect response).

2s later, next word appears and we repeat.

Computer flashcard sight-word reading

After finished, all 30 trials were assessed (often next day before running the intervention).

Real flash cards, not computer – most times.

Have 3s to read and then on to next word.

Words read correctly over 2 consecutive sessions considered learned or acquired.

Acquired words are replaced with next unknown word.

Response Intervals

- Black, Skinner, Forbes, Davis & Gettelfinger (in submission). A Comparison of Sight-Word Learning Rates Across Three Computer-Based Interventions
- 2 students with disabilities
- Computer-based flashcard
- 1, 3, and 5s response intervals – 10 words per treatment (three cycles – 30 trials, 3/word).

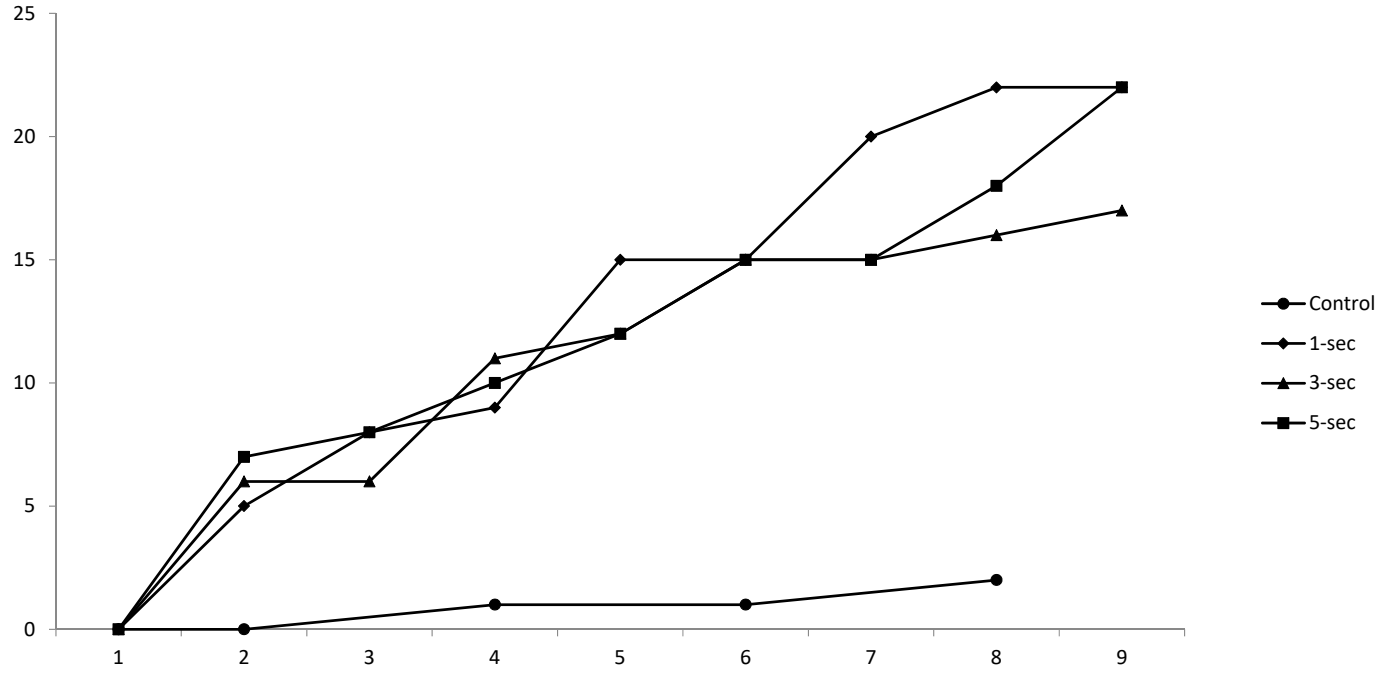
Trial:

Word → 1, 3, or 5 s RI → 1s repeat word → 1s next word

1s = 90s session; 3 = 150 s session; 5s = 210

- Acquired when read correctly within 2s on flashcard assessment.
- Which treatment better for Amber?

Response Intervals



Response intervals

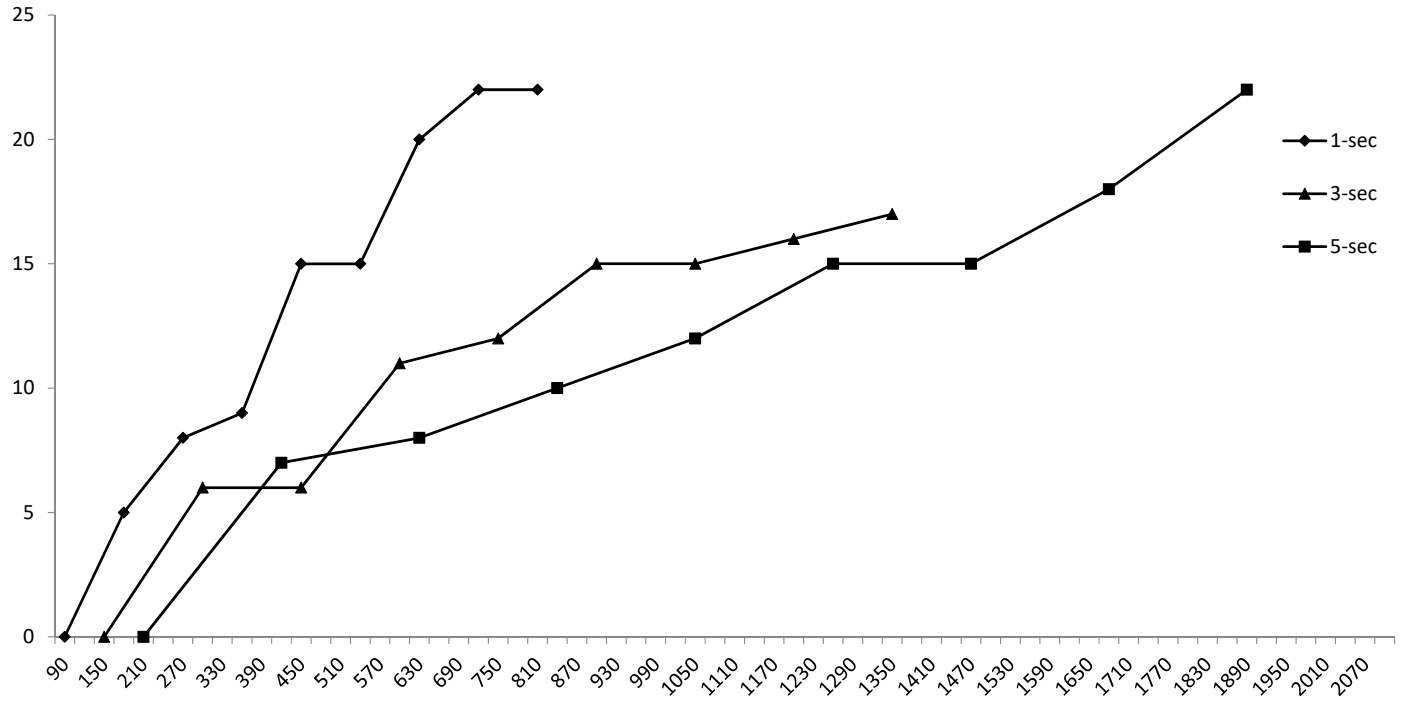
Neither is better – May have theoretical implications about pacing, immediate feedback, opportunities to respond, and learning.

Again, a theoretical wash, found nothing to support any theories.

Applied – because all the same let Amber choose her preferred intervention?

Wrong- because one procedure caused a much stronger learning rate.

Response Intervals



Yaw et al. Four students Disability

Every day taught sight words using computer program – re-assessed the next day. Correct, two times in a row within 3 seconds to be considered learned.

When? First thing before day started.

Why? No other time.

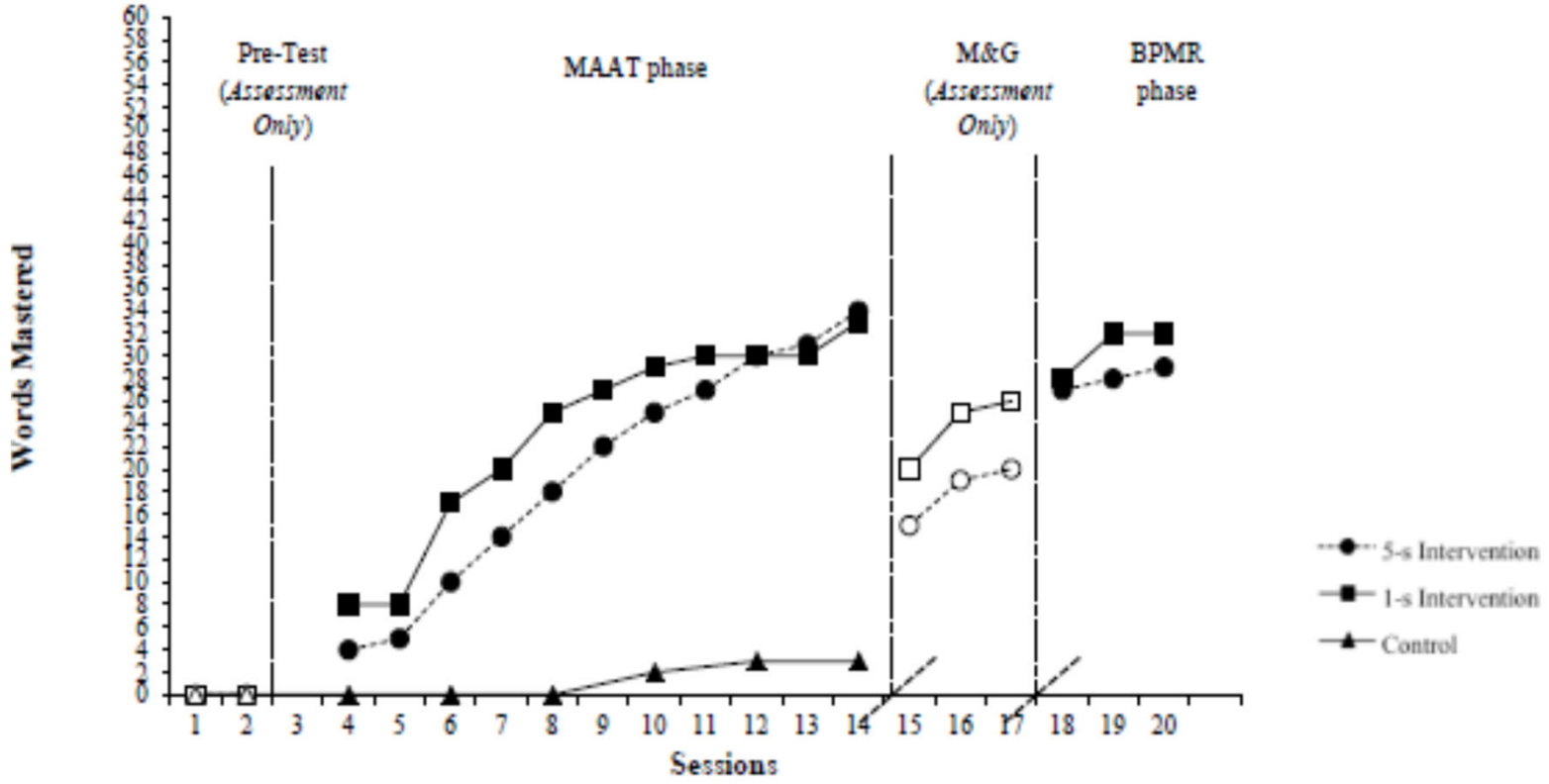
My student would drive every morning 1 hour to run the study.

Yaw et al. Four students Disability

Two treatments – 1s to read word v 5s to read word before recording is played.

Data was very similar across the four students – I will show one student in the interest of time.

Yaw et al. – Learning per session



Yaw et al. Learning per session.

Please pay attention to the lack of maintenance over the summer.

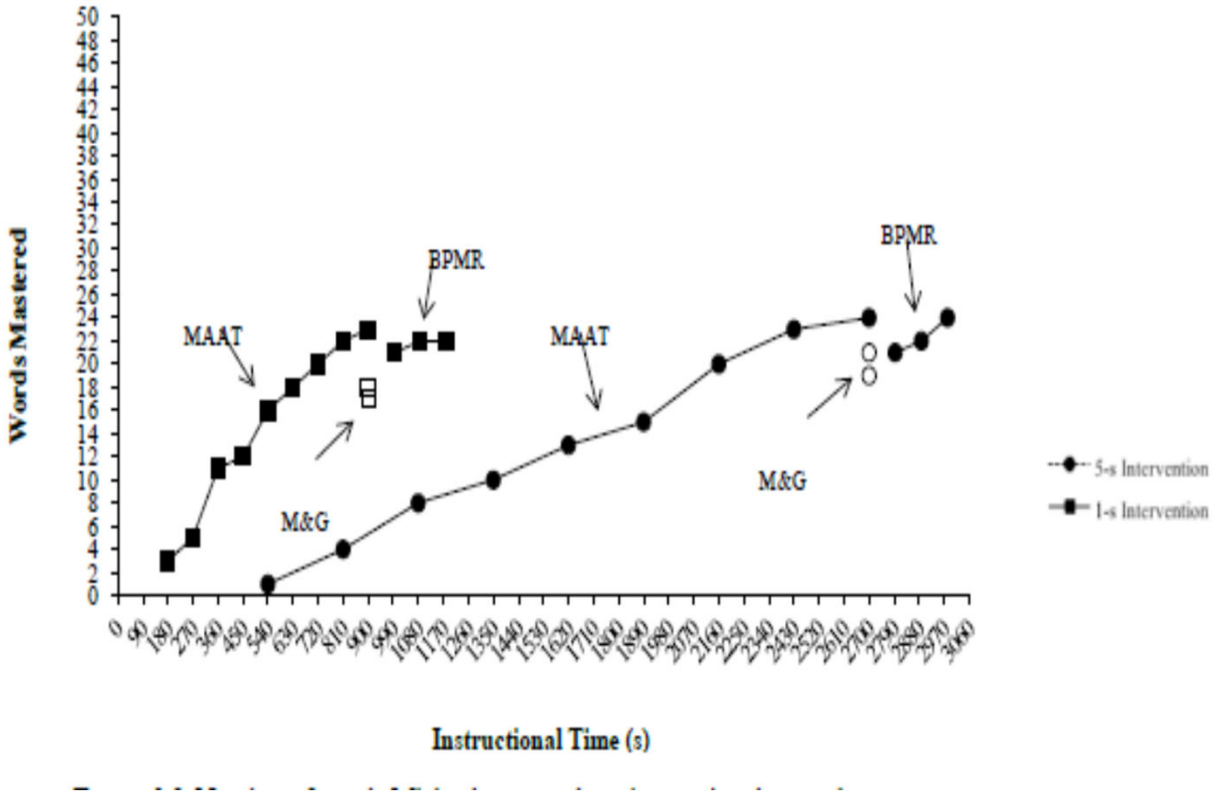
Next, note how quickly they caught up – 3 sessions.

Note: maintenance by session – merely assessing caused open symbols to increase.

Re-taught all words together (5-s and 1-s in 3 brief sessions).

Re-learning is often more rapid than learning (how long would it take you to learning to ride a bike with no hands?)

Yaw et al. Learning as a function of instructional time



Yaw et al. Learning per cumulative instructional time.

Again, look at maintenance after summer – open symbols.

Note how they are vertical or on same horizontal axis. This is because we applied no more instructional time.

Please pay attention to the lack of maintenance over the summer.

Next, note how quickly they caught up – 3 sessions.

Re-learning is often more rapid than learning (how long to take you to learning to ride a bike with no hands.

Cazzell et al. two studies

So, we generally decided that briefer response intervals were better.

Black did find one student who learned most during 5s intervals, but learning rates or speed were equivalent to 1s intervals.

All students liked the more rapid pacing more, except the one Black student who was mixed between 5s and 1s – she did not like 3s.

Cazzell et al. two studies

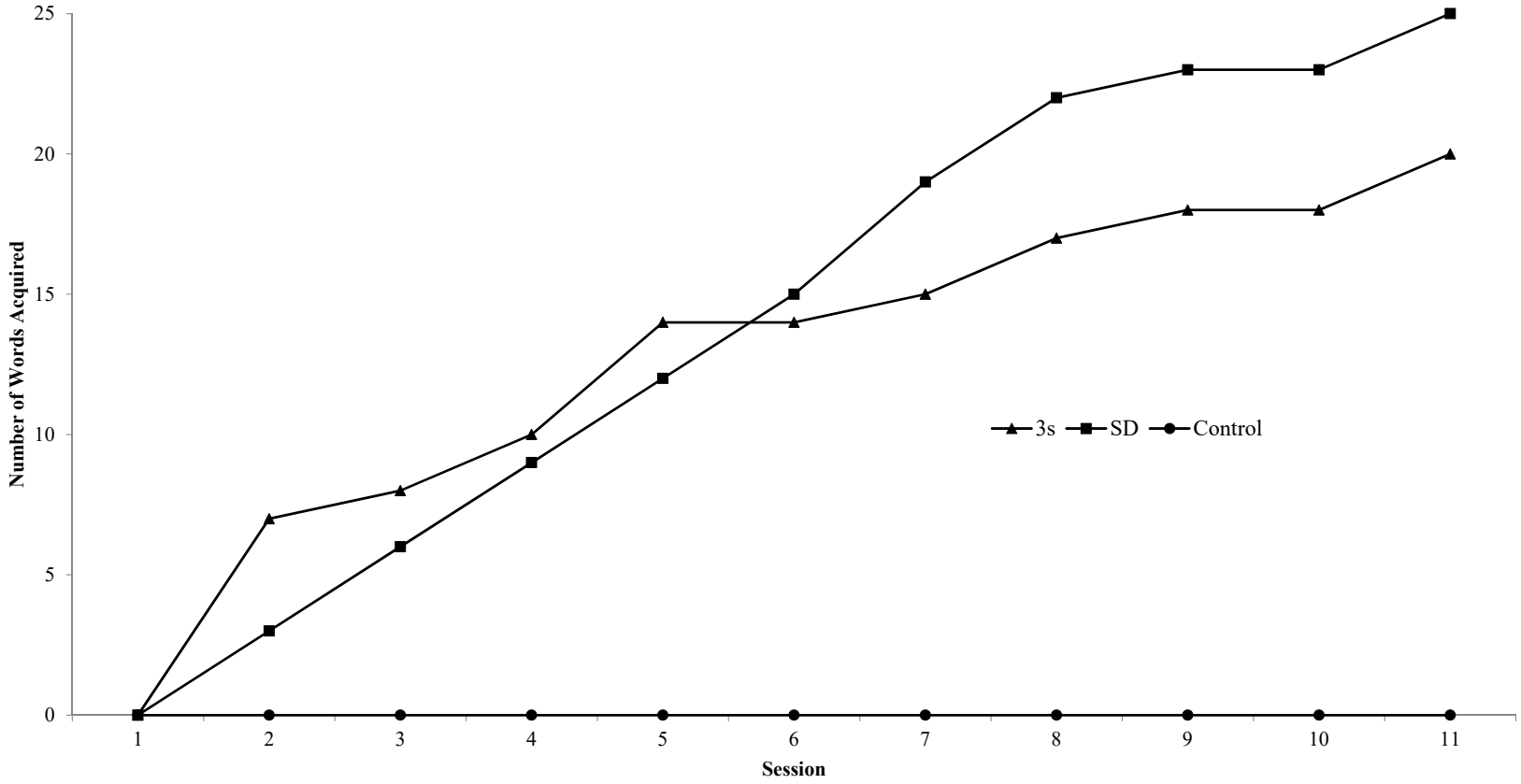
Cazzell fixed my problem with the computer guy.

Why set response intervals? Instead, let students choose the response interval by pressing the space bar to hear the word being played.

Thus, if same students read the word immediately, they can get immediate feedback (enhance learning with immediate feedback).

But, if they need more time to respond, they can take it (enhance learning by enhancing active academic responding).

Cazzell – three students, this was typical



Cazzell found:

- All three students quickly self-determined response intervals.
- Average response rate was about 3s, sometimes took more and sometimes took less.
- Cause equal learning rate (i.e., session series graph looks similar to time series graph.
- Neither procedure was consistently better but…

Cazzell found cont.

- All three student were given a preference assessment.
  - Given 5 opportunities to choose which intervention they would apply with a new set of words (after we finished).

ALL 3 CHOSE THE SELF-DETERMINED INTERVALS.

Important, because technology frees the teacher, but they have to choose to do it which makes it more acceptable.

Cazzell et al.

Also important because students with ID often have difficulty self-determining – by providing high rates of opportunities to self-determine, we may address this problem (hypothesis, not sure).

Regardless – a few more studies to do – but we may be on to something and I may finally be ready to tell my computer guy how to build program!

Need to compare to 1s intervals and learning speed.

Precise measures of instructional time

1. = effective strategies, ID ones that take less time

   RtI – Reading, then math, then reading (it is working, but not enough time)
2. Allows us to identify procedures and strategies that enhance learning enough to justify the additional time to supplement current procedure with these procedures.
3. Allows for more meaningful comparative effectiveness studies that allow educators to identify procedures that allow for the most rapid remediation of problems (hello, recess).

Precise measures of instructional time

4. Allows for complex studies. For example, may find that intervention X is better when you have 30 minutes to apply; but y is better when you have 60 minutes. Difficult to answer such questions because we do not have precise measures of learning.

Interactions – pick interventions based on time available.

5. Educators can prevent problems when research indicates intervention that result in the greater learning rates.

Precise measures of instructional time

Why should educators read our research when it causes us to:

6. Recommend procedures that slightly enhance learning but take so much additional time they retard learning rates (incremental rehearsal – Cates, Joseph).

7. Exacerbate number 5 with invalid meta analyses. More precise measures of learning rates should allow for more valid meta analysis as we collapse findings across studies.

- As is we are comparing 3 minute interventions with 15 minutes ones and ignoring this difference in instructional time – Educators cannot ignore how long interventions take.

6 & 7 – may enhance trust and the probability that educators consume our research.

Precise measures of instructional time

8. Already measured our horizontal axis so precisely, WCPM.
9. Discovers patterns that have been hidden by our alternate measures scale (advance learning research).
10. Prevents us from recommending procedures that slightly enhance learning, but take so much additional time they retard learning rates.

Precise measures of instructional time

Summary:

Enhancing learning by causing more learning in the same amount of time, or same learning in less time, may allow us more time to contribute (more time to work) and enjoy (more time to spend appreciating art, music, or a nice hike outdoors).

I HATE SUMMER SCHOOL – Enhancing learning rate may reduce the need for it

Questions

1. Ever correct to use sessions, days, or events???

Yes – example – I have equated learning trials to discover if some are more effective than others (causal mechanisms critical) - may figure how to apply later.

2. What about other time variables – teacher time to learn, transition time???

Yes – but want to start somewhere and want to focus on STUDENTS who are harmed by our current procedures, and who always must invest time when learning.

Questions

3. What do you think of meta analyses?

I have just given you two examples of why how our attempts to hold critical variables constant within studies has often failed (I messed up in 1995 – remember).

Comparing across studies – read Poncy's work going forward.

Finished – time for Recess

During recess, I would be happy to chat with anybody about this.

This type of thing is fun for me.

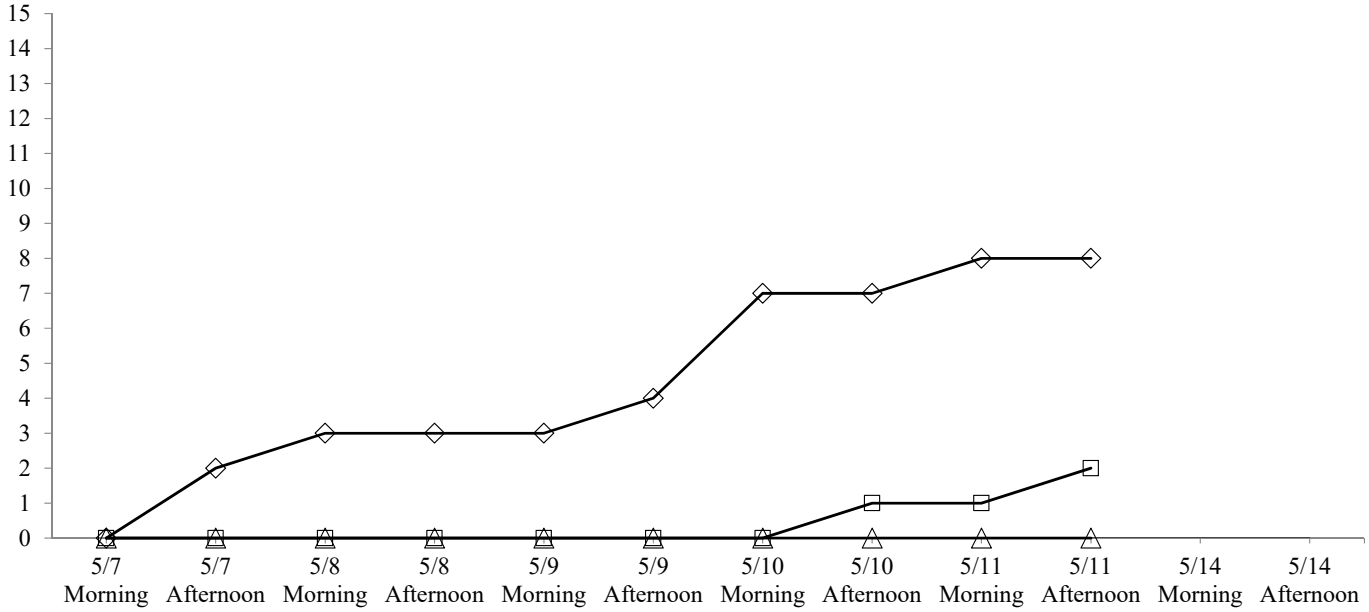
Shaped during grad school when we drank beer and talked research – then were R+ for this talk by…… Ed, Ed, Bob, Tim, Diane, Bud.

Again – thank you for shaping me so that I love doing this stuff.

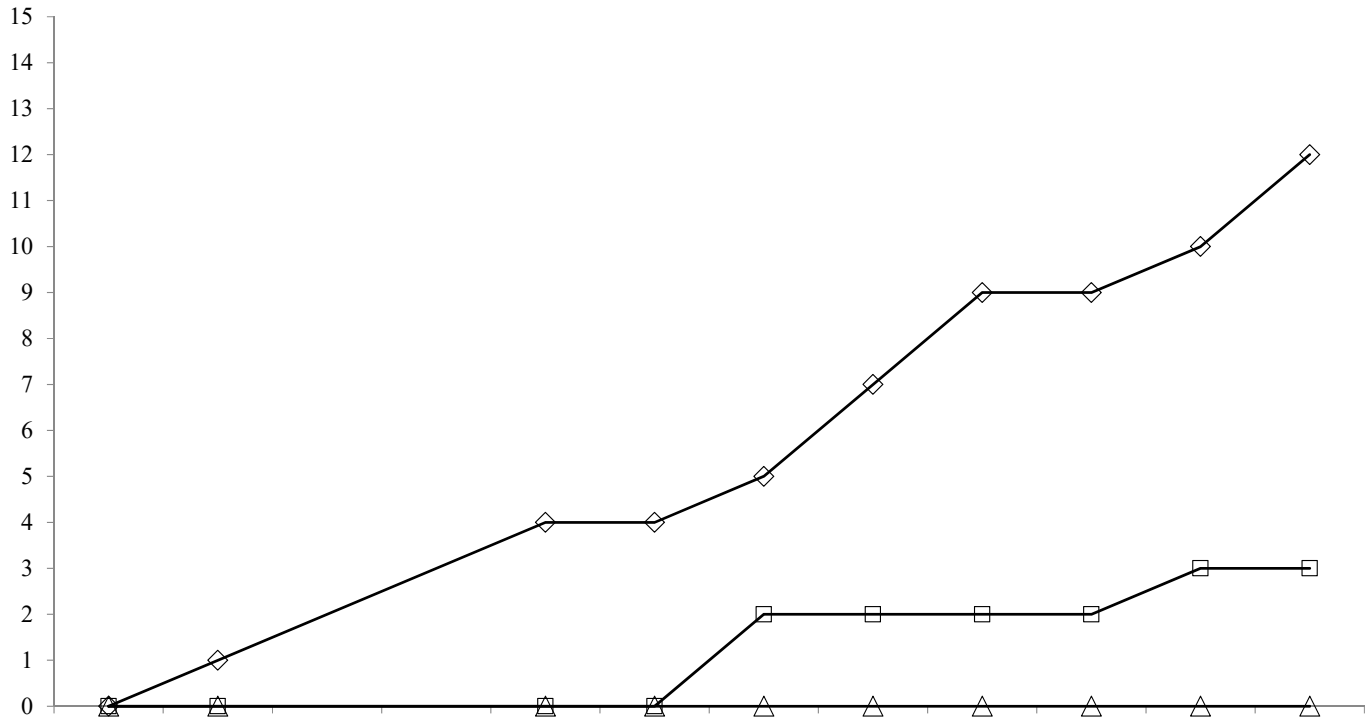
Incremental Rehearsal Time Held constant

- Forbes, B. E., Skinner, C. H., Black, M. P., Yaw, J. S., Booher, J., & Delisle, J. (in press). Extending research on known and unknown ratios to computer-based instruction. *Journal of Applied Behavior Analysis*.
- Adapted Alternating Treatments
- Two computer based flashcard interventions
- Interspersal (12 known, 3 unknown)
- Drill (15 unknown)
- As word acquired
- Elementary students with disabilities (LD and FD)

Incremental Rehearsal Time Held constant



Incremental Rehearsal Time Held constant



Incremental Rehearsal Time Held constant