

An Examination of Methods for Testing

Analyses of the Effects of Instructional Components on Oral Reading Fluency

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Abstract

Brief experimental analyses of academic performance are emerging as a new tool educators can use to link assessment to intervention. This approach involves testing treatments directly

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ment selection. Because academic performance problems are behavioral deficits, the goal of these studies has been to increase rates of accurate responding by directly applying treatments. This approach has been applied successfully to spelling and reading comprehension (McComas et al., 1996), spelling and math computation (Hendrickson, Gable, Novak, & Peck, 1996), classroom behavior (Kern, Childs, Dunlap, Clark, & Eddy,

1994), and handwriting (Kern, Childs, Dunlap, Clark, & Eddy, 1994).

One goal of the current study was to determine if the use of a direct instructional approach would increase the accuracy of spelling and reading comprehension. The second goal was to determine if the use of a direct instructional approach would increase the accuracy of spelling and reading comprehension. The third goal was to determine if the use of a direct instructional approach would increase the accuracy of spelling and reading comprehension.

The current study was designed to evaluate the effectiveness of a direct instructional approach for increasing the accuracy of spelling and reading comprehension.

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The purpose of this study was to investigate a set of procedures for conducting brief experimental analyses of the effects of reading interventions on oral reading fluency. The procedures described in this investiga-

tion were used to evaluate the effects of a reading intervention on oral reading fluency in a group of 10 students with reading disabilities.

The study was conducted in a classroom setting. The students were randomly assigned to two groups: a control group and an experimental group.

The control group received no intervention, while the experimental group received a reading intervention.

The reading intervention consisted of a series of reading lessons that focused on improving oral reading fluency.

The lessons included a variety of activities, such as reading aloud, reading silently, and reading with a partner.

The students in the experimental group showed significant improvement in oral reading fluency compared to the control group.

The results of the study suggest that the reading intervention was effective in improving oral reading fluency in students with reading disabilities.

These findings have important implications for the development of reading interventions for students with reading disabilities.

Future research should continue to explore the effectiveness of reading interventions for students with reading disabilities.

The study was supported by a grant from the National Institute of Education Research.

The authors would like to thank the students and teachers who participated in the study.

The authors would also like to thank the reviewers for their helpful comments.

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Table 1
Participant Information

Student	Gender	Age	CRW/min (Errors)	Comprehension
1	Male	11	100	85
2	Female	11	100	85
3	Male	11	100	85
4	Female	11	100	85
5	Male	11	100	85
6	Female	11	100	85
7	Male	11	100	85
8	Female	11	100	85
9	Male	11	100	85
10	Female	11	100	85
11	Male	11	100	85
12	Female	11	100	85
13	Male	11	100	85
14	Female	11	100	85
15	Male	11	100	85
16	Female	11	100	85
17	Male	11	100	85
18	Female	11	100	85
19	Male	11	100	85
20	Female	11	100	85
21	Male	11	100	85
22	Female	11	100	85
23	Male	11	100	85
24	Female	11	100	85
25	Male	11	100	85
26	Female	11	100	85
27	Male	11	100	85
28	Female	11	100	85
29	Male	11	100	85
30	Female	11	100	85
31	Male	11	100	85
32	Female	11	100	85
33	Male	11	100	85
34	Female	11	100	85
35	Male	11	100	85
36	Female	11	100	85
37	Male	11	100	85
38	Female	11	100	85
39	Male	11	100	85
40	Female	11	100	85
41	Male	11	100	85
42	Female	11	100	85
43	Male	11	100	85
44	Female	11	100	85
45	Male	11	100	85
46	Female	11	100	85
47	Male	11	100	85
48	Female	11	100	85
49	Male	11	100	85
50	Female	11	100	85

Table 2
Passages: Number of Words and Readability

Passage	Number of Words	Readability
1	100	0.5
2	150	0.6
3	200	0.7
4	250	0.8
5	300	0.9
6	350	1.0
7	400	1.1
8	450	1.2
9	500	1.3
10	550	1.4
11	600	1.5
12	650	1.6
13	700	1.7
14	750	1.8
15	800	1.9
16	850	2.0
17	900	2.1
18	950	2.2
19	1000	2.3
20	1050	2.4
21	1100	2.5
22	1150	2.6
23	1200	2.7
24	1250	2.8
25	1300	2.9
26	1350	3.0
27	1400	3.1
28	1450	3.2
29	1500	3.3
30	1550	3.4
31	1600	3.5
32	1650	3.6
33	1700	3.7
34	1750	3.8
35	1800	3.9
36	1850	4.0
37	1900	4.1
38	1950	4.2
39	2000	4.3
40	2050	4.4
41	2100	4.5
42	2150	4.6
43	2200	4.7
44	2250	4.8
45	2300	4.9
46	2350	5.0
47	2400	5.1
48	2450	5.2
49	2500	5.3
50	2550	5.4
51	2600	5.5
52	2650	5.6
53	2700	5.7
54	2750	5.8
55	2800	5.9
56	2850	6.0
57	2900	6.1
58	2950	6.2
59	3000	6.3
60	3050	6.4
61	3100	6.5
62	3150	6.6
63	3200	6.7
64	3250	6.8
65	3300	6.9
66	3350	7.0
67	3400	7.1
68	3450	7.2
69	3500	7.3
70	3550	7.4
71	3600	7.5
72	3650	7.6
73	3700	7.7
74	3750	7.8
75	3800	7.9
76	3850	8.0
77	3900	8.1
78	3950	8.2
79	4000	8.3
80	4050	8.4
81	4100	8.5
82	4150	8.6
83	4200	8.7
84	4250	8.8
85	4300	8.9
86	4350	9.0
87	4400	9.1
88	4450	9.2
89	4500	9.3
90	4550	9.4
91	4600	9.5
92	4650	9.6
93	4700	9.7
94	4750	9.8
95	4800	9.9
96	4850	10.0
97	4900	10.1
98	4950	10.2
99	5000	10.3
100	5050	10.4
101	5100	10.5
102	5150	10.6
103	5200	10.7
104	5250	10.8
105	5300	10.9
106	5350	11.0
107	5400	11.1
108	5450	11.2
109	5500	11.3
110	5550	11.4
111	5600	11.5
112	5650	11.6
113	5700	11.7
114	5750	11.8
115	5800	11.9
116	5850	12.0
117	5900	12.1
118	5950	12.2
119	6000	12.3
120	6050	12.4
121	6100	12.5
122	6150	12.6
123	6200	12.7
124	6250	12.8
125	6300	12.9
126	6350	13.0
127	6400	13.1
128	6450	13.2
129	6500	13.3
130	6550	13.4
131	6600	13.5
132	6650	13.6
133	6700	13.7
134	6750	13.8
135	6800	13.9
136	6850	14.0
137	6900	14.1
138	6950	14.2
139	7000	14.3
140	7050	14.4
141	7100	14.5
142	7150	14.6
143	7200	14.7
144	7250	14.8
145	7300	14.9
146	7350	15.0
147	7400	15.1
148	7450	15.2
149	7500	15.3
150	7550	15.4
151	7600	15.5
152	7650	15.6
153	7700	15.7
154	7750	15.8
155	7800	15.9
156	7850	16.0
157	7900	16.1
158	7950	16.2
159	8000	16.3
160	8050	16.4
161	8100	16.5
162	8150	16.6
163	8200	16.7
164	8250	16.8
165	8300	16.9
166	8350	17.0
167	8400	17.1
168	8450	17.2
169	8500	17.3
170	8550	17.4
171	8600	17.5
172	8650	17.6
173	8700	17.7
174	8750	17.8
175	8800	17.9
176	8850	18.0
177	8900	18.1
178	8950	18.2
179	9000	18.3
180	9050	18.4
181	9100	18.5
182	9150	18.6
183	9200	18.7
184	9250	18.8
185	9300	18.9
186	9350	19.0
187	9400	19.1
188	9450	19.2
189	9500	19.3
190	9550	19.4
191	9600	19.5
192	9650	19.6
193	9700	19.7
194	9750	19.8
195	9800	19.9
196	9850	20.0
197	9900	20.1
198	9950	20.2
199	10000	20.3
200	10050	20.4
201	10100	20.5
202	10150	20.6
203	10200	20.7
204	10250	20.8
205	10300	20.9
206	10350	21.0
207	10400	21.1
208	10450	21.2
209	10500	21.3
210	10550	21.4
211	10600	21.5
212	10650	21.6
213	10700	21.7
214	10750	21.8
215	10800	21.9
216	10850	22.0
217	10900	22.1
218	10950	22.2
219	11000	22.3
220	11050	22.4
221	11100	22.5
222	11150	22.6
223	11200	22.7
224	11250	22.8
225	11300	22.9
226	11350	23.0
227	11400	23.1
228	11450	23.2
229	11500	23.3
230	11550	23.4
231	11600	23.5
232	11650	23.6
233	11700	23.7
234	11750	23.8
235	11800	23.9
236	11850	24.0
237	11900	24.1
238	11950	24.2
239	12000	24.3
240	12050	24.4
241	12100	24.5
242	12150	24.6
243	12200	24.7
244	12250	24.8
245	12300	24.9
246	12350	25.0
247	12400	25.1
248	12450	25.2
249	12500	25.3
250	12550	25.4
251	12600	25.5
252	12650	25.6
253	12700	25.7
254	12750	25.8
255	12800	25.9
256	12850	26.0
257	12900	26.1
258	12950	26.2
259	13000	26.3
260	13050	26.4
261	13100	26.5
262	13150	26.6
263	13200	26.7
264	13250	26.8
265	13300	26.9
266	13350	27.0
267	13400	27.1
268	13450	27.2
269	13500	27.3
270	13550	27.4
271	13600	27.5
272	13650	27.6
273	13700	27.7
274	13750	27.8
275	13800	27.9
276	13850	28.0
277	13900	28.1
278	13950	28.2
279	14000	28.3
280	14050	28.4
281	14100	28.5
282	14150	28.6
283	14200	28.7
284	14250	28.8
285	14300	28.9
286	14350	29.0
287	14400	29.1
288	14450	29.2
289	14500	29.3
290	14550	29.4
291	14600	29.5
292	14650	29.6
293	14700	29.7
294	14750	29.8
295	14800	29.9
296	14850	30.0
297	14900	30.1
298	14950	30.2
299	15000	30.3
300	15050	30.4
301	15100	30.5
302	15150	30.6
303	15200	30.7
304	15250	30.8
305	15300	30.9
306	15350	31.0
307	15400	31.1
308	15450	31.2
309	15500	31.3
310	15550	31.4
311	15600	31.5
312	15650	31.6
313	15700	31.7
314	15750	31.8
315	15800	31.9
316	15850	32.0
317	15900	32.1
318	15950	32.2
319	16000	32.3
320	16050	32.4
321	16100	32.5
322	16150	32.6
323	16200	32.7
324	16250	32.8
325	16300	32.9
326	16350	33.0
327	16400	33.1
328	16450	33.2
329	16500	33.3
330	16550	33.4
331	16600	33.5
332	16650	33.6
333	16700	33.7
334	16750	33.8
335	16800	33.9
336	16850	34.0
337	16900	34.1
338	16950	34.2
339	17000	34.3
340	17050	34.4
341	17100</	

this condition was to determine whether rewards for more proficient reading were likely to improve student responding (Lovitt, Eaton, Kirkwood, & Pelander, 1971). The reported results for the instructional and HCO passages are based on the 1st min of the final reading of both passages.

Experimental Design and Procedures

The analysis of student performance was conducted in three parts. First, a brief analysis was conducted in which two control and three treatment conditions were administered in a standard order. Next, a multielement design was used to compare the effects of the instructional and HCO conditions on an individual basis. This portion of the analysis, referred to as the extended analysis, was designed to test specific hypotheses regarding the effects of combinations of treatment components on student's reading fluency based on the results of the brief analysis. Finally, effects of instruction-only and instruction plus contingent rewards were analyzed to determine whether adding rewards improved the effects of instruction.

Student performance improved by 30% or more in pair conditions. The number of trials to reach and maintain compliance with the reward criteria was 10 or fewer.

Each condition was administered until the student met the criterion. Each session lasted 10 min. The two conditions were administered

but experimenters avoided providing praise based on

best performance. The best performance was not contingent on the student's performance throughout all of the trials in the condition. The student was not given a reward until the

student met the criterion. The number of trials to reach and maintain compliance with the reward criteria was 10 or fewer. Each condition was administered until the student met the criterion. Each session lasted 10 min. The two conditions were administered

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TESTING TREATMENTS

improve reading fluency of
chosen treatment

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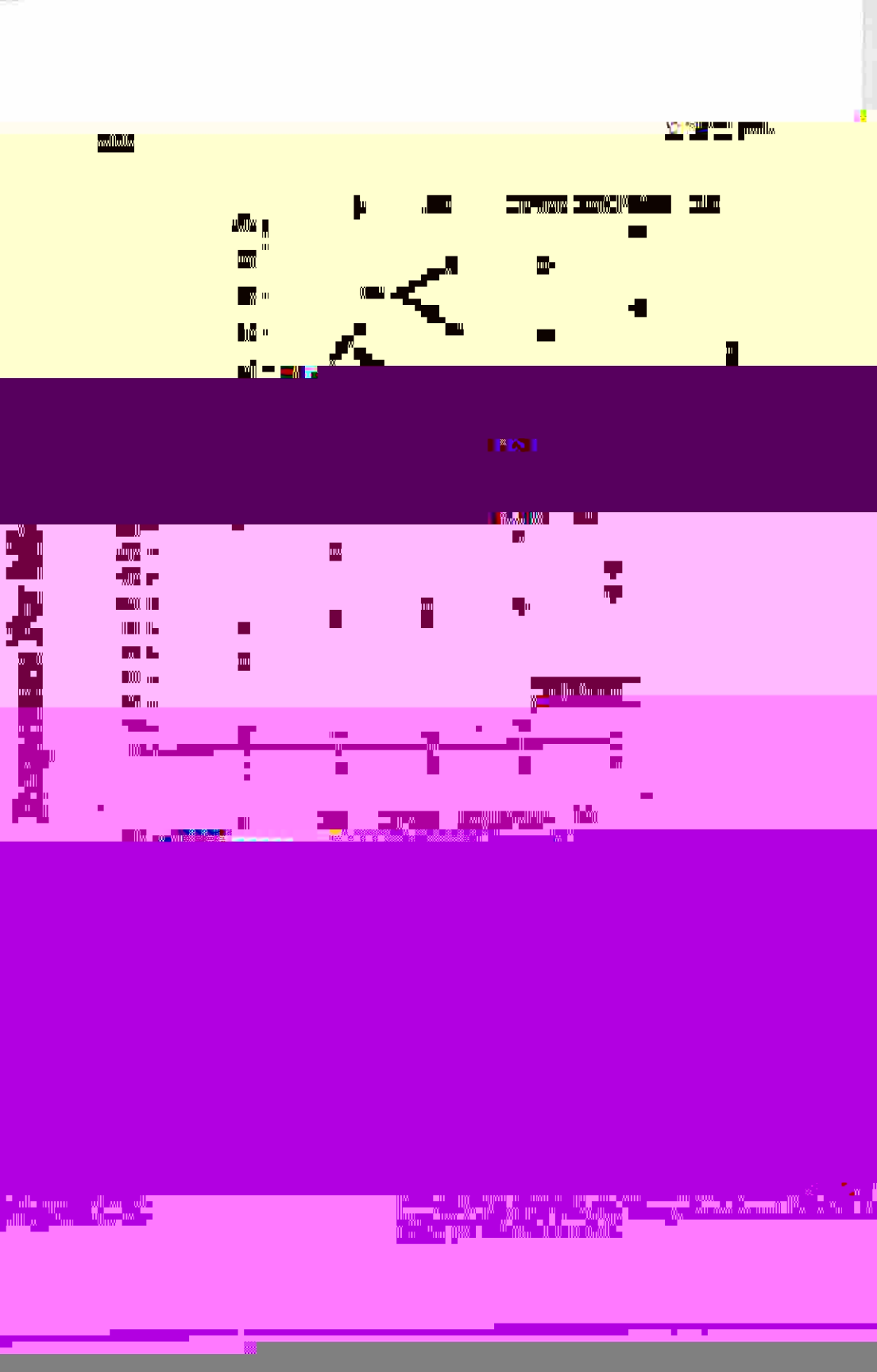
... treatment component(s) that produced the
... based on visual analysis, were chosen for further analysis.
This strategy of choosing treatment components based on incremental ef-
fects was believed to produce simpler
vention strategies.

the passages until they got better at reading them.

The CR condition was then combined with the instructional treatment package. The students were offered rewards for meeting their goals. Goals were described as how quickly students needed to read the passage (with

pants in how well they improved their reading fluency across treatment conditions. Treatment components were

that led to the largest incremental improvements



component.

There was no large visible component in the HCO passages in the

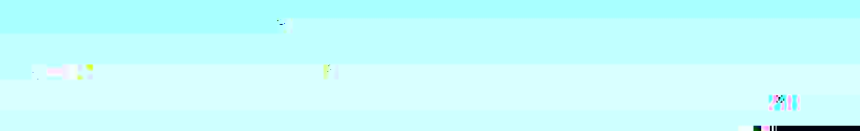


FIG. 1. Distribution of HCO passages in the x - y plane. The HCO passages are concentrated in the ring-like structure centered at the origin.

Figure 1 shows the distribution of HCO passages in the x - y plane. The HCO passages are concentrated in the ring-like structure centered at the origin.

The HCO passages are concentrated in the ring-like structure centered at the origin. The HCO passages are concentrated in the ring-like structure centered at the origin.

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Dion's error rate was high in this case because the sample size was small. The error rate was high because the sample size was small.

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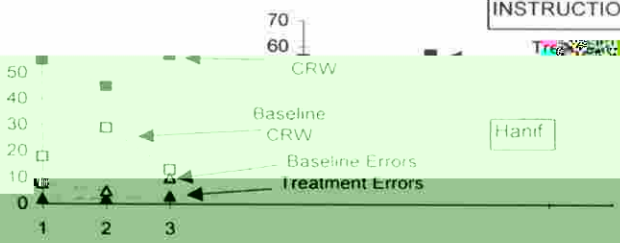
There is a **small number of observations** that means when

Table 5

Definition ^a *Comparison of the effects of a treatment package with the effects of a control package on the primary outcome in the study population*

Participant	Treatment Package	Control Package
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1
9	1	1
10	1	1
11	1	1
12	1	1
13	1	1
14	1	1
15	1	1
16	1	1
17	1	1
18	1	1
19	1	1
20	1	1
21	1	1
22	1	1
23	1	1
24	1	1
25	1	1
26	1	1
27	1	1
28	1	1
29	1	1
30	1	1
31	1	1
32	1	1
33	1	1
34	1	1
35	1	1
36	1	1
37	1	1
38	1	1
39	1	1
40	1	1
41	1	1
42	1	1
43	1	1
44	1	1
45	1	1
46	1	1
47	1	1
48	1	1
49	1	1
50	1	1
51	1	1
52	1	1
53	1	1
54	1	1
55	1	1
56	1	1
57	1	1
58	1	1
59	1	1
60	1	1
61	1	1
62	1	1
63	1	1
64	1	1
65	1	1
66	1	1
67	1	1
68	1	1
69	1	1
70	1	1
71	1	1
72	1	1
73	1	1
74	1	1
75	1	1
76	1	1
77	1	1
78	1	1
79	1	1
80	1	1
81	1	1
82	1	1
83	1	1
84	1	1
85	1	1
86	1	1
87	1	1
88	1	1
89	1	1
90	1	1
91	1	1
92	1	1
93	1	1
94	1	1
95	1	1
96	1	1
97	1	1
98	1	1
99	1	1
100	1	1

INSTRUCTIONAL



HCO



fin

Chad's results are displayed on the left side of the top two panels of

Figure 4. WHO LPP/PP/C² model results compared with P₁ and P₂ for 1990-2000

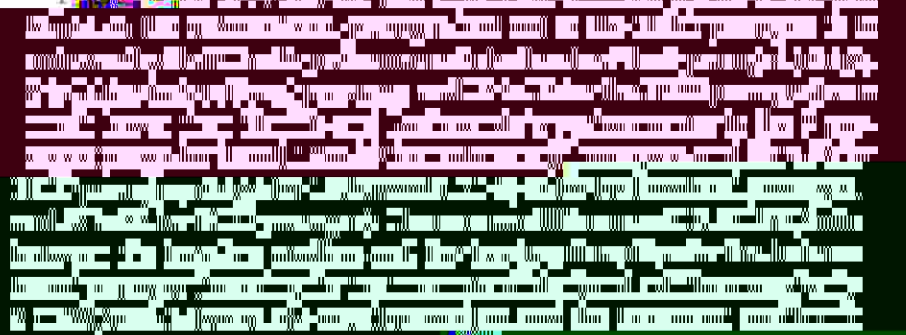
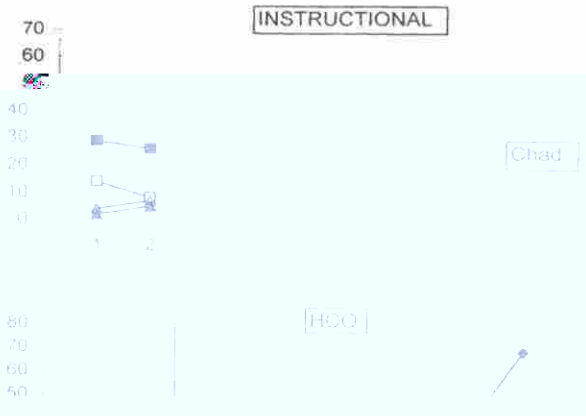


Table 1. WHO LPP/PP/C² model results compared with P₁ and P₂ for 1990-2000

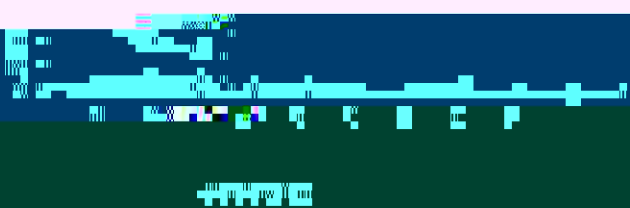
Year	P ₁	P ₂	LPP/PP/C ²
1990	100	150	120
1991	120	180	140
1992	150	220	170
1993	180	260	200
1994	220	300	240
1995	260	340	280
1996	300	380	320
1997	350	420	360
1998	400	460	400
1999	450	500	440
2000	500	540	480

The results of the WHO LPP/PP/C² model are compared with the P₁ and P₂ estimates for the period 1990-2000. The top panel shows the number of cases over time, and the bottom panel shows the same data in a bar chart format. The LPP/PP/C² model results are generally consistent with the P₁ and P₂ estimates, showing a steady increase in cases over the period. The P₂ estimates are consistently higher than the P₁ estimates, and the LPP/PP/C² model results fall between the two.

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able, but generally lower, than the values reported for the other two studies.

Concentrations of HCO^- in the HCO passages were also generally higher than for the other two studies, but the magnitude of the differences was smaller than for the HCO concentrations in the HCO passages when the data were averaged over all three administrations of baclofen.



Fig. 1. Time course of plasma baclofen concentration (ng/ml) in the HCO passages when the data were averaged over all three administrations of baclofen.

Table 1. Mean plasma baclofen concentration (ng/ml) in the HCO passages when the data were averaged over all three administrations of baclofen

Time (min)	Baclofen	HCO	HCO
0	0	0	0
15	500	300	200
30	1000	600	400
45	800	500	350
60	600	400	300
75	400	300	250
90	600	400	300
105	1000	600	400
120	400	300	250

Values are given as mean \pm SEM. The HCO values are the mean of the HCO and HCO values. The HCO values are the mean of the HCO and HCO values.

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Instructional treatments were applied to the first two passages, and the last two passages.

use participants worked on each passage until they met criterion performance (were administered the treatment three times) in passages, the slopes of improvement within passages, beginning levels of performance, and number of trials to criterion used to compare instruction-only with instruction plus rewards. There were greater slopes of improvement for the

Because levels of performance in the HCO condition were higher at the beginning and end of the study, it could be argued that the instruction plus rewards condition would have had greater slopes of improvement. If there were

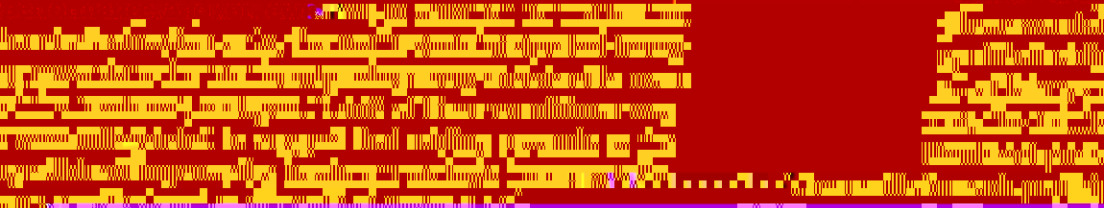


Figure 1. Performance levels over time for instruction-only and instruction plus rewards conditions.

... the instruction plus rewards condition. The instruction plus rewards condition showed a steeper slope of improvement within passages, indicating that participants in this condition improved more rapidly than those in the instruction-only condition. This suggests that the addition of rewards to the instructional treatment enhanced the rate of learning.

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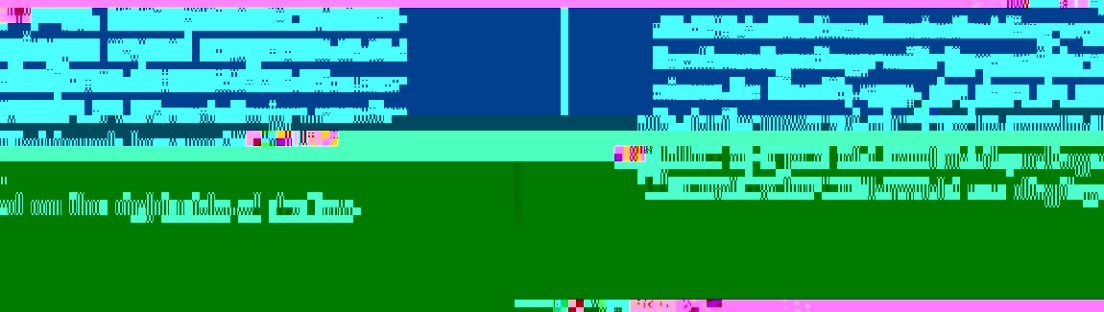


Figure 2. Performance levels over time for instruction-only and instruction plus rewards conditions.

min in the HCO baseline passages during the extended analysis. Under rewarding conditions, he read 70 and 67 CRW/min, respectively, for the two passages on the 1st trial. A small effect for rewards was observed for Hanif. Rewards did not appear to improve results for Ashley. Repeated administration of the instruction-only condition



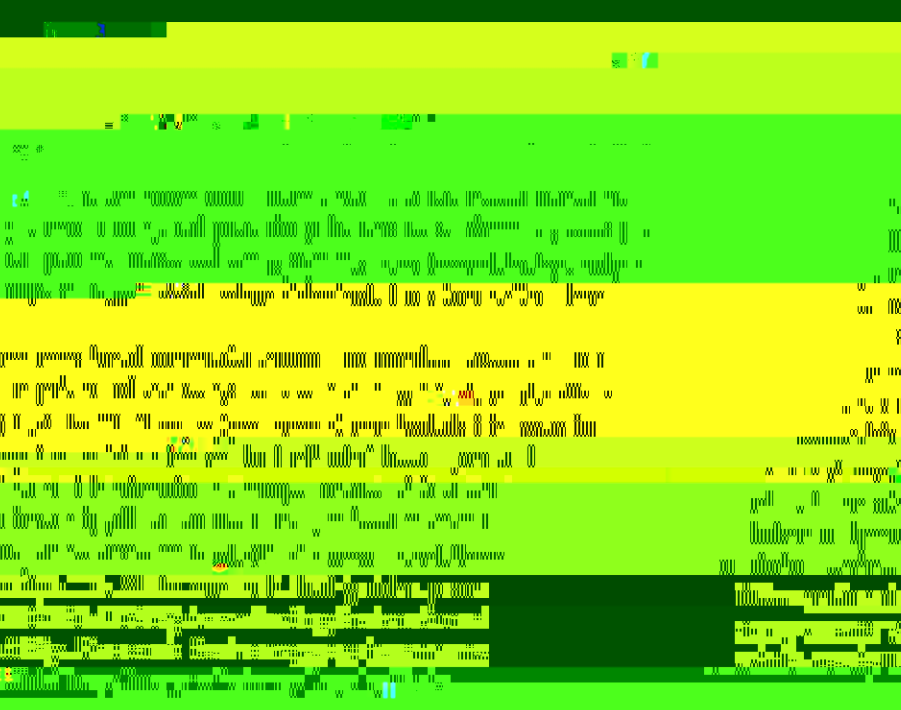
Interventions derived from brief experimental analyses may be useful as adjuncts to the current instruction children are receiving. Brief experi-

high errors and low CRW/min in the initial screening. Interestingly, although they were all second graders in the same school, different interventions were identified across the students. These students were chosen because they were referred to the first author for intervention. However, their low reading level may have interfered with finding passages that they could read with reasonable accuracy without some instruction preceding initial reading. In future studies,

longer and are probably better suited to brief experimental analysis. It has been shown to establish firm mastery of sound-symbol relations that can be generalized to decodable connected text (Adams, 1990).

Ashley's performance in the brief test conditions reveals a weakness of the procedures reported in this study. The EM condition was supposed to present easier materials. However, because the prior conditions (B, RR, P/RR) were carried out in first grade materials, choosing materials for the EM condition posed a problem. Words consisting of phonemes using only single-consonant, short vowel words would be easier for

achieved through an intervention. The HCO passages may help investigators and practitioners alike probe for generalization. Unfortunately, in this study limited generalized increases were observed for all the treatment conditions. SM was necessary for all participants. It may be that the tactic of choosing the simplest intervention



in rules should be reviewed. It is critical to keep in mind that the results of these analyses do not guarantee increases over time. Brief treatment

interventions derived from idiographic analyses of academic performance. One potential, uncontrolled source of variability in this investigation



90% accurate might reduce this problem.

There was a continuity of sequence in the multi-part of the analyses that should be addressed in future studies. The reward plus instruction condition always followed the instruction-only condition. We chose this strategy to avoid problems with withdrawing rewards once they were introduced. This issue was seen as especially important because the students were being asked to work for the rewards. From an experimental standpoint, withdrawing rewards after they had been introduced could exaggerate differences across conditions (in favor of producing larger effects for reward conditions). It appears that more basic research on the interaction of rewards with instructional variables is necessary before further tech-

forcement contingency was probably not the only variable influencing per-

Notice should examine the role of social factors.

Appendix

Guidelines for Selecting Treatment Components Based on The Brief Analysis Sequence

1. If RR produces as large an effect as LPP/RR (or almost as large as LPP/RR), select RR.

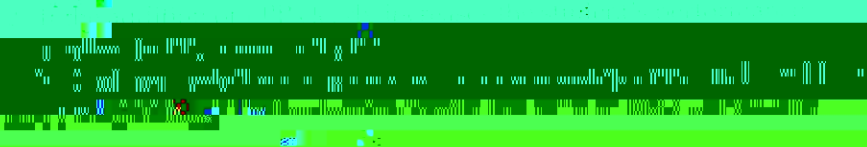


Figure 1. Percentage of RR selected versus percentage of RR that produces as large an effect as LPP/RR.



Figure 2. Percentage of RR selected versus percentage of RR that produces almost as large an effect as LPP/RR.

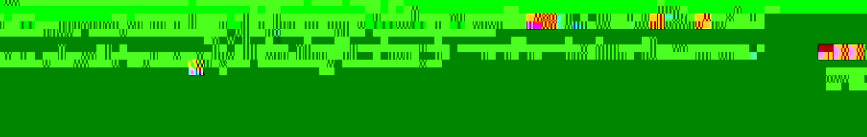


Figure 3. Percentage of RR selected versus percentage of RR that produces almost as large an effect as LPP/RR.



Figure 4. Percentage of RR selected versus percentage of RR that produces almost as large an effect as LPP/RR.

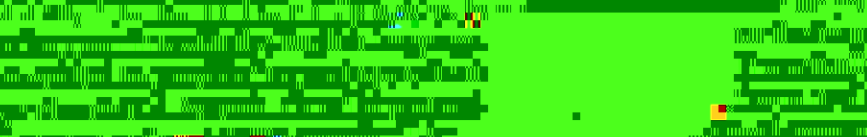


Figure 5. Percentage of RR selected versus percentage of RR that produces almost as large an effect as LPP/RR.



Figure 6. Percentage of RR selected versus percentage of RR that produces almost as large an effect as LPP/RR.



Figure 7. Percentage of RR selected versus percentage of RR that produces almost as large an effect as LPP/RR.

