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ABSTRACT

This study examined the hypothesis that focusing attention away from external stimulation and on the self might improve the task performance of students with attention deficit/hyperactivity disorder. Forty-three middle school students, (12 with hyperactivity, 4 without hyperactivity but inattention, and 27 without either attention deficit disorder or hyperactivity), attempted to solve a partially solvable word puzzle in the presence and absence of a mirror, counterbalanced for condition and form order. Differences between students with and without disorders in task accuracy and time were found only in the no mirror condition. Furthermore, the beneficial effect of the mirror for children with hyperactivity, relative to comparison children, was most pronounced for those who looked at the mirror. Results are interpreted in terms of attentional bias toward external stimulation of students with hyperactivity. (Contains 34 references.) (DB)

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Abstract

Mirrors have been used to focus attention to aspects of the self (e.g., to known strategies, standards). We hypothesized that this could be important for students with hyperactivity, who typically direct attention outward to external novelty. In this study, we administered a partially solvable word-puzzle to 43 middle school students, with and without hyperactivity, in the presence and absence of a mirror, counterbalanced for condition and form order. Differences between students with and without disorders in accuracy and time were found only in the no mirror condition. Furthermore, the beneficial effect of the mirror for children with hyperactivity, relative to comparison children, was most pronounced for those who looked at the mirror. Findings were interpreted in terms of their heuristics in addressing the production deficits of these children.

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Attentional Focus of Students with Hyperactivity During a Word-Search Task

Proponents of self-control training propose that children are better equipped to manage life's problems and challenges, if they have the ability to alter and maintain their own goal-directed behavior with a minimum of external support than are children who are dependent on adult direction (Kanfer & Phillips, 1970; Karoly, 1977). Self-control is particularly important in classrooms where children are called upon to work independently or with their classmates. Several methods have been developed to enhance the self-control of children.

Early attempts to enhance self-control were based upon operant methodology. Children were often trained to cue, monitor, reinforce, and punish their own behavior (Thoresen & Coates, 1986). Although there were high expectations for improving maintenance of behavior through self-control, as defined by the operant methodology, an examination of the efficacy data did not indicate greater effectiveness of self-delivered antecedents and consequences over externally delivered stimuli (Craighead, Wilcoxon-Craighead, & Meyers, 1978; Marholin, Siegel, & Phillips, 1977).

The failure of the operant skills approach in affecting long-term change led to a more process-oriented approach, typically involving self-verbalization of strategies. It was hoped that the cognitively regulated approach would (a) require less effort to perform, thereby promoting maintenance over time, and (b) be less situation-specific in its effects, thereby enhancing generalization of behavior across settings and trainers. The results of several studies have demonstrated the efficacy of cognitive-based strategies in enhancing the academic performance of a variety of populations (for review see Harris, 1994). However, for children with attention deficit/hyperactivity disorder (AD/HD) cognitive training has not improved generalization or maintenance of self-control behavior (for review see Abikoff, 1985; 1991).

The relative failure of both operant and process oriented approaches to promote maintenance and generalization of self-regulation has been attributed to the fact that both methods require additional tasks (e.g., self-verbalizing, self-reinforcement), which slows performance, disrupts the smoothness of an ongoing behavioral chain, and disrupts complex processing (for review see Zentall, 1989). The failure of these methodologies for students with AD/HD could also be attributed to the specific characteristics of these children. Students with AD/HD have preferences for external novel stimulation (Zentall, 1993) and are often thought to respond better to externally represented controls (Pfiffner & Barkley, 1990). That is, individuals with AD/HD rely on overt or external cues, whereas behavioral self-regulation may require an internal or self-focus of attention (control-process model of self-regulation, Carver, Blaney, & Scheier, 1979).

Carver and Scheier (1981, p. 107) have proposed that attention falls on a continuum from inward to outward focus. According to Carver and Scheier's model, as attention outward to the environment increases, attention to the self decreases; conversely, as attention to the environment decreases, attention to the self increases. For example, redirecting attention to novel stimuli in the environment (i.e., outward focus) can "distract" an individual's self-focus away from an internal state (e.g., pain). Alternatively, directing an individual's attention internally increases the awareness of the private self (e.g., thoughts, strategies, attitudes, feelings, values, physiological states).

For many individuals, self-awareness must be learned. In particular, students with AD/HD may need to learn to focus attention to aspects of the self. Several methods have been developed in an effort to teach students to direct attention inwardly. These methods generally fall into one of two major categories: (a) manipulations of emotional arousal, or (b) manipulations of cognitive factors, including type of feedback.

Increased attention to the self can be brought about by increasing an individual's level of physiological arousal (e.g., associated with emotional states, Carver, 1979; Carver & Scheier, 1981; Salovey, 1992). Changes in emotional state have been achieved

(Meichenbaum, 1979; Wood, Saltzberg, & Goldsamt, 1990). Meichenbaum (1979) suggests that fantasy may free the child from the control of external stimulation, allowing attention to be directed to internal representations.

When one is self-focused, a larger array of information about the self can be brought to mind. However, the type of information that can be retrieved may be mediated by specific emotions (Salovey, 1992). For example, a positive emotional state correlated with enhanced performance on learning a new task (Yasutake & Bryan, 1995). In addition, expectancies can act like emotional states to moderate task performance, but only when self-attention is high. That is, individuals with positive expectancies persisted longer at a task when self-focus was high; but in the absence of self-focus, neither positive nor negative expectancy affected task persistence (Carver, Blaney, & Scheier, 1979).

It is also possible to focus attention to aspects of the self using cognitive strategies. For example, cognitive-training studies typically present a cue to a child at random intervals, which signals the child to attend to his or her own behavior (i.e., to self-monitor and self-reinforce) (e.g., Hallahan & Sapona, 1983). Motivational researchers further suggest that an internal focus can be enhanced when evaluative feedback is related to self-improvement more than when there are normative comparisons (e.g., Ames, 1992; Elliott & Dweck, 1988; Jagacinski & Nicholls, 1987). These researchers suggest that an emphasis on social comparisons can decrease goal orientation, particularly when the child compares unfavorably with classmates. When a student engages in self-evaluation, with private feedback from adults, the student is more likely to increase effort, which ultimately results in enhanced performance.

Unfortunately, each of these cognitive techniques relies on adult training and compliance. It is for these reasons that we needed to identify alternative cognitive methods to focus attention to the self. Carver and Scheier reported that an audience, observer, mirror, or camera increased self-focused attention (Carver, 1979; Carver & Scheier, 1981), although the effects have only been demonstrated with normal adults.

In summary, the overriding conclusion from Carver and Scheier's review of research was that the relative absence of self-focus resulted in the relative absence of self-control. They do not discuss what may be responsible for individual differences in biasing the direction of attentional focus. However, the data that indicate that physiological arousal increases self-focus may provide a link to one explanation of hyperactivity, impulsivity, and attentional disorders (Zentall, 1975; Zentall & Zentall, 1983). Zentall has proposed that children with hyperactivity are physiologically less responsive to, or have a greater need for stimulation. These students attempt to self-generate an optimal level of stimulation through , for example, instrumental activity, aggression, and attention focused outward to novel stimuli in the environment. High levels of physiological arousal, which precipitates self-focusing of attention, would occur less frequently in students with AD/HD. Thus, students with AD/HD have a greater need for methods to facilitate self-attention.

Of these methods we have selected a mirror as a relatively simple way to experimentally increase self-attention and performance. Carver and Scheier (1981, p. 300) have stated that a mirror focuses attention to private aspects of the self (e.g., to standards, task instructions, strategies), rather than to aspects of one's public self. With normal adults, Carver and Scheier reviewed evidence that mirrors increased the: (a) number of letters copied in a copying task (p. 296), (b) persistence in an insolvable task with a favorable outcome expectancy (p. 208), and (c) number of self-focused verbal responses produced for a sentence completion task (p. 45). We hypothesized that the number of words that students with AD/HD would accurately identify in a word puzzle task would be equivalent to the performance of comparisons in the mirror condition and different from that of comparisons only in the condition without the mirror.

Method

Participants

All sixth, seventh, and eighth grade teachers in an urban midwestern middle school were asked by their principal to nominate students who were more active and inattentive than their classmates. Thirty were nominated. Those same teachers were then asked to nominate students who were less active and generally more attentive than classmates, but of the same grade, age, gender, and academic ability as the active and inattentive students. Of the 30 students nominated in each group, parent and student permission were obtained from 77% of the active/inattentive and 90% of the comparison group.

Teachers were then asked to complete a behavioral rating scale--the ADD- H Comprehensive Teacher Rating Scale for each child (ACTeRS; see Ullmann, Sleator, & Sprague, 1984, 1985, 1991, for norms, validity data, and reliability estimates). The ACTeRS is one of the most widely used behavior rating scales for diagnosing attention deficit disorder with or without hyperactivity and has a total of 24 items which are divided into four subscales -- (a) Attention, (b) Hyperactivity, (c) Social Skills, and (d) Oppositional Behavior. The ACTeRS scale was used to assign students to one of three groups: Hyperactive (H), Inattentive (I), and Comparison (C).

The H group was comprised of students who scored at or below the 25th percentile on either the activity subscale or both the hyperactivity and inattentive subscales, whereas the I group was comprised of students who were at or below the 25th percentile on the inattentive subscale only (Ullmann et al., 1995). This assignment procedure resulted in 12 students in the H group (5 boys and 7 girls), one of which was Hispanic and one African American, and 4 students in the I group (3 boys and 1 girl), including one African American. Two students in the H group were taking methylphenidate at the time of the study, but their behavioral ratings still met the criteria for inclusion. The remaining nominated students, who scored above the 50th percentile on both the Hyperactivity and Inattentive subscales of the ACTeRS. were placed in the comparison (C) group. This resulted in 27 students (15 boys and 12 girls) in the C group including one Hispanic. A total sample 43 students, 23 boys and 20 girls were selected using these procedures.

No differences in age, grade, and gender were found among the three groups. A significant difference among groups was found in total battery (English/language and mathematics) achievement (Comprehensive Tests of Basic Skills / Fourth Edition, published by CTB/McGraw Hill). In addition, we found a mean difference among the groups on the ACTeRS. which was used in the formation of the groups (see Table 1).

Task

Each child was asked to complete a partially solvable word search puzzle (as per Carver & Scheier, 1981, but adapted from Mining Glossary and Games, National Energy Foundation, 1991). Puzzles were reproduced on standard (20 cm x 27.5 cm) copy paper and were presented as a 10 cm x 15 cm vertical letter array in the top two thirds of the page. Two different mining puzzles (A & B) were used, which differed in the letters in the array and the words to be found. Each puzzle had two forms (1 & 2), which differed in the number of words which could be found. Form 1 had 11 findable and 5 nonfindable words, and Form 2 had 12 findable and 4 nonfindable words. Both forms had the same number of word-answer placements (i.e., horizontal, vertical, reversed, and diagonal).

Experimental Setting, Conditions, and Procedures

Two testing sessions, each 25-40 min, took place during the child's regular school day. Each child was individually called to the counselors office by one of the secretaries, where they were instructed to go to one of two conference rooms. In all sessions the student was seated at a table facing the wall. In both conference rooms a pastel seascape picture of a sail boat (86 cm X 56 cm) hung on the wall and was positioned to the left and above the student during both sessions. The two conference rooms varied minimally in size (2.5 m x 3 m to 3 m x 4 m), and the students had the same small table (75 cm x 96 cm) and side views of one blank wall and one wall with a bookcase. The task was administered individually by a trained experimenter.

In the mirror condition there was a 68 cm x 90 cm mirror leaning against the wall on the table in the front view. The presence of the mirror was ignored by the experimenter, who made no reference to it's presence. The setting was the same for the no mirror condition except there was a blank wall in the front view.

During the initial setting, the students filled out a brief nine item short-answer questionnaire, asking students for their perceptions of homework. This 5-10 minute warm-up exercise gave students a chance to acclimate to the novelty of their surroundings and to the unfamiliar experimenter.

After the questionnaire was completed the experimenter read the word search puzzle directions to the student. Students were told that not all of the words in the list could be found in the puzzle, and the experimenter did not know which words or how many words there were in that specific puzzle. They were also told that the puzzles might have words straight across, up and down, on the diagonal, or possibly even backwards. The experimenter asked students to explain the task in their own words. Once the experimenter was certain the student understood the directions, additional instructions were: (a) to work on this puzzle until they thought they had found all the words, (b) to try hard and work as long as they could, but (c) their work would not be graded. When they thought they had finished, they were to call the experimenter, who would be studying in the corner of the room. That is, the experimenter was present in both conditions, but to all appearances the experimenter was not there to observe the students.

During the task the experimenter was out of the child's line of vision, even through the mirror. When the child was finished, the experimenter put down her work and told the child, "you have done a very good job; you found a lot of words." This process was repeated in the second session. Differences between sessions were as follows. At the end of the first session, the experimenter asked, "Was this puzzle difficult? How did you find the words? I will be back in two weeks with a different puzzle for you to try. At the end of that session, I will ask you which puzzle you liked best." At the beginning of the second session, no homework survey was given. At the end of the second session the experimenter asked, "Which puzzle did you like best and why?"

Experimental Design

Participants in the H, I, and C groups were randomly assigned to one of two orders of treatment (mirror first or no mirror first) and to one of two puzzle forms (1 or 2, that remained constant across sessions). Order of treatment and puzzle forms were counterbalanced across groups to randomly distribute the effects of order of treatment and form of puzzle. We assessed and found design equivalence for achievement (I-STEP) in a Group x Order interaction, $F(2, 36) = 1.41$, $p = .256$. (see Table 1).

Measures

The dependent variables were time, accuracy, and upward glances. Time was measured in minutes from when the experimenter instructed a student to begin until the student reported to the experimenter they were finished. Time was recorded with a stop watch that was hidden from the participants. Accuracy was computed by dividing the number of correct words found by the number of possible word answers. An upward glance was defined as lifting the head so that the student no longer could look directly at their paper.

Results

Although we documented equivalence for achievement in the cells of the design, our population groups differed in achievement. For this reason, we entered achievement as a covariate in a three-way analysis of covariance for Group, Treatment, and Order of Treatment. Because achievement was not a significant covariate for either time or accuracy, and did not qualitatively alter the findings, we dropped the achievement covariate from subsequent analyses.

Time

Prior to analyzing our data, raw scores (time in min) were transformed into logarithms. The log time data were analyzed using a 3 Group (H, I, and C) X 2 Treatment (mirror and no mirror) X 2 Treatment Order (mirror first or mirror second) analysis of variance (ANOVA) with group and order as between-groups factors and treatment serving as the within-groups factor. See Table 2.

The ANOVA for the dependent variable, time, yielded a significant effect for group, $F(2, 34) = 4.01$, $p = .027$. Pairwise contrasts yielded overall differences between the two disordered groups, $F(1, 34) = 7.34$, $p = .011$ ($M_H = 2.66$ $SD = .213$, $M_I = 3.08$ $SD = .379$) and between the H and C groups, $F(1, 34) = 3.78$, $p = .06$ ($M_H = 2.66$ $SD = .213$, $M_C = 2.87$ $SD = .267$). These differences indicated that the H group took less time to complete the task across treatment conditions than did the I or C groups, who did not differ.

A higher order interaction between group and treatment was found [$F(2, 34) = 3.19$, $p = .054$] indicating that the groups responded differentially to the treatment conditions, see Figure 1. Simple effect analyses of this interaction using a Newman-Keuls post hoc multiple comparison test indicated that in the traditional no mirror condition, the I group ($M = 3.11$ $SD = .461$) took more time to complete the task ($p < .05$) than both the H ($M = 2.71$ $SD = .173$) and C ($M = 2.82$ $SD = .294$) groups, who did not differ. In the mirror condition, only the H ($M = 2.59$ $SD = .307$) and the I ($M = 3.05$ $SD = .30$) groups differed ($p < .05$), again with the I group taking more time to complete the task.

Accuracy

Prior to analyzing the accuracy data, raw scores (i.e., number of words found) were standardized ($M = 100$, $SD = 15$) to allow for comparisons across both forms of the puzzle, which contained an unequal numbers of words. There were no differences in accuracy between the H and I groups, therefore we pooled the accuracy data for the two disordered groups (H/I) and ran the same analysis, but with only two levels of the grouping factor. This analysis yielded an effect of group [$F(1, 39) = 3.25$, $p = .079$][1] with children with disorders somewhat less accurate ($M = 94.91$ $SD = 13.25$) than comparisons ($M = 102.05$ $SD = 11.29$).

Because of our a priori prediction that the mirror would differentially affect accuracy between groups, we subsequently examined the simple effects for accuracy in each treatment condition, even though the interaction of Group X Treatment did not reach the conventional level of significance [$F(1, 39) = 2.14$, $p = .151$].[2] In this analysis, group differences were yielded only in the traditional no mirror condition [$F(1, 39) = 5.54$, $p = .024$], indicating that the students with disorders were less accurate ($M = 91.83$ $SD = 18.44$) than comparisons ($M = 103.41$ $SD = 12.11$) only in the absence of the mirror (see Figure 2). No other between or within-subjects effects approached significance (see Table 2).

Supplementary Analyses

We conducted several additional analyses, for example, to assess perceived task difficulty and the effects of upward glances at the mirror on performance. A chi-square analysis revealed that the groups did not differ in upward glances (looks/no looks) to the mirror [$\chi^2(2, n = 43) = .541$, $p = .763$] or to the picture on the wall in the no mirror condition, [$\chi^2(2, n = 43) = .342$, $p = .843$]. We also assessed whether accuracy performance was mediated by glancing at the mirror, using a 2 Group (H/I vs. C) X 2 Upward Glance (lookers vs. nonlookers) ANOVA.[3] The ANOVA yielded an interaction between group and upward glances [$F(1, 32) = 5.17$ $p = .029$], indicating that the groups responded differently (see Figure 3). Simple effect analyses indicated that participants from the combined H & I group, who did not look at the mirror, performed worse ($M = 92.41$ $SD = 13.12$) than participants from the C group who did not look up ($M = 107.61$ $SD = 9.62$), $F(1,39) = 4.35$, $p = .044$. However, there were no differences [$F(1,39) = 1.09$, $p = .30$] between students from the H/I group who looked at the mirror ($M = 101.35$ $SD = 14.55$) and comparison children who looked at the mirror ($M = 95.15$ $SD = 17.94$) (see Figure 3).

After completing their first puzzle, students were asked if they thought the puzzle was difficult or easy. A chi-square analysis was conducted to determine whether the C and H/I groups differed in perceived difficulty of the puzzle. This analysis revealed that 56.25% of children from the H/I group thought that the puzzle was difficult compared to 29.63% of children from the C group [$\chi^2(1, \underline{n} = 43) = 2.98$, $\underline{p} = .084$]. A difference in perceived level of difficulty was not found between the mirror and nonmirror conditions [$\chi^2(3, \underline{n} = 43) = 3.43$, $\underline{p} = .330$].

Figure 4 documents the data of three students, who were nominated by their teachers as active and inattentive. The data for these students were not included in the main analyses, because they failed to meet the inclusion criteria for either the H or I group--probably because they were taking psychostimulant medication. The supplementary question addressed by these descriptive data was whether the performance of these three medicated children was similar to the performance of comparison students with similar ACTeRS scores. From a visual examination of Figure 4, we concluded that their time and accuracy data in response to both experimental conditions were similar to those of the comparison group.

Discussion

We proposed that an attentional bias toward external stimulation, which characterizes students with AD/HD, would prevent self-focusing of attention and therefore preclude self-control. In this study, we examined the effects of a mirror as a means to increase self-focus and improve self-control. Self-control was operationally defined as performance on a partially solvable word puzzle.

We found that children with and without disorders responded differently to the presence of a mirror. Overall, the mirror "normalized" the accuracy performance and the time spent working on the puzzle for the H/I group. That is, in the mirror condition the hyperactive and inattentive groups did not differ from comparisons in performance; although differences were found in the traditional nonmirror condition. More interestingly, the effects of the mirror for children with H/I were especially beneficial for those who looked at the mirror and detrimental for those who did not, relative to comparison children.

Although we predicted greater gains for students with H/I than for comparisons in the mirror condition, we did not predict that the effects of the mirror and of looking at the mirror would disrupt the performance of the comparisons. The relative performance loss of this group in the self-focus condition could be explained as an outcome of increasing the self-attention of students, who were already self-focused. That is, students in the comparison group were unable to achieve an optimal balance between self-focus and external focus. As a result of this imbalance during the mirror condition, students in the comparison group may have been too self-focused and less likely to attend to important perceptual characteristics of the task. Carver and Scheier (1981, p. 298) have reported that attention directed inward <u>can</u> disrupt the performance of normal adults when (1) a task requires discrimination among the perceptual characteristics of external stimuli, (2) a task is unfamiliar and individuals spend proportionately more time selecting an appropriate strategy, or (3) when several competing standards are made salient (e.g., through instructions). The first of these explanations may apply to the comparison children in this study in that the task required discrimination among groups of letters within rows and columns in a letter array.

Overall, these data provide generality for some of the conclusions of Carver and Scheier. For children with AD/HD, who have an attentional bias toward external stimuli, methods to increase self-attentional focus can improve performance. This may be particularly important, because these students typically fail to perform appropriately in situations, even when they know that a particular strategy is appropriate in that setting (i.e., production deficits, Torgesen, 1977). It may be that children with AD/HD fail to spontaneously access what is known. If so, the findings from this study could serve as heuristics for research on production deficits. As a caveat, it is possible that these self-attentional techniques will be less useful for those students with AD/HD, who have already learned to focus internally (e.g., to generate stimulation through daydreaming, thinking, questioning) or those students who are being successfully treated with psychostimulant medication (see Figure 4).

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Table 1

Statistical Equivalence Among Groups

	Hyperactive		Inattentive		Comparisons		F
Age in Years	13.92	(1.46)	14.12	(1.10)	13.71	(1.31)	0.22
Grade	7.08	(0.90)	7.25	(0.96)	6.93	(0.92)	0.20
Total Achievement (T Scores)	43.00	(22.81)	55.25	(24.45)	82.41	(16.54)	18.44***
ACTeRS-H	33.58	(8.63)	47.50	(3.32)	51.67	(3.92)	43.51***
ACTeRS-I	36.00	(8.63)	36.00	(2.58)	54.30	(4.96)	45.46***

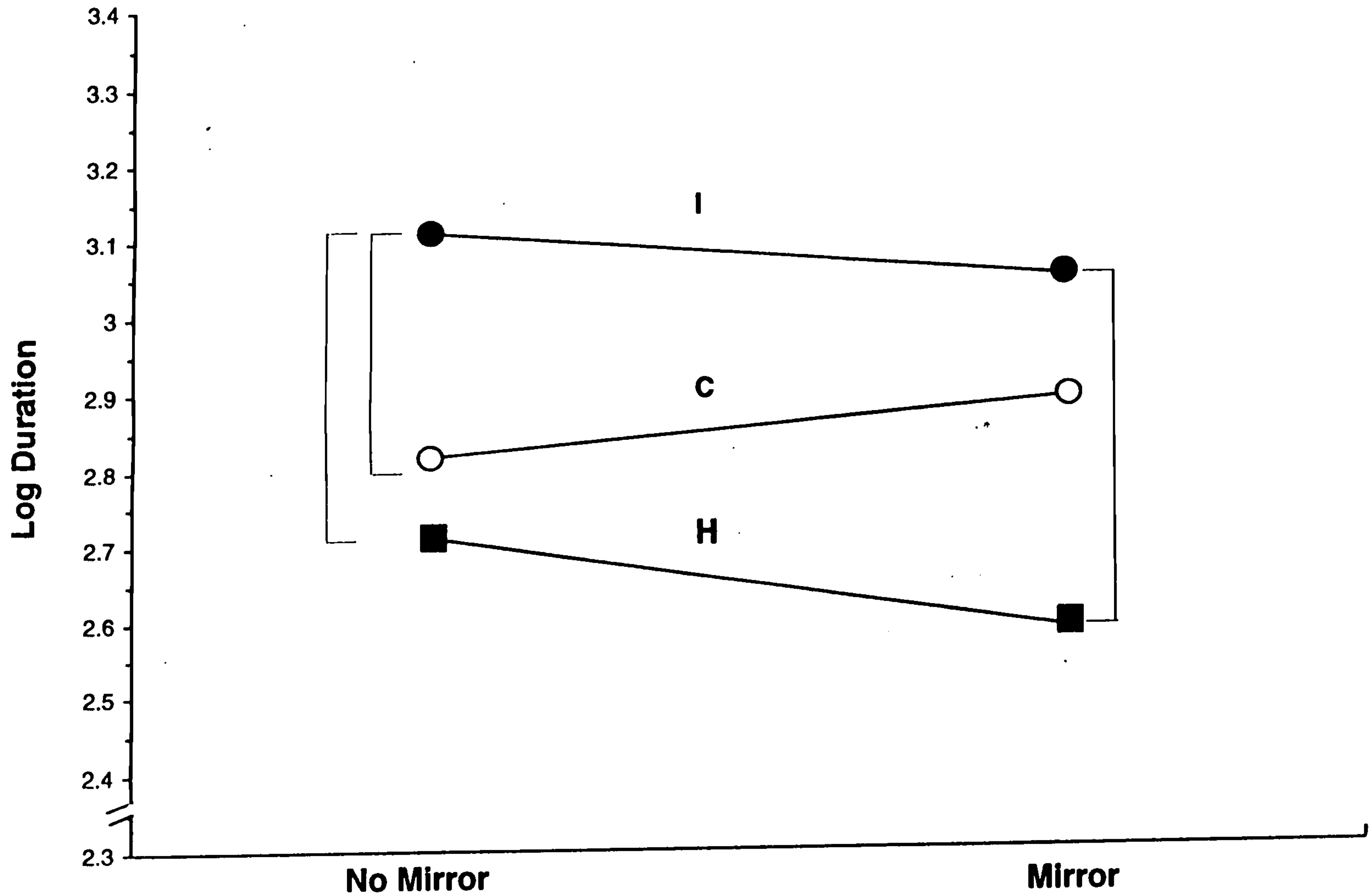
***$p < .0001$

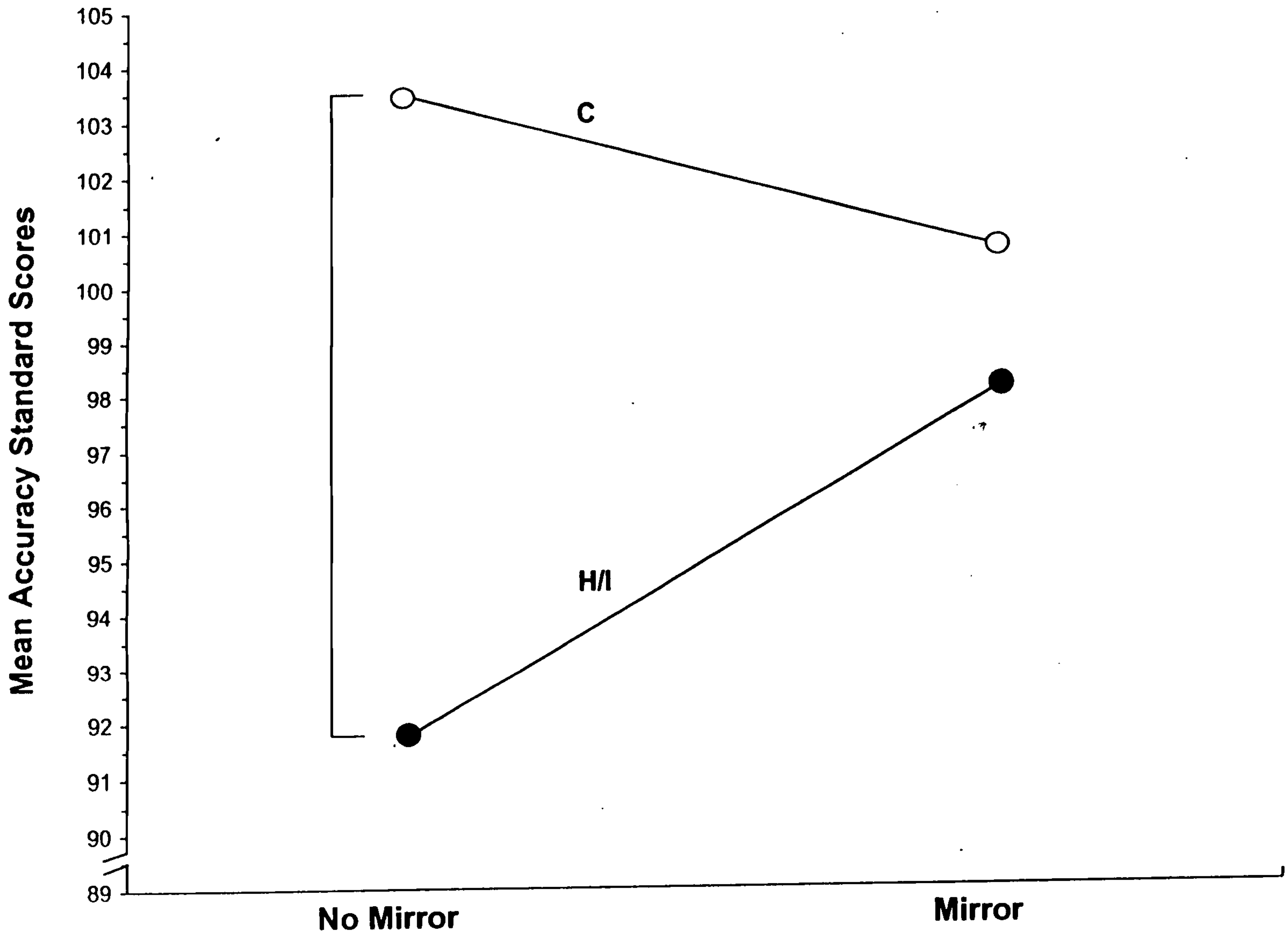
Table 2

Analysis of Variance for Time and Accuracy Data

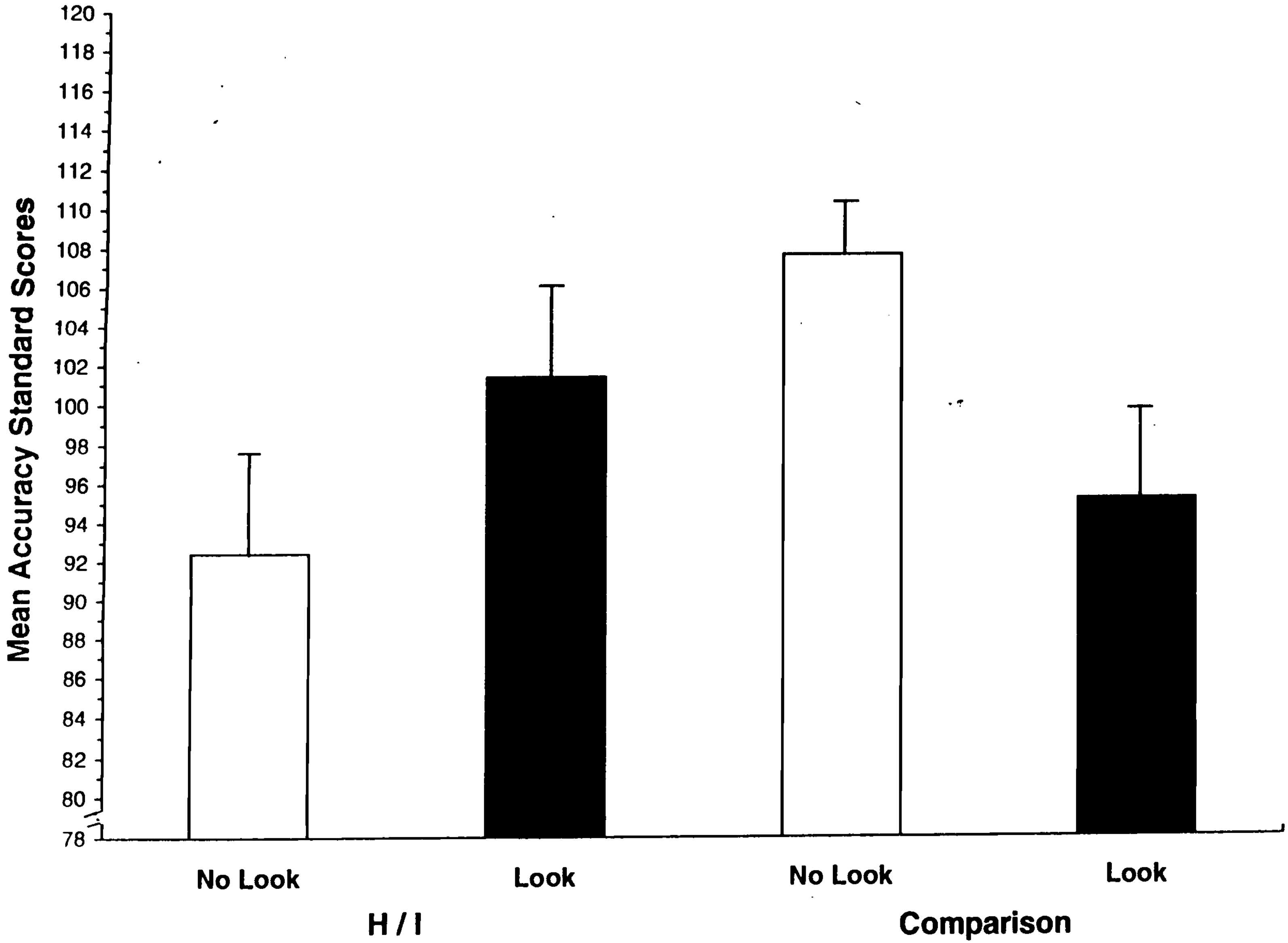
Source	Time		Accuracy	
	df	F	df	F
		Between subjects		
Group (G)	2	4.01**	1	3.25*
Order (O)	1	.78	1	0.01
G x O	2	.95	1	0.14
Error	34	(.15)	39	(303.55)
		Within subjects		
Treatment (T)	1	.84	1	.19
T x G	2	3.19**	1	2.14
T x O	1	2.11	1	.01
T x G x O	2	.61	1	.72
Error	34	(.02)	39	(166.80)

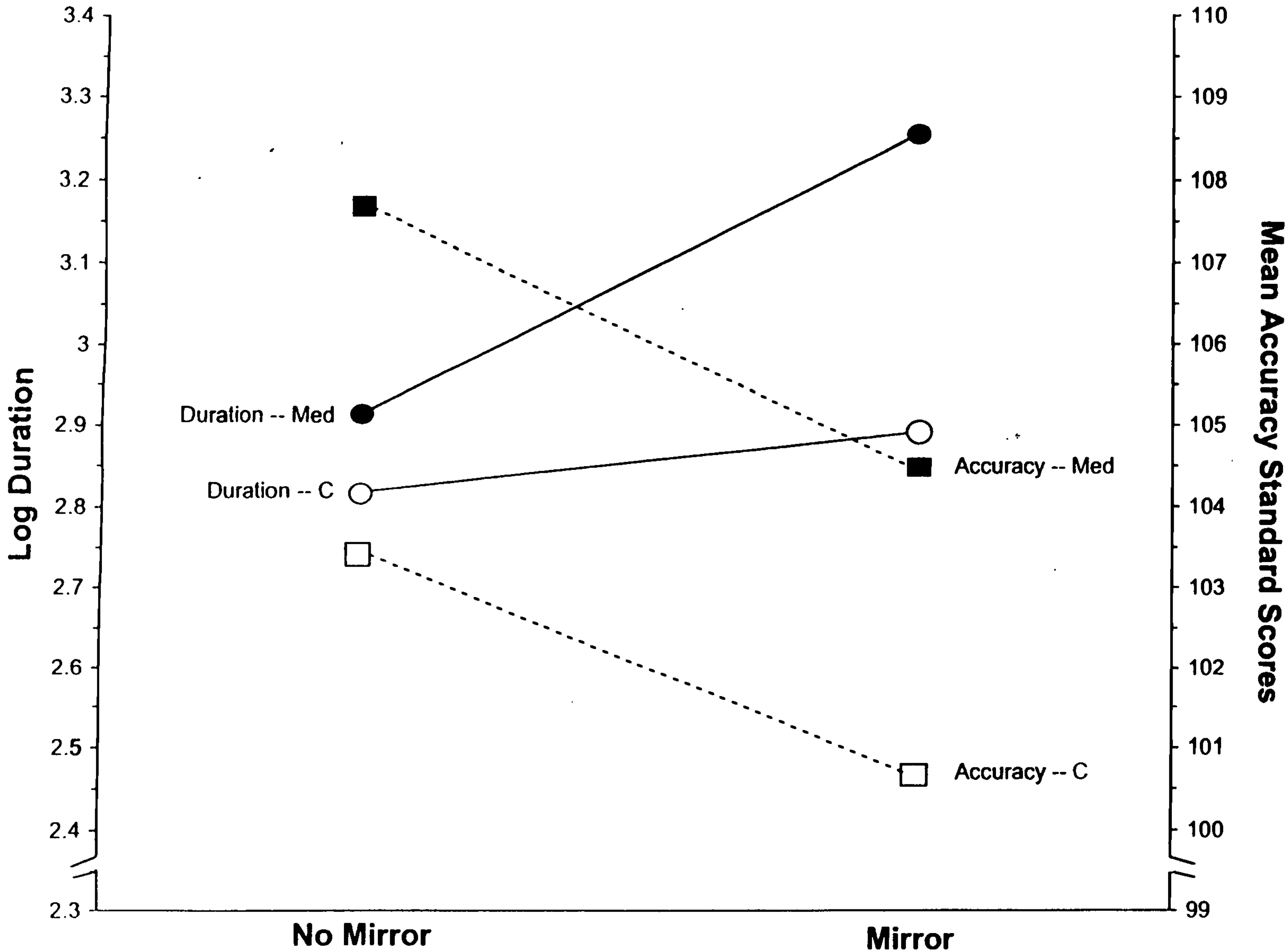
Note. Values enclosed in parentheses represent mean square errors.
*$p < .10$. **$p < .05$.


Log Duration
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
I
C
H
No Mirror
Mirror


Mean Accuracy Standard Scores
105
104
103
102
101
100
99
98
97
96
95
94
93
92
91
90
89
C
H/I
No Mirror
Mirror

14


Mean Accuracy Standard Scores
120
118
116
114
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
82
80
78
No Look
Look
No Look
Look
H / I
Comparison


3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
Log Duration
Duration -- Med
Duration -- C
Accuracy -- Med
Accuracy -- C
110
109
108
107
106
105
104
103
102
101
100
99
Mean Accuracy Standard Scores
No Mirror
Mirror

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