A Longitudinal Study of Relations between Outer-Directedness and IQ Changes in Preschoolers

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ACHENBACH, THOMAS M., and WEISZ, JOHN R. *A Longitudinal Study of Relations between Outer-Directedness and IQ Changes in Preschoolers.* CHILD DEVELOPMENT, 1975, 46, 650–657. The study was designed to determine whether outer-directedness, measured by glances at *E* during object assembly tasks administered according to the Turnure and Zigler (1964) procedure, predicts changes in preschoolers' Binet IQs over 6 months. With MA as a covariate to control for the small but significant relationship between glances and developmental level, an ANOCOVA showed a significant interaction resulting from increases in the IQs of non-outer-directed Ss and declines in the IQs of outer-directed Ss. Glances at *E*'s puzzle while S assembled his own were unrelated to glances at *E* or to IQ changes, but, unlike glances at *E*, were significantly related to improvements in performance from puzzle 1 to puzzle 2.

Originating in observations that retarded children are more influenced by cues from other people than are children of higher IQ, the concept of "outer-directedness" has come to be defined as a tendency to rely on external cues more than on one's own reasoning processes. Zigler (1971) has hypothesized that the greater outer-directedness of the retarded results from the fact that they have experienced more failure when relying on their own intellectual resources than have normal children. Their history of failure causes the retarded to distrust their own abilities and to seek cues from the external environment in situations where a normal child of the same overall ability, as measured by mental age (MA), would behave more independently.

That retarded children are more outer-directed than MA-matched normals has been demonstrated by the greater imitativeness of the retarded in standardized tasks where they have the option of conforming or not conforming to the behavior of a human model (Turnure & Zigler 1964). The hypothesis that outer-directedness can be increased by the experience of failure was confirmed by the finding that normal as well as retarded children were more imitative following failure than following success. Turnure and Zigler also found that, when given a puzzle to assemble, retarded subjects glanced more frequently than normals toward the experimenter, who was assembling another puzzle. The potential utility of outer-directedness was demonstrated by the fact that, despite performing poorly on the first puzzle, retardates performed better than normals when they were unexpectedly given the experimenter's puzzle to assemble.

Later studies have corroborated the finding of greater reliance on external cues by retardates than by normals in a large variety of situations (Achenbach & Zigler 1968; Balla, Styfco, & Zigler 1971; Sanders, Zigler, & Butterfield 1968; Yando & Zigler 1971; Zigler &

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Yando 1972). Outer-directedness has also been found to relate significantly to field dependence in normals (Ruble & Nakamura 1972), as well as in retardates (Massari & Mansfield 1973), and to teachers' ratings of low expectancy of success, low achievement, low self-confidence, lack of independence, high help seeking, and high persistence in normals (Ruble & Nakamura 1973).

Zigler (1971) has hypothesized that children become less outer-directed as they grow older, both because reasoning capabilities increase and because socializing agents provide fewer deliberate cues for children's behavior. Although they become less outer-directed as they mature, retarded children nevertheless remain more outer-directed than normal children of equivalent MA. According to Zigler, this is because behavioral expectations are typically based on CA, and the retarded child, having a lower MA than CA, experiences more failure than the normal child in attempting to meet the expectations for his CA. Findings on the hypothesized relationship between outer-directedness and developmental level have been mixed, with some studies reporting no differences among MA or CA groups (Achenbach & Zigler 1968; Massari & Mansfield 1973) and others reporting at least some evidence for developmental differences (Balla et al. 1971; Ruble & Nakamura 1973; Yando & Zigler 1971; Zigler & Yando 1972).

The purpose of the present study was to reverse the typical approaches to outer-directedness in order to determine whether the outer-directed style itself might predict changes in rate of development, as measured by the Stanford-Binet Short Form IQ. If outer-directedness represents a failure to use one's ability, and if it interferes with problem solving, then it is possible that it becomes an obstacle to at least some aspects of cognitive development. Identification of the exact mechanisms by which outer-directedness may interfere with development was beyond the scope of this study. However, one possibility is that the outer-directed style tends to limit a child to the learning of associations between specific environmental cues and specific responses, thereby interfering with the acquisition of general concepts and problem-solving skills.

This formulation in no way prejudges the reasons why a child may retain the outer-directed style. These reasons may include organic factors that retard a child's rate of development below the norm, but they may also include nonorganic factors such as lack of good role models, the presence of an older or brighter sibling against whose achievements a child is judged, and personality characteristics arising from idiosyncratic combinations of biological and environmental determinants. When firmly entrenched, the outer-directed style may create a vicious circle whereby excessive reliance on external cues occasionally leads to short-term, partial successes but to longer-term failures in arriving at independent solutions, thereby creating further incentives to rely on external cues rather than on one's own thinking.

Known as "associative responding," a developmentally later version of what is manifest in younger children as outer-directedness has already been shown to correlate with IQ changes during early adolescence. While outer-directedness consists of reliance on cues in the immediate environment, associative responding consists of a general reliance on associative processes rather than on reasoning. It is operationally defined as an excess of high-association errors over low-association errors on analogy items of the Children's Associative Responding Test (CART [Achenbach 1970]). That associative responding may have an effect on development was demonstrated by the fact that fifth- and sixth-grade associative responders initially matched to nonassociative responders for IQ, MA, and CA became significantly inferior to the nonassociative responders in IQ over the course of a 2-year longitudinal study (Achenbach 1971). The same effect was manifested in a longer-term study of IQ changes from grade 3 to grade 9 (Achenbach 1975).

While it has thus been shown that associative responding predicts IQ changes during the school years, the present study was designed to determine whether outer-directedness might analogously predict IQ changes in preschoolers. A 6-month period was chosen for study because of the rapid rate of change in children at young ages.

It is possible that outer-directedness is not related to early development to the same degree that associative responding is related to later development, because cognitive styles may be less entrenched and more situation-specific at early than at later ages. Furthermore, biological determinants may be more influential early in development than later. On the other hand, if outer-directedness were found to predict IQ changes during the preschool period, the potential for intervention might be great, since structured tutoring has been shown to reduce associative responding even as late as adolescence (Salomon & Achenbach 1974).

Besides determining whether outer-directedness predicts IQ changes, the present study was designed to determine whether outer-directedness is related to developmental level (MA, CA) in preschoolers, as the mixed findings of previous studies include no data on this age group. Related to the question of developmental differences is the problem of separating developmental variance from trait variance. As Achenbach and Weisz (1975) have pointed out, if a trait correlates with development, then any relationships between the trait and other variables may be accounted for by the variance both have in common with development. In order to establish the independent contribution of trait variance to a relationship between a measure of the trait and another variable, developmental variance must first be partialed out of the relationship. Accordingly, the analyses undertaken here controlled for developmental variance in the relationship between outer-directedness and IQ changes from time 1 to time 2, 6 months later.

The measure of outer-directedness consisted of the number of times the subject glanced at the experimenter during object assembly tasks administered according to a procedure like that of the Turnure and Zigler (1964) and Ruble and Nakamura (1972, 1973) studies. Although Turnure and Zigler did not distinguish glances at the experimenter's puzzle from those at the experimenter himself, Ruble and Nakamura (1972) found that field-independent children tended to glance more at the experimenter's puzzle, while field dependents tended to glance more at the experimenter. Unlike the retarded children in the Turnure and Zigler study, the field-dependent normals in the Ruble and Nakamura study did not improve from puzzle 1 to puzzle 2, and their performance was inferior to that of field independents on both puzzles. This suggests that glancing at the experimenter is the more appropriate measure of outer-directedness per se, whereas glancing at the experimenter's puzzle may have a different significance in this particular experimental situation. Consequently, the two variables were analyzed separately in the present study.

Method

As part of a larger study, children in day-care centers and a nursery school received two 3-day series of testing, separated by an interval of approximately 6 months. Children were tested either in a vacant room of their setting or in a mobile unit parked outside. The first testing was done in the fall after the children had become accustomed to their setting, while the second testing was done the following spring. Testing sessions lasted from about 20 to 30 minutes. On the first day of each testing series, a female experimenter administered several gamelike tasks unrelated to the study reported here. The Stanford-Binet Short Form was administered on the second day, using an optimizing procedure whereby easy items were alternated with difficult items. The measure of outer-directedness was administered on the third day of the first testing series, following some other gamelike tasks.

Measure of outer-directedness.—The measure of outer-directedness consisted of the number of glances made toward the experimenter during two puzzles administered according to a procedure like that of Turnure and Zigler (1964), although the puzzles employed here were designed to be more appropriate for preschoolers. Puzzle 1 consisted of a 17-cm square, constructed of 0.6-cm-thick Masonite, painted blue, and cut into four pieces. It was placed in a 1.2-cm-thick Masonite frame measuring 24.2 × 20 cm. Puzzle 2 consisted of a Masonite circle 17.4 cm in diameter and 0.6 cm thick, cut into four pieces, painted yellow, and set into a recessed frame like that of puzzle 1.

Sitting beside the subject, the experimenter said: "Here are some pieces of a puzzle. I want you to put them together as quickly as you can. While you are putting yours together, I will put one together too. But you put yours together as fast as you can. Do you have any questions? Okay. Here's your puzzle." While the subject was working on puzzle 1, the experimenter assembled puzzle 2, left it in view for 10 seconds, disassembled it, left the pieces in view for 20 seconds, and reassembled it. She continued this procedure until the subject finished his puzzle or until the 90-second time limit had elapsed. She then covered the disassembled pieces of puzzle 2 with her hand, placed it in front of the subject, and said: "Here is another puzzle to put together as quickly as you can. Do it as fast as you can. Do you have any questions? Okay, here's your puzzle." The experimenter watched passively while the subject assembled puzzle 2.

A female observer sitting at an unobtrusive angle from the subject timed the subject's performance with a stopwatch and recorded his glances toward the experimenter and the experimenter's puzzle. Because Ruble and Nakamura (1973) have reported a correlation of .96 between scoring of glances by an experimenter and an observer in a similar situation, it seemed unnecessary to have the experimenter count glances for the sake of a reliability check. Ruble and Nakamura also found a correlation of .60 between glances in two testing sessions a month apart, thus indicating reasonable stability for the glancing measure.

Scoring of performance on the puzzles was analogous to that used by Turnure and Zigler (1964). One point was awarded for each piece correctly placed within the 90-second time limit, one extra point for putting all the pieces together, two bonus points for completing the puzzle within 20 seconds, and one bonus point for completing it in 21–40 seconds. The total score for each puzzle could thus range from 0 to 7 points.

Subjects.—The subjects were 55 boys and 47 girls from a nursery school and four day-care centers in New Haven, Connecticut. Ages at the time 1 testing ranged from 35 to 74 months, with a mean of 50.0 and standard deviation (SD) of 8.4. According to Hollingshead's (1957) seven-point scale for breadwinner's occupation, mean socioeconomic status (SES) was 3.0, SD = 1.7. Since 1 represents the highest SES, the mean of the sample was above the middle of the scale in SES, but all seven steps on the scale were represented. Seventy-six of the children were white, 23 black, two Oriental, and one Asian Indian. All appeared fully competent in standard American English. At the time 1 testing, IQs (according to 1973 Binet norms) ranged from 66 to 156, with a mean of 103.8, SD = 18.3. The MAs ranged from 33 to 87 months, with a mean of 57.3, SD = 11.3. From time 1 to time 2, there was a nonsignificant increase of 2.0 points in mean IQ, and a significant increase of 7 months in MA ($t[101] = 9.90$, $p < .001$).

Results

The mean number of glances at the experimenter during the puzzles was 1.9, SD = 2.6, the distribution being positively skewed from zero to 12. The mean number of glances at the experimenter's puzzle was 2.0, SD = 2.1. This distribution was also skewed positively, from zero to 10. The correlation between glances at the experimenter and at her puzzle was not significant ($r = .16$), indicating that these two variables were independent of each other.

Because of the skewed distributions, subsequent analyses were based on median splits of the glancing scores. The most equal division on each glancing variable was at one glance. Fifty-eight subjects glanced one or no times and 44 glanced more than once at the experimenter during puzzles 1 and 2, while 49 glanced one or no times at her puzzle and 53 glanced more than once. Subjects below the median split were assigned a score of 1; those above the split, a score of 2. The ϕ correlation between these divisions for the two glancing variables was only .05, again indicating the lack of relationship between them. There were no significant differences between the sexes, 20/47 versus 24/55, $\chi^2 < 1$, or between nonwhites and whites, 8/26 versus 36/76, $\chi^2 = 1.55$, $p > .20$, in the proportions who were above the median on glances at the experimenter, or on glances at the experimenter's puzzle, 23/47 versus 30/55, 16/26 versus 37/76, both χ^2s < 1.

Outer-directedness correlated negatively with time 1 Binet MA, $r_{pb} = -.28$, $df = 100$, $p < .01$, and CA, $r_{pb} = -.22$, $p < .05$, thus indicating that more highly developed children tended to be significantly, though not dramatically, less outer-directed than less developed children, whether MA or CA was the index of development. Since MA correlated more highly with glances than did CA, MA was the developmental index controlled for in subsequent analyses. IQ did not correlate significantly with outer-directedness, $r_{pb} = -.10$. Glances toward the experimenter's puzzle did not correlate significantly with either of the developmental indices, $r_{pb} = -.07$ with MA, $r_{pb} = .00$ with CA, or with IQ, $r_{pb} = -.10$.

Outer-directedness and IQ changes.—The relation between outer-directedness and changes in Binet performance was assessed by comparing IQ changes from time 1 to time 2 in the 58 subjects at or below the median on glances at the experimenter and the 44 subjects above the median on glances. Since glances correlated significantly with development, it was necessary to control for developmental variance in testing the relationship between glances and IQ changes (see Achenbach & Weisz 1975). This was done by calculating a 2 (sex) × 2 (SES 1–3 vs. SES 4–7) × 2 (glancers vs. nonglancers) × 2 (repeated measures on time 1 vs. time 2 IQ) unweighted-means ANOCOVA, with MA as the covariate. Cell sizes ranged from eight to 18.

The only main effect on IQ was SES, with upper-SES children having significantly higher IQs than lower-SES children, $F(1,93) = 15.26$, $p < .001$. No interactions among the non-repeated-measures factors approached significance. However, there was a significant interaction between outer-directedness and time 1 versus time 2 IQ, $F(1,93) = 4.83$, $p < .05$. Averaged over the sex and SES groups, glancers decreased in mean IQ from 100.2 at time 1 to 99.9 at time 2, whereas nonglancers increased from 104.2 to 107.2. The only other significant effect was the interaction of sex with time of testing, $F(1,93) = 5.13$, $p < .05$. This reflected the fact that girls increased by about three points in IQ, whereas boys decreased slightly. However, this effect was independent of the effect of outer-directedness, and no other interactions approached significance. Table 1 portrays mean IQ scores for time 1 and time 2 by sex and glancing status.

It should be noted that dividing subjects at the median on glances is an extremely liberal procedure, considering that it is based on a single brief measure taken at the beginning of the 6-month period and including subjects whose glancing scores were at the median. By dropping the 15 subjects whose score of one glance put them at the median for outer-directedness, the F value for the interaction between outer-directedness and time 1 versus time 2 IQ was increased from 4.83 to 5.59, $p = .02$. This reflected the fact that the 43 subjects who did not glance at all showed an average increase of 4.4 points in IQ, from 104.8 to 109.2, $t = 1.90$, $p = .06$, as compared to the increase of 3.0 points, $t = 1.82$, $p = .075$, when the 15 subjects at the median were included. A still more conservative division of subjects (e.g., between those glancing zero times and those glancing three or more times) would have led to still greater separation between the IQ changes of outer-directed and non-outer-directed subjects. However, this was considered superfluous because the divergence between glancers and nonglancers in IQ was significant even with the most liberal division of subjects by means of the median split.

TABLE 1

Mean IQ Scores for Time 1 and Time 2 by Sex and Outer-Directedness

	N	Time 1	Time 2
Outer-directed:			
Boys	24	104.5	102.4
Girls	20	96.0	97.5
Non-outer-directed:			
Boys	31	105.8	107.3
Girls	27	102.6	107.0

Comparisons of groups on the basis of their changes in scores from one occasion to another may risk artifactual effects arising from regression of extreme scores on the variable of interest (e.g., IQ) toward the mean of the population distribution of that variable. However, regression effects were likely to have attenuated rather than enhanced the significant effect of outer-directedness, because, while nonglancers were nonsignificantly higher than glancers in initial IQ, 104.2 versus 100.2, $p > .20$, the increase in mean IQ for nonglancers and the decrease for glancers were *opposite* to the changes expected from regression.

Another issue to be considered is whether the initially somewhat lower mean MA of the glancers influenced the findings. Covarying MA was intended to control for this possibility. However, a more direct assessment was made of the possibility that IQ spurts were associated with high initial MA regardless of glancing status. This was done by calculating the correlations between initial MA and the size of IQ changes from time 1 to time 2, among glancers, nonglancers, and both groups combined. All three correlations were *negative*: −.48 ($p < .01$) among the 44 glancers, −.15 (N.S.) among the 58 nonglancers, and −.25 ($p < .05$) for both groups combined. Thus, the overall relationship between MA and IQ change, when glancing status was not a factor, worked *against* finding larger IQ increases among nonglancers than glancers. Since the positive changes in IQ were nevertheless significantly greater among nonglancers than among glancers, the ANOCOVA appears to have controlled appropriately for the negative correlation between initial MA and IQ change.

While the interaction between IQ changes and outer-directedness was opposite to what would be produced by either the effects of statistical regression or the correlation between initial MA and IQ change, the significant interaction between IQ changes and sex was in the same direction as would be produced by both these effects. Since girls had lower initial IQs than boys (99.3 vs. 105.2), a greater increase among girls than boys could occur through regression toward a common mean. Furthermore, since girls had lower initial MAs than boys (54.7 vs. 58.1 months), the negative correlation between MA and IQ change could also have contributed to the greater increase in IQ among girls than among boys. It seems possible, therefore, that the interaction between sex and IQ changes could have resulted from statistical artifacts. To test this possibility, matched pairs were formed in which one member was a boy and one was a girl, but both were similar in SES, glancing status, MA, and IQ. It was possible to form 33 pairs. The mean MAs were identical for each sex (57.4 months), while the mean IQs differed by 1.7 points (104.4 for boys vs. 102.7 for girls, $t < 1$). A matched t test comparison of the IQ changes from time 1 to time 2 showed that girls' IQs increased by 1.0 point less than boys' ($t < 1$). Although a regression effect of the girls' IQs downward toward their group's mean and the boys' upward toward their group's mean cannot be ruled out, this result certainly suggests that the overall interaction of sex with IQ change is not very robust.

Outer-directedness and puzzle performance.—The effect of outer-directedness on changes in performance from puzzle 1 to puzzle 2 was assessed with a $2 \times 2 \times 2 \times 2$ repeated-measures ANOCOVA like that employed for IQ changes. Mean score on puzzle 1 was 3.1 points, $SD = 2.4$, and on puzzle 2, 3.5 points, $SD = 2.3$. Since the total possible score was 7 on each puzzle, the means indicate that the puzzles were moderately difficult for the preschoolers. There was a significant main effect of outer-directedness, with outer-directed children scoring lower on both puzzles, $F(1,94) = 21.50$, $p < .001$. However, neither outer-directedness, sex, nor SES affected changes in performance, all p's $> .10$. The overall improvement from puzzle 1 to puzzle 2 was of borderline significance, $F(1,93) = 3.64$, $p = .06$.

Glances at the experimenter's puzzle.—A sex × SES × below versus above median on glances at the experimenter's puzzle × time 1 versus time 2 IQ (repeated-measures) ANOVA was calculated in order to determine the relationship between IQ changes and glances at the puzzle. Cell sizes ranged from seven to 19. Since MA did not correlate significantly with glances at the puzzle, $r_{pb} = -.07$, it was unnecessary to employ MA as a covariate. There was no significant interaction between glancing and time 1 IQ versus time 2 IQ, or any other significant effect involving glancing, all F's < 1.

Although glances at the experimenter's puzzle had no relation to IQ changes, they did affect changes in performance from puzzle 1 to puzzle 2. A sex × SES × glances × puzzle 1 versus puzzle 2 (repeated-measures) ANOVA showed that children who were above the median in glances at the experimenter's puzzle improved significantly more from puzzle 1 to puzzle 2 than did children who were below the median, $F(1,94) = 10.86$, $p < .01$. This effect was accounted for by an increase in mean score from 2.5 on puzzle 1 to 3.8 on puzzle 2 for glancers and a decrease from 3.6 to 3.1 for nonglancers. Thus, it appears that, at least in the preschool period, children who glance specifically at the experimenter's puzzle may be purposefully seeking information. Furthermore, the information they gain is available for later use.

Discussion

The lack of significant correlations between glancing at the experimenter and glancing at her puzzle argues for separating these variables in any research employing the puzzle tasks or similar paradigms. Glances at the experimenter had low but significant correlations with both MA, $r_{pb} = -.28$, and CA, $r_{pb} = -.22$, indicating that the negative relationship hypothesized between outer-directedness and developmental level exists among preschoolers. The lack of significant correlations between glances at the experimenter's puzzle and the developmental indices, $r_{pb} = -.07$ with MA, $r_{pb} = .00$ with CA, further indicates that glancing at the experimenter's puzzle did not represent the same type of outer-directedness as glancing at the experimenter. Since glancing at the experimenter's puzzle was positively related to improvement in performance from puzzle 1 to puzzle 2, while glancing at the experimenter was not, and since Ruble and Nakamura (1972) found field-independent children to do more of the former, while field dependents did the latter, glancing at the experimenter's puzzle probably represents systematic information seeking rather than socially oriented outer-directedness.

The primary finding of the study, that outer-directedness was inversely related to changes in Binet IQ over a 6-month period, suggests not only that the outer-directed style may *result* from experiences associated with relatively low IQ (see Zigler 1971), but that, whatever its initial causes, it is predictive of changes in rate of cognitive development, as measured by IQ. In the present study, the significant interaction between IQ changes and outer-directedness resulted from a combination of a slight decline in the IQs of outer-directed children and a rise in the IQs of non-outer-directed children. In parallel studies of the related style of associative responding in school-age children, the interaction between IQ changes and associative responding was manifested in varying combinations of increases and decreases in IQ that summed to a significant divergence between the IQs of associative and nonassociative responders when initial MA was controlled for (Achenbach 1971, 1975).

Since practice on the IQ test and other experiential factors may influence the specific level of IQ performance for a particular sample relative to the population employed to norm the IQ test, the critical issue is not whether one part of the sample increases or declines relative to the normative group. The critical issue is whether children differing in cognitive style within the sample differ in the direction and/or degree of their IQ changes. In the present study, it is possible that practice with the Binet attenuated the decline in IQs of the outer-directed children while enhancing the increase in IQs of the non-outer-directed children. Likewise, in the studies of associative responding, it is possible that the educational experiences of the entire sample would have caused an overall increase or decline relative to the normative population. However, the important finding in each case is that cognitive style predicted the divergence of IQs across a period of time. Since developmental variance in the measures of cognitive style was controlled for, the divergence in rate of cognitive development appears to have been related to the differences in cognitive style per se. Salomon and Achenbach (1974) have provided evidence that structured one-to-one tutoring can modify the associative style in school-age children. It now remains to be seen whether similar stylistic characteristics can be modified in preschoolers and what long-term effects such efforts can produce.

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