Influence of a Misleading Context on a Design-Copying Task With Children With and Without Learning Disabilities

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KEY WORDS
• attention
• field dependence-independence
• learning disorders
• psychomotor performance
• task performance and analysis
• visual perception

OBJECTIVE. I investigated developmental and ability differences on a visual–motor task that requires inhibition of misleading information.

METHOD. Children, including those with and without learning disabilities, and adults copied simple line or dot figures inside a tilted frame with instructions to make the figures straight. Two response methods were used: drawing (motor) and placement of bars or washers (motor reduced).

RESULTS. All participants were influenced by the misleading frame, making figures that deviated from true vertical in both motor and motor-reduced formats. Adults were less influenced than children, and children with learning disabilities were more influenced than their peers. Production of more complex figures resulted in increased influence of the misleading frame.

CONCLUSION. The ability to inhibit misleading contextual information and find an appropriate frame of reference may be an important developmental process in visual–motor skill development. Implications for assessment and task analysis are discussed.


Occpational therapy practitioners working with school-age children are often asked to address issues of visual–perceptual skill development. This is a major area of practice with children, but it is one of the least understood (Schnick, 2005). Assessment tools commonly used for perceptual development often involve measuring a child’s ability to match (nonmotor) or copy (motor) line figures of varying complexity. These tools are widely used but have been criticized. Salvia and Ysseldyke (1995) gave a scathing review of visual–motor tests: “For the most part, they are neither theoretically nor psychometrically sound” (p. 556). A clearer understanding of the processes involved in visual–motor tasks, such as those used in standard assessments, is needed to determine what poor performance means. The aim of this study was to investigate one of these processes—field dependence—as a possible source of developmental change and developmental delay.

Field dependence is the tendency to be influenced by the immediate context of a scene (Morra, 2002; Witkin, Olzman, Raskin, & Karp, 2002), and it has been found to decrease with age but remain a factor in perception into adulthood, with some adults found to be more field dependent than others. Field dependence may be a factor in developmental disabilities. Children with mild mental retardation who were matched for mental age with typically developing children were found to have significantly poorer scores in field-dependence measures (Alevriadou, Hatzinikolaou, Tsakiridou, & Grouios, 2004), and high school students with learning disabilities scored more poorly than their typically developing peers (Huang & Chao, 2000).
Measures of field dependence are typically judgment (nonmotor) tasks, most commonly the Rod-and-Frame test (Witkin & Asch, 1948), which involves judging the verticality of a rod placed within a tilted frame, and the Embedded Figures Test (Witkin et al., 2002), which is similar to a hidden figures game. In the current study, field dependence is investigated using a design-copying task (motor) in which a tilted response frame provides the immediate context exerting influence on productions. This new task, the Misleading Frames Task, is based on the classic Rod-and-Frame test but involves a construction rather than a judgment response. The purpose of the test is to determine whether field dependence might be a factor in understanding developmental and ability differences in a common visual–motor assessment task.

When a child performs poorly on a design-copying test, what is it that he or she cannot do? The child may have relatively intact visual perception in nonmotor situations but struggle with constructing responses. The problem is sometimes identified as a deficit in visual–motor integration (Beery & Beery, 2004; Schneck, 2005). This diagnosis provides a label for the observed problem but does not explain the cause. Piaget (1969; Piaget & Inhelder, 1956; Piaget, Inhelder, & Szeminska, 1960) offered a more in-depth analysis of the difference between perception and construction that incorporates the idea of field dependence. In an experiment using small clay balls, he asked children to construct a straight lineup of the balls from one point to another. He observed that young children had great difficulty creating the lineup if it ran oblique to the table’s edge, yet the same children could accurately judge the correctness of the same line. The problem, he proposed, lies in the difference between perceiving and representing. A mental representation from which to plan the action is necessary to create the lineup, whereas judgment of correctness can be done perceptually (Piaget & Inhelder, 1956).

An important factor in this representation, and one that was the object of the current study, is managing the influence of the nearby features of the task. If those features facilitate a correct representation—for example, a horizontal boundary line for the construction of a horizontal lineup—then the representation and construction of the figure is direct and easy to coordinate. If, conversely, the nearby features are conflicting, as in the case of creating a diagonal line in the presence of the same horizontal boundary, then the representation of the figure must be coordinated using a different frame of reference to be constructed correctly. In such a situation, the burden on the child is twofold: finding an appropriate frame of reference and inhibiting the influence of the obvious, salient, but incorrect frame of reference. Piaget found that younger children were more strongly influenced by misleading boundaries; in his terms, younger children were centered on field effects. Older children were better able to overcome this influence and choose a more appropriate frame of reference for the lineups and, therefore, were considered to be decentered.

Using Piaget’s model, the explanation for the difference between the ability to make perceptual judgments and the ability to construct a response does not lie in visual–motor integration; rather, it is an issue of representing and coordinating a response in the absence of direct guidelines and sometimes in the presence of misleading cues. Some researchers have used motor-free or motor-reduced (e.g., overlays or sticks) tasks and compared them to drawing responses on the same task items. They have consistently found that children used the same organization and made the same errors in both conditions (Bouaziz & Magnan, 2007; Piaget & Inhelder, 1956; Tada & Stiles, 1996). Therefore, it appears that the motor aspect of the task is not necessarily the source of difficulty.

Field dependence, then, may be a factor in construction tasks such as a design-copying task. Piaget found this to be true of young preoperational children (preschoolers) on simple tasks, but perhaps it is also true of older children under more challenging conditions and may be an area of even greater difficulty for some children with learning disabilities. On a design-copying task, the perceptual cues arising from the context of the task can influence the creation of a figure. Greater success in accuracy would be expected from children who are better able to overcome the influence of a misleading context and instead find a frame of reference that will facilitate the goal of the task. Piaget characterized mature performance on a perceptual analysis task as being able to keep multiple frames of reference available in mind and having the flexibility to choose from among them to achieve the goal of the task (Piaget & Inhelder, 1956; Piaget et al., 1960).

Misleading Frames Task

The primary purpose of this study was to investigate the differences between children with greater and lesser abilities in their ability to inhibit an immediate, attention-grabbing but misleading context and find a more facilitative frame of reference. A new measure devised for this purpose, the Misleading Frames Task (Figure 1), involves copying simple line figures, but the copies are made within a misleading tilted frame. The challenge, then, is not to accurately construct the figure but to correctly orient the construction on paper. The task items include simple perpendicular figures made of either lines or dots. The use of dot figures was inspired by Piaget’s experiment using the lineup of clay balls. The dots in the figures must be coordinated in relation to each other as well as to the configuration as a whole. This
additional demand on attention may reduce the cognitive resources needed for inhibiting the misleading frame (Roberts & Pennington, 1996). This theory was supported in a recent study by Coté and O'Donnell (2007) in which it was found that dot figures resulted in a greater influence of a misleading frame compared with line figures, even though they formed similar perpendicular figures. This was true for both kindergarteners and adults, although the adults’ drawings were much more accurate.

A secondary purpose was to investigate the relative contributions of the perceptual analysis involved in overcoming the influence of field dependence and the influence of motor control on a drawing task. To accomplish this purpose, two types of response methods were used: a drawing response (motor) and a placement response in which metal bars and washers were used for constructions (motor reduced). The placement method lessens the demands on motor planning and allows for corrections.

To compare the two methods, a baseline item was used that had a true square as a response frame. Because constructions made by any humans are rarely perfectly accurate, the baseline item provided an estimate of deviation normally present in freehand constructions. Presumably, it would be easier to place a bar exactly vertical than it would be to draw a perfectly vertical line. Any additional amount of deviation found on the tilted frame items could then be assumed to be caused by the influence of the misleading frame. If the deviation above and beyond the baseline measures is the same for both the drawing and the placement methods, then the theory proposed by Piaget (1969) that perceptual analysis, and not motor output, explains accuracy in performance would be supported.

Figure 1. Responses from a 9.2-year-old boy with learning disabilities on the Misleading Frames Task. Top row includes placement items (dotted lines added), and bottom row includes drawing items.
Concurrent Validity for the Misleading Frames Tasks

The Misleading Frames Tasks were designed for this study. Similar drawing-only tasks were used in Coté and O’Donnell (2007) but otherwise have no history in developmental literature. Therefore, the Block Design test from the Wechsler Intelligence Scale for Children III (Wechsler, 1991) was used to provide concurrent validity of the tasks as measures of both perceptual analysis and field dependence. The Block Design Test consists of plastic blocks with some sides that are solid white or solid red and some sides that are bisected diagonally, creating two triangles (one red and one white). The blocks are used to recreate stimulus designs. This test has a long history in neuropsychological assessment. It is generally recognized as a measure of visual–spatial organization and has been widely used and researched (Lezak, Howieson, & Loring, 2004). The test has also been used as a measure of field dependence (Case & Globerson, 1974; Morra, 2002).

Hypotheses

The main assumption of this study was that the immediate context of a visual scene exerts influence on the organization of a design-copying task and that the extent of this influence is related to both the task characteristics and the level of field dependence of the participant. The hypotheses tested fell into two main categories: the relative difficulty of the different types of tasks across all participants and age and ability differences on task performance. Specifically, hypotheses predicted that (1) all participants would create more accurate figures in the baseline condition than in the tilted frames condition, (2) line figures would be made more accurately than dot figures, (3) the error found on the tilted frame items that is above and beyond the baseline items would be the same for placement and drawing conditions, (4) adults would create more accurate figures than children, and (5) typically developing children would perform better than children identified as having learning disabilities (LD). Adult participants were included in this study to provide a measure of mature performance. Finally, it was hypothesized that concurrent validity would be demonstrated by a significant negative correlation between the task measures and scores on the Block Design test (negative because higher scores on the Block Design test indicate poorer performance).

Method

This study was approved by the Rutgers University institutional review board and by the Board of Education of the participating school district. Consent was obtained from adult participants and, in the case of the children, from one parent. Children were informed of the procedures before the study and told that participation was voluntary.

Participants

Three groups of participants were included in this study. The group of children without LD (the non-LD group) included 86 (47 male, 39 female) public school students in Grades 1 through 5 (ages 6.5 to 11.0 years) who were enrolled in after-school programs in four elementary schools in a suburban New Jersey school district. The group of children with LD (the LD group) included 19 (15 male, 4 female; ages 7.2 to 13.2 years) children who were recruited from a pool of children receiving occupational therapy services for deficits in the area of visual perception or visual–motor skill development. These children were of normal intelligence and had no motor impairment that could affect performance on the study tasks. The adult group included 39 (8 male, 31 female) undergraduate students without LD who volunteered for this study in fulfillment of a course requirement. Approximately 90% of the school-age groups and 90% of the college students were White.

Administration

Participants worked individually with me. The after-school non-LD students worked at a table in the corner of the general purpose room where the program was run. The LD students were seen in their therapy room during one of their regularly scheduled therapy sessions. Adults were seen in a testing room at the university. All participants received the same set of tasks in the same order. Tasks were administered in the sequence described in the following sections.

Misleading Frames Tasks. A sample of these tasks is shown in Figure 1. First, a familiarization task was presented to demonstrate the procedure. The examiner presented a sample task item (not pictured) along with two 2.5-in. brass bars placed over the stimulus figure at the top of the paper and said, “See how these sticks match the lines of this design?” The bars were then moved to inside the tilted frame at the bottom of the page, and the design was recreated. “I can use the sticks to make the same design inside this crooked box. Notice that I made it straight like the design not crooked like the box.” Straight and crooked were both demonstrated. The participant was then given the bars and instructed, “Now I want you to make this design nice and straight inside the box.” The examiner corrected, if necessary, until the participant understood the goal of the task.

The series of placement task items, one item per sheet of paper, was given next. Each item had a stimulus figure printed on the top half of an 8.5-in. × 14-in. page and a
response frame printed on the bottom half. Response frames were tilted 28° toward either the right or the left for the tilted frame items, and a true square was used for the baseline items. The stimulus figure serving as the baseline item was rotated among the three line figures (the dot figure was always a tilted frame item) generating three different protocols that were given in rotation to participants. Participants were given the two bars with instructions to use the bars to make the line figures inside the frame. Metal washers were provided for the dot figure. Each paper was placed in front of the participant, squarely aligned with the edge of the table and held in place by the examiner. When the participant was satisfied with his or her response, the examiner used a felt-tip marker to mark the ends of the bars or the center of the washers to record the construction.

The drawing task items followed next, and participants were told that they now had to draw the response using a marker. The stimulus items were slightly varied from the placement tasks to maintain interest and avoid practice. Participants were repeatedly reminded to “make it nice and straight” as new items were presented.

Block Design: Finally, the Block Design test was administered to all participants according to the published instructions. A stopwatch was used to record the time taken to complete each item. Scoring for this test reflects both accuracy and speed of completion.

Measures for Misleading Frames Tasks

Measures obtained were the deviations of the lines created by participants from true horizontal or vertical. A grid printed on a transparency and a protractor were used to measure deviations of the constructed lines using the nearest reference line (e.g., the paper’s edge) as the standard. For the dot figures, a line on the transparency was placed along the best estimate of the direction of a line formed by the row of dots. All measures were recorded in positive degrees (Tinajero, Paramo, Quiroga, & Rodriguez-Gonzalez, 2000). Each task item contained two lines, and deviation measures for both were averaged to obtain that item’s score. The two line figures for each method (placement and drawing) were then averaged to generate a composite line score. Dot figures involved only one item in each method so that no averaging was needed.

Some children created figures that were far from correct either because they oriented the figure to the side of the frame that had the greatest tilt or because of no apparent orientation at all. To avoid the effect of large errors on data analysis, the deviation measures were capped at 28°, the angle of the tilted frame. Reliability for this measuring procedure was checked by a second scorer. A graduate student who was unaware of the purpose of the study measured 15 randomly chosen protocols for a total of 230 lines. Measures were 91% within 1° of the original measures.

Data Analysis

Paired-samples t tests were used to test for differences in means for the baseline and tilted frames tasks. The differences between placement (motor reduced) and drawing (motor) responses and between simple (lines) and more complex (dot) figure constructions were tested by a 2 × 2 analysis of variance (ANOVA) for each group (groups could not be included as a factor in a single ANOVA because of disparity of sample sizes). Between-subject measures tested for differences among the ages and ability levels of the participants on the study tasks. Because the number of participants in each of the three groups differed greatly, direct comparison of group means would not be valid. Instead, the LD participants’ scores were evaluated in terms of frequency within quartiles of scores for all children and tested by chi-square analysis. A subgroup of the non-LD group was created consisting of the 39 oldest children for the purpose of comparing group means with the adult group by t test. Correlational analysis between the Block Design scores and a composite score on the Misleading Frames Tasks was used to measure concurrent validity.

Results

Misleading Frames Tasks

All types of figures created within the tilted frames deviated significantly from their respective baseline measures, and the effect sizes were strong. The means for all participant groups combined are shown in Table 1. Differences in performance by group are shown in Figure 2.

Placement vs. Drawing

Comparing the total deviations in each of the two methods (placement and drawing) and the two types of figures (lines and dots) in a 2 × 2 within-subjects ANOVA, a significant main effect of the method was found with the non-LD group (F[1, 86] = 4.98, p = .03), and the adult group (F[1, 39] = 40.90, p < .001). The drawing method resulted in greater deviations than placement for both groups. There was also a main effect of the type of figure for both groups: non-LD (F[1, 86] = 10.82, p < .001) and adults (F[1, 39] = 10.78, p = .002), with dot figures resulting in greater deviations than lines. The LD group (n = 19) did not show a main effect for either method or figure, possibly because of the limited sample size. No gender differences were found on task performance for the non-LD group (the LD and adult groups were too unbalanced for gender comparisons).
Examining only the baseline items (dark part of the bars in Figure 2), placement responses were more accurate than drawing in general (paired samples $t_{144} = 6.23, p < .001$).

The deviation measures on the tilted frame items that were over and above the baselines (light part of the bars in Figure 2) yielded a different pattern in a $2 \times 2$ ANOVA from when total deviation scores were used, as reported previously. Now the non-LD group showed no main effect of method ($F_{1, 86} = 0.012, p = .91$). Figure 2 illustrates the similarity of errors in both methods for the non-LD group when baseline measures were taken into account. For the adult group, the main effect of method remained significant ($F_{1, 39} = 7.49, p = .009$). An interaction effect was found with the non-LD group ($p = .04$), with the placement of dots having greater error than drawing dot figures, whereas placement of lines were more accurate than drawing of lines.

Age and Group Differences

To make between-subject comparisons, a composite error score on the tilted frame items was calculated by summing a participant’s deviation measures of line and dot figures constructed in both placement and drawing conditions (baselines not included). Accuracy of orientation of constructions improved with age. This was only a trend within the non-LD group with correlation between age and total errors just missing significance ($r = –.21, p = .06$). A significant difference was found between the oldest participants in the non-LD group and adult participants ($t_{39} = 3.50, p < .001$). The LD group participants were significantly more likely to have scores in the lowest quartile of all children’s scores pooled (Table 2).

Concurrent Validity

Block Design scores were significantly correlated with the composite scores on the Misleading Frames Tasks across all groups ($r = –.52, p < .001, n = 144$), and it remained significant when age was controlled for ($r = –.35, p < .001, n = 144$). As with the Misleading Frames Tasks, the children in the LD group were significantly more likely to be in the lowest quartile of all children’s scores on this test (Table 2).

Discussion

Misleading Frames Task

Constructions made inside the tilted frames were more deviant than those made in the baseline frames. This was true at all ages and ability levels and in both response methods. The main hypothesis was thus supported: The immediate context had an influence on constructions made by all participants. Also, as predicted, the dot-design constructions deviated significantly more than the line constructions. This finding may be important because it suggests that the effort involved in coordinating the dots to each other, as well as within the configuration as a whole, compromised the cognitive resources needed to simultaneously inhibit the tilted frame. This finding concurs with what Piaget and Inhelder (1956) found with young children, and it supports theoretical models that propose an interaction between attention capacity and inhibition (Kane & Engle, 2003; Morra, Angi, & Tomat, 1996; Roberts & Pennington, 1996). The results of this study suggest that limited attentional capacity may be a factor in a participant’s ability to accurately orient constructions in the presence of misleading information.

Table 1. Mean Deviations in Degrees Made in Tilted Frames Compared With Baseline Frames ($N = 144$)

<table>
<thead>
<tr>
<th></th>
<th>Placement</th>
<th></th>
<th></th>
<th>Drawing</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Lines</td>
<td>Dots</td>
<td>Baseline</td>
<td>Lines</td>
<td>Dots</td>
</tr>
<tr>
<td>Mean (standard deviation)</td>
<td>1.40 (1.42)</td>
<td>3.61 (2.76)</td>
<td>5.09 (4.42)</td>
<td>2.33 (1.70)</td>
<td>4.88 (3.36)</td>
<td>5.62 (4.48)</td>
</tr>
<tr>
<td>Paired samples $t$</td>
<td>—</td>
<td>10.13*</td>
<td>10.45*</td>
<td>—</td>
<td>8.87*</td>
<td>8.71*</td>
</tr>
<tr>
<td>$d^a$</td>
<td>—</td>
<td>1.56</td>
<td>2.60</td>
<td>—</td>
<td>1.50</td>
<td>1.94</td>
</tr>
</tbody>
</table>

Note. — = not applicable.

*Effect size Cohen’s $d$ calculated using the standard deviation of the baseline measures.

$^a p < .001.$
Placement vs. Drawing Responses

It was predicted that no difference would be found in accuracy between placement and drawing because the effort of finding an appropriate frame of reference, and not motor control, was believed to be the determining factor in how well a participant performed. This finding was true for children on the line figures; when the baseline error was taken into account, the error was similar for both placement and drawing methods. However, an interesting finding was the interaction effect when lines and dots and placement and drawing measures were analyzed. For the children, the dot figures made with a marker were more accurately oriented than those made by placing washers. This finding was surprising because the ability to make corrections appears to have improved accuracy in the baseline condition, but in the tilted frames condition, it had the opposite effect. The reason may involve the children’s inability to keep multiple goals in mind during the entire construction process. Some children were observed placing the washers in a fairly correct orientation at first, but then adjusting their placements to make the design look more like the stimulus figure (e.g., making the spacing exactly right). In the process of making adjustments, the orientation became more displaced; by attending to this different goal, the influence of the frame became stronger. The adult group, by contrast, was more accurate with placement than drawing, possibly because of the many adjustments made to their placement figures that could not be made to their drawings and the ability to keep the original goal in mind. It does not appear that drawing ability was a factor in accuracy because the motor-reduced method resulted in considerable error that was comparable to, although not identical to, the motor-response method. Greater accuracy in placement responses may be accounted for by the ability to make corrections, but only for those who could keep the original goal in mind.

Table 2. Frequency of Scores of Participants With Learning Disabilities (n = 19) in Quartiles of All Children (n = 105)

<table>
<thead>
<tr>
<th>Test</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>χ² (df = 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misleading Frames</td>
<td>2/26</td>
<td>2/27</td>
<td>3/26</td>
<td>12/26</td>
<td>16.46*</td>
</tr>
<tr>
<td>Block Design</td>
<td>2/26</td>
<td>3/26</td>
<td>2/26</td>
<td>11/26</td>
<td>12.67*</td>
</tr>
</tbody>
</table>

Note. 1st quartile = highest level performance.
*p < .01.

The issue of judgment versus production was not directly addressed in this study; participants were not asked to judge the correctness of their work. Some adult participants, however, volunteered that the task was not as easy as it first appeared. They could see what needed to be done, but the process of drawing the frames “got in the way.” The children rarely offered comments, but a few made gestures indicating dissatisfaction with their production. These reactions suggest that perception is more accurate than construction on comparable tasks, a finding consistent with Piaget and Inhelder (1956).

Age and Ability Differences

Among the non-LD group, with ages spanning approximately 5 years, age differences in performance were only a nonsignificant trend. When comparing performance between the oldest children and adults, however, the difference was highly significant. This finding corresponds to Piaget’s characterization of concrete operations level of development (roughly 7 to 14 years) versus formal operations (≥15 years). According to Piaget (1969) a characteristic of concrete operations in the development of perception is the ability to find an alternative frame of reference. By contrast, a preoperational (preschool) child’s perception is often dominated by the immediate field effects. The school-age children in this study were clearly able to consider another frame of reference because most of their constructions were closer to vertical than to the orientation of the tilted frame. However, their efforts were inconsistent; sometimes their productions were a little inaccurate, and sometimes the effect of the misleading frame more strongly dominated or at least interfered with their productions. This inconsistency was observed from child to child within an age group (with some children more accurate than others); moreover, for many children performance varied from task item to task item. The age range of the children in this study corresponds to the concrete operations stage, and Piaget noted that development through this stage is slow and highly individual. Members of the adult group, presumably capable of formal operations, were significantly more accurate and more consistent. They were better able to simultaneously inhibit the tilted frame, choose from among potential frames of reference, and keep a represented frame plus goals in mind throughout the construction process.

Compared with their peers, the children in the LD group were more likely to make greater errors in their constructions. They had no difficulty with the actual reproduction of figures (a few inversions and reversals were spread across both groups of children) but appeared to be more influenced by the misleading frames. Figure 1 shows the constructions of one boy in the LD group who had a high total error score on the tasks and showed inconsistent performance. Some of the lines he created were correctly oriented. The vertical lines were generally correct but may have been directly aligned with the vertical line in the stimulus item and so may not have been the result of a coordinated mental representation. The second line of a few figures was not well coordinated with either a correct frame of reference or perpendicular to the first line and so was more poorly...
information is the shape of the stimulus figure that must be analyzed in order to inhibit misleading information. Therefore, field dependence may be a consideration for the interpretation of performance on tests that involve multiple demands on attention, the influence of context might be an important factor in performance.

**Concurrent Validity**

The measures on the Misleading Frames Tasks and the scores on the Block Design test were significantly correlated, suggesting that the two are related. However, the correlation was only moderate when age was controlled for, suggesting that the two tests do not measure exactly the same thing. What they may share is the ability to analyze and coordinate the presence of salient but misleading information. In the case of the Block Design test, the misleading context was apparent and stronger for the less able children. Sometimes this influence was subtle—only a few degrees of deviation; other times, it was stronger. It may be that in typical classroom activities, in which the task might not be simple but may involve multiple demands on attention, the influence of context might be an important factor in performance.

**Limitations of This Study**

Several factors limit the generalization of the findings from this study. The participants were nearly all White, suburban, and middle class. It is possible that different results might be found with different ethnic groups. In addition, the number of participants in the LD group was small, and most participants were male. Most of the adult group was female. Although no performance differences were found between male and female participants in the non-LD group, it cannot be assumed that gender is not a factor in the other groups and that it may have biased the results.

**Implications for Occupational Therapy Practice**

The findings of this study suggest that children who have LD in the area of visual perception may be more strongly influenced by context than their typically developing peers on a design-copying task. Because design copying is a common assessment task, this study may provide some useful insight into the processes involved in production of a test item response. Items on some tests require the drawing of a diagonal line or a triangle inside a square box or on a dot matrix that has strong vertical and horizontal references. The context can be one of the parameters to be considered and manipulated in a dynamic assessment (Katz, Golstand, Bar-llan, & Parush, 2007) of visual–motor skills. For example, having a child produce a problematic figure with either no frame or a facilitating frame can reveal whether the interference is contributing to the problem. The misleading context need not necessarily be the frame or printed boundaries; a child’s first line drawn may provide a context for the next line in a multipart figure, or other figures on the paper may exert an influence.

Inhibition of irrelevant information is a critical component of some visual perception tests as well. For example, a figure ground or form constancy test typically involves maintaining attention to a target in the presence of distractors (Hammill, Pearson, & Voress, 1993). Field dependence may be a consideration for the interpretation of performance on many different types of assessment tasks.

Another important finding from this study is that the complexity of the design can interact with the ability to inhibit misleading information. Therefore, field dependence...
is not a set cognitive characteristic for a child; rather, its influence varies from task to task and may therefore explain why some children are successful in one situation but not in another even though the two situations appear comparable to the adult eye.

Field dependence can also be a factor in many paper-and-pencil tasks typically expected of elementary school children. The lines and boundaries on handwriting paper or the spaces provided for writing on pages of workbooks can influence a child’s writing and organization on paper. Less obvious contextual influences may exist. For example, in early geometry work, a student might be asked to mentally represent a rotation or partition of a form, but the pictures on the worksheet may be difficult to inhibit, thus interfering with the ability to visualize the correct response. Such interference may have a stronger influence on some children who receive occupational therapy.

Visual–motor skills are complex and varied and can be disrupted for a variety of reasons (Schneck, 2005). A careful task analysis can reveal the processes that might hinder performance. In this study, one process, field dependence, was found to be a possible factor in an LD child’s ability to accurately copy figures when a misleading context was present.

Future research in this area might address the influence of immediate context on other visual–motor tasks such as the lines on handwriting paper or the work surfaces used by children in classrooms. Other populations of disabled children with various diagnoses might be included in future research to determine if field dependence is an important factor in their visual–motor performance.

Acknowledgments

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References


