Individual Differences in Cognitive Styles for Visual Representation and Comparison

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Abstract

The goal of the present research is to identify whether individuals use consistent holistic or analytic cognitive styles across visual discrimination tasks. In this research the polygon, geometric figures, and modified radar graph visual discrimination tasks were used to see if individuals used the same cognitive style for completing all of these tasks. The results support the similarity in initial style that participants use across these visual discrimination tasks.

Introduction

Cognitive style is the information-processing method individuals use to complete any given task (Robertson, 1985). For Example, some individuals take a big-picture, holistic approach when collecting information to solve a problem, while others take a more detailed, analytical approach to solving a problem. As Bruner, Goodnow, and Austin (1956) suggest there are individual differences in the initial information-processing method people use to complete a task. For visual discrimination tasks, some individuals start out by using a holistic thought process, and others start out by using an analytic thought process. Do individuals utilize a consistent initial information-processing cognitive strategy to perform visual comparison tasks? If an individual uses the same initial holistic or analytic strategy in performing visual comparison tasks across related tasks, then we can say they are using a holistic or analytic cognitive style.

The goal of the present research is to identify whether individuals use consistent holistic or analytic cognitive styles across visual discrimination tasks. In this research the polygon, geometric figures, and modified radar graph visual discrimination tasks were used to see if individuals used the same cognitive style for completing all of these tasks. Cognitive style of participants was determined by analyzing slopes of the reaction times across the object manipulations in a similar fashion to Cooper (1982), Job, Nicoletti, and Rumiati (1982), and Gillan and Harrison (1999). Then we correlate the slopes of each of the visual discrimination tasks. A significant correlation between the initial strategies that individuals use across the different visual comparison tasks would lend evidence to participants using the same initial strategy to visual discrimination tasks.

Methods

Eighty undergraduate students between the ages of 18 and 27 participated in the experiment. Each participant completed three different discrimination tasks. The order of presentation of these tasks was counterbalanced, and participants were randomly assigned to a task order. During the polygon comparison task, participants were presented with polygon pairs taken from Doane, Alderton, Sohn, and Pellegrino (1996) stimulus set. The polygon comparison pairs had six different levels of difficulty for each of the number of sides, as well as a same comparison. The Geometric figures comparison task drawn from Job et al. (1982) consisted of two sets of geometric figures. Each set of geometric figures consisted of three geometric shapes concentrically placed inside each other. The Radar Graph comparisons consisted of four graphs placed vertically along the computer screen, similar to Gillan et al. (1999) Leg and Outline star graph condition. A total of 450 trials varied with the distance from the center, the number of legs, and the position of the different graph.

We analyzed the reaction time for each of the task types to identify the style that participants used to compare the shape. In general, analytic strategies were defined by increased reaction times as the complexity of comparisons increased. Holistic strategies were defined in general by little to no change in the reaction time as the complexity of the comparisons increased.

Results and Discussion

Polygon Style

Slopes were calculated based on the responses to ‘same’ comparisons as a function of complexity. Figure 1 clearly shows a difference between the two groups. Participants using an analytic style took more time to make the comparison as the number of sides of the polygons increases. The holistic participants, on the other hand, showed little to no increase in reaction time as they are comparing polygons with more and more sides.

Geometric Figure Style

Slopes were calculated across the conditions for ‘same’ comparisons, ‘different’ comparisons and ‘similar’ comparisons. As suggested by Figure 2, there was a

significant Response Type ('same', 'different', 'similar') effect, $F(2, 134) = 339.078$, $p < .05$ on reaction time, a significant Initial Style between-subjects effect, $F(1, 67) = 892.409$, $p < .05$, and a significant Response Type by Initial Style interaction, $F(2, 134) = 61.341$, $p < .05$, but no significant between-subjects effect of Initial Style.

Radar Graph Style

Slopes were calculated based on the responses to 'same' comparisons as a function of number of sides of the radar graphs. A median split was used to identify holistic and analytic participants. As can be seen in Figure 3, the holistic participants showed no significant increase in reaction time as the number of sides increased, whereas the analytic participants showed a significant increase.

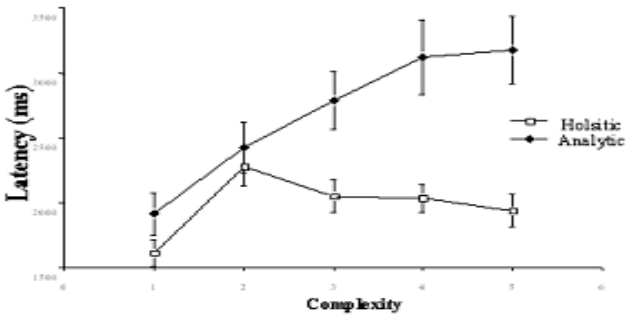

Figure 1. Polygon comparison mean reaction time as a function of complexity

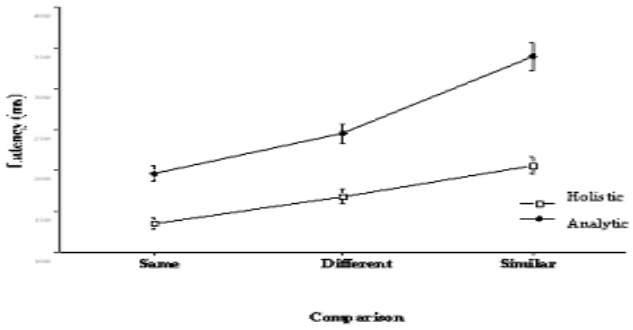

Figure 2. Geometric figure comparison mean reaction time as a function of comparison type

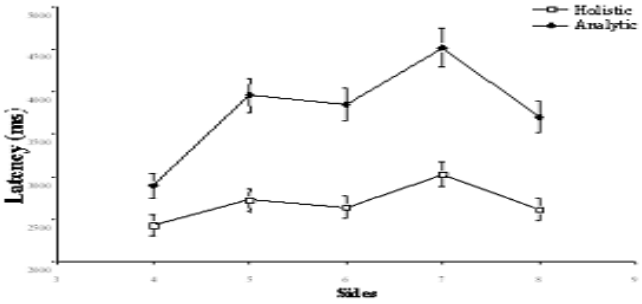

Figure 3. Radar graph discrimination mean reaction time as a function of the number of sides

Correlation of Initial Style Measures

A correlation analysis was used to test the relationships of the style measurements of the different tasks. Since a bi-modal distribution of measures of style is expected, a spearman's correlation coefficient (*r)* was used. As suggested by Table 1, the Radar Graph slopes were most significantly correlated with polygon slope. The correlations between Geometric Figures slope and the Radar Graph ($r = .356$) as well as the Polygon ($r = .352$) comparison tasks were marginally significant.

Table 1. Correlation of style measures for the three visual task types.

Measure of Style	Polygon Slope	Geometric Slope	Radar Slope
1. Polygon Slope	-		
2. Geometric Slope	$r = .356$ $p = .088$	-	
3. Radar Slope	$r = .590$ $p = .003$	$r = .352$ $p = .072$	-

The present results show a strong picture of the similarity in initial style that participants use across these visual discrimination tasks. The correlations between the measures of style between these tasks lend evidence to the concept that people approach new tasks using a similar cognitive style, even if that style changes as the task progresses

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