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Individual differences in the revision of an abstract knowledge structure

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Abstract

Following the recent suggestion (Hockey, in press) that cognitive science has much to gain from the consideration of variability in cognitive functioning, this paper addresses the question of what aspects of memory performance underlie differences in cognitive 'style' such as 'Ambiguity Tolerance'. Subjects allocated to 'tolerant' and 'intolerant' groups on the basis of a traditional pencil & paper measure of 'Ambiguity tolerance' took part in a conceptual editing task which required them to disregard information learnt on a previous occasion. The results of the study show significant differences between groups, both in terms of recall and discrimination, and are interpreted as supporting the view that Ambiguity tolerance effects result from differences in the organisation and availability of the underlying conceptual representation.

Introduction

Our research focuses on two main issues: The circumstances under which abstract knowledge structures are revised or updated following particular learning episodes, and whether there are individual differences in the the processes which underlie such revisions. This paper focuses primarily on the second of these issues.

Despite the attraction of normative models of cognitive processing, it has been suggested by a number of authors (Hockey, in press; Robertson, 1985), that our understanding of many cognitive processes could be enhanced by taking into account the variability in cognitive functioning.

An approach which has been highlighted as being of particular importance to this endeavour is that of 'Cognitive Style' (Robertson, 1985), which concerns the way individuals' conceptually organise their environment (Goldstein & Blackman, 1978). This paper explores the effects of one such style variable [1], 'Tolerance of Ambiguity / Rigidity', on the revision of an abstract knowledge structure.

Tolerance of ambiguity

The concepts of 'Ambiguity tolerance / Rigidity' have a long history and have been investigated using a variety of techniques both within, and outside of, the psychological laboratory (for a review see Goldstein & Blackman, 1978). These include studies concerned with; Perceptual ambiguity, problem solving, category sorting, and concept learning. The results of such studies suggest that individuals vary in their ability to restructure the means by which they organise environmental input, particularly where input contains information which is inconsistent with either some prior knowledge structure or with other aspects of the input.

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[1] As the terms Tolerance of ambiguity and Rigidity have often been used interchangeably by previous authors (Goldstein & Blackman, 1978), no distinction will be drawn between these concepts within this paper.

In addition, such studies have led to the general conclusion that: "Rigid individuals tend to have their cognitions 'walled-off' from each other which results in apparent behavioural inconsistency" (Goldstein & Blackman, 1978).

Rationale

The study made use of a variation on the general Person - Impression formation paradigm, which is a form of concept learning task which has been used several times previously to investigate Tolerance of ambiguity effects. In studies of this sort, subjects are presented with information, typically either behavioural descriptions or trait terms, which relate to one or more fictitious persons. Often aspects of the information are inconsistent with respect to either information presented earlier or else with other items within the same set. Although a number of dependent variables are applicable to this type of study, subjects most commonly are required to produce descriptions or judgments of the fictitious person or persons. Thus the experiment to be reported within this paper differed from earlier studies in two respects. Firstly the focus of the current study was on memory performance rather than trait or behavioural judgments, and secondly, the study was designed to investigate the effects of ambiguity tolerance at retrieval.

Design

The experiment was a between-subjects design and consisted of 4 treatment groups. The general experimental procedure was as follows:

Subjects were presented for one minute with a set of 10 trait adjectives (List 1) and were instructed to form an impression of a fictitious 'John Smith'. After a gap of 12 minutes, during which time subjects completed several intervening tasks, the subjects were presented with a further set of trait adjectives (List 2) describing the same fictitious person. The trait terms in List 1 were **not** manipulated in this experiment. The trait terms which made up List 2 comprised of a set of 10 synonyms to the items in List1. However, 50% of these terms were randomly varied to the antonym of the corresponding List 1 term, thus producing a set of List 2 items which contained 50% inconsistent items. Thus if the List 1 term was **mean**, and its synonym **stingy**, then the List 2 item, if selected for change, might be to **charitable.**

Following a further set of intervening tasks, subjects were tested for their recall of the **List 2 information only**, for their recognition accuracy (New - Old) of items from both lists, and for their discrimination accuracy (List 1 - List 2 - New). The experimental manipulation concerned the stage in the above procedure at which subjects were instructed to disregard the information given in List 1. The specific conditions were as follows:

Table 1: Experimental Design

Time	1	2	3	4	5
Condition 1	List 1	***	List 2	------	Test
Condition 2	List 1	------	List 2	***	Test
Condition 3	------------------		List 2	------	Test
Condition 4	List 1	------	List 2	------	Test

*** = Subjects instructed to disregard the items in List 1

Thus condition 3 constitutes a control where the List 1 information is never learned, and condition 4 an additional control, where no disregard instructions are given. Condition 4 also differs from the other treatment groups in that, at test, subjects are required to recall information from **both** List 1 and List 2.

Finally, scores on the McDonald (1970) scale for Ambiguity tolerance were obtained and a median split produced two groups of high and low scorers designated here as ambiguity TOLERANT and INTOLERANT.

Results

Condition 4 Recall

An analysis was carried out on the data from Condition 4. In this condition subjects learnt both List 1 and List 2, and were tested for their recall of items from both lists. Thus this condition forms a measure of the relative memorability of the two lists in the absence of any instructions to disregard items. The result of this analysis (ANOVA) revealed a main effect for List ($F_{1\ 14} = 22.67$, $P < 0.001$), and shows that in the absence of disregard instructions, the items from List 1 are significantly better recalled than those from List 2.

Recall

Figure 1 shows the mean recall performance, for List 2 information only, across the treatment groups. Analysis of variance (ANOVA) revealed a significant main effect for condition ($F_{2\ 41} = 4.53$, $P < 0.02$). Pairwise comparisons reveal no significant difference between recall in Condition 1, where disregard instructions were given prior to learning List 2 and in the Control condition (Condition 3) where List 1 is not presented for learning. However, recall in condition 2, where the disregard instructions were presented after **both** lists had been learnt, was significantly worse than for both of the other conditions ($P < 0.05$).

This result indicates that subjects only have difficulty in disregarding the information in List 1 when this instruction does not occur until after they have learnt List 2.

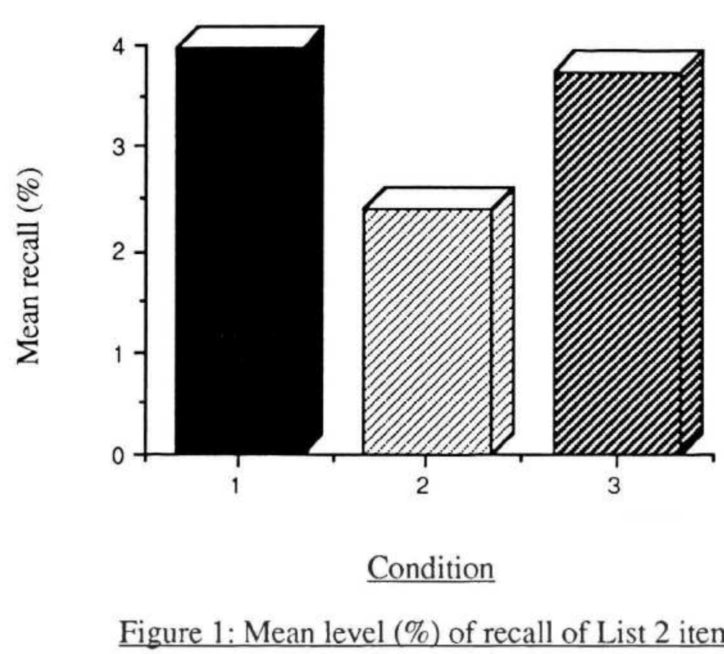

Figure 1: Mean level (%) of recall of List 2 items

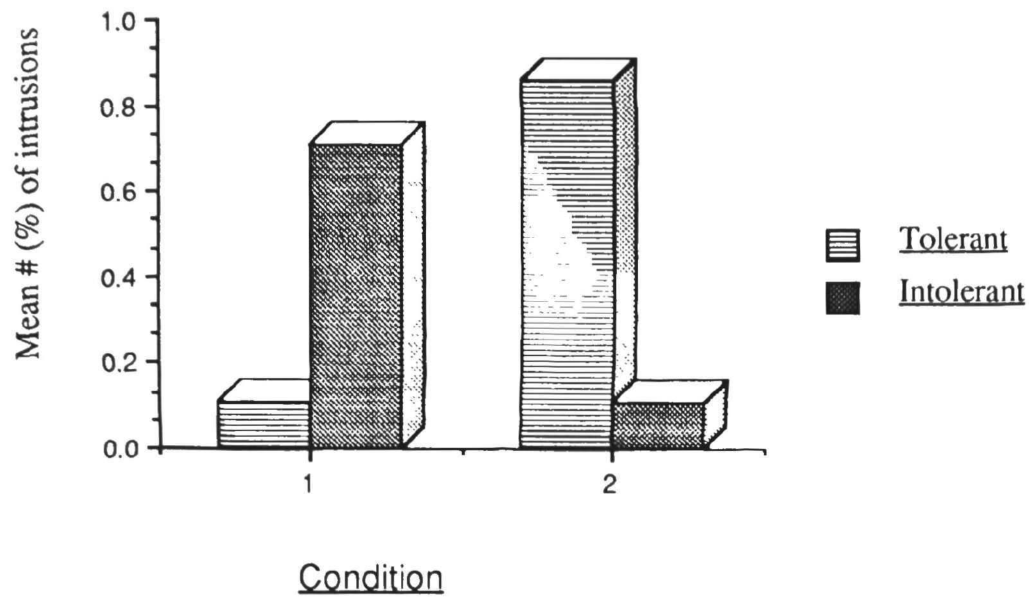

Figure 2: Mean number of List 1 intrusions occurring during subjects' recall of List 2 items

List 1 intrusion data
An ANOVA was carried out on the number of List 1 items recalled by subjects when instructed to recall List 2 items only (Fig. 2). Although the total number of intrusions was small, the results of this analysis were statistically significant. They reveal no main effect for Ambiguity tolerance or for Condition, but a significant interaction effect between Ambiguity tolerance and Condition ($F_{1\ 28}$ = 7.13, $P < 0.01$).
Analysis of the simple effects of this interaction reveal that Condition has a significant effect on the Ambiguity tolerant group ($F = 4.4$, $P < 0.05$) but not on the Intolerant group and that Tolerance of Ambiguity only has a significant effect ($F = 4.4$, $P < 0.05$) at Condition 2, where subjects are not instructed to disregard the List 2 information until after they have learnt List 2.

This result suggests that the Ambiguity tolerant group have greater difficulty in separating information given on different occasions and that the Intolerant group may be maintaining separate representations of the two sets of information.

Recognition Data

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An Analysis of Variance carried out on the recognition data (Old - New) revealed a main effect for condition ($F_{3\ 45} = 8.08$, $P < 0.001$). Pairwise comparisons (Newman-Keuls) reveal that Conditions 1,2, & 4 do not differ significantly from one another, but that recognition performance in Condition 3, where List 1 items were not presented, is significantly better ($P < 0.01$) than in all of the other conditions.

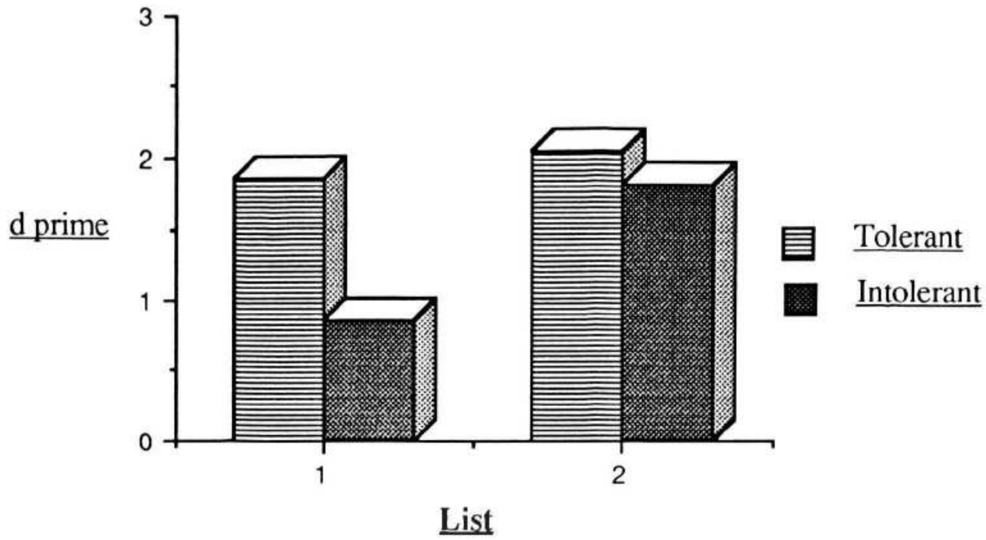

Figure 3: Discrimination performance for List 1 and List 2 items across the two levels of ambiguity tolerance

Discrimination data

d Prime

An Analysis of Variance carried out on the discrimination data (List 1 List 2 - New) revealed the following effects:

A main effect for Ambiguity Tolerance ($F_{1\ 32} = 6.19$, $P < 0.02$), the ambiguity tolerant group showing more accurate discrimination performance overall.

A main effect for condition ($F_{2\ 32} = 3.53$, $P < 0.04$), which reveals that there was no significant difference in performance between Condition 1, where instructions to disregard List 1 are given prior to learning List 2, and condition 4 where no disregard instructions were given. In Condition 2 (disregard instructions given after List 2 items have been learnt, performance is significantly poorer than for both Condition 1 and condition 4 ($P < 0.05$).

A main effect for List ($F_{1\ 32} = 16.22$, $P < 0.001$), which reveals discrimination accuracy was greater for the items presented in List 2 than for those in List 1.

In addition to these main effects there were two significant interactions. Firstly, an interaction effect (Fig. 3) between Ambiguity tolerance and List type ($F_{1\ 32} = 7.07$, $P < 0.01$).

An analysis of the simple effects within this interaction reveal that Ambiguity tolerance has a significant effect on List 1 discrimination ($P < 0.001$) and that List has a significant effect on the Ambiguity intolerant group alone.

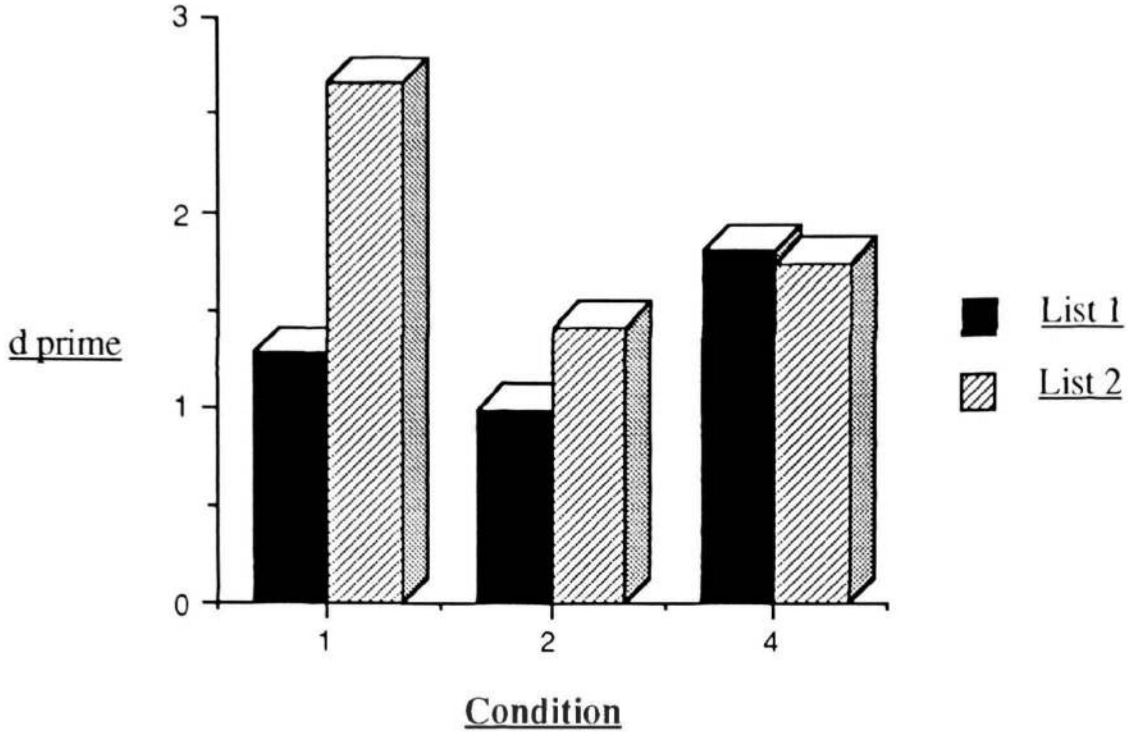

Figure 4: A comparison of list discrimination across the three relevant conditions

This result indicates that the Ambiguity intolerant group are effectively disregarding the List 1 items when instructed to do so, whereas for the ambiguity tolerant group discrimination performance for the List 1 items does not differ significantly from that of List 2. Again this result can be interpreted as evidence for the tolerant group forming a unified impression of the two sets of information.

There was also a significant interaction effect (Fig. 4) between Condition and List ($F_{2\ 32} = 8.8$, $P < 0.001$). The simple effects of this interaction reveal that Condition only has a significant effect on List 2 performance ($P < 0.002$) and that List only has a significant effect at Condition 1 ($P < 0.001$).

As with the recall data, this result shows that subjects can effectively disregard information if the instruction to do so is given prior to learning new, related information (Condition 1).

Beta Data

Analysis of the Beta data revealed only two main effects and no statistically significant interactions. These were:

A main effect for Ambiguity Tolerance ($F_{1\ 32} = 5.78$, $P < 0.02$), with the Tolerant group showing significantly higher Beta levels than the Intolerant group, and a main effect for List ($F_{1\ 32} = 10.28$, $P < 0.003$), with Beta levels greater for List 2 than from List 1.

Summary of Results

The results from this study show that in the absence of specific instructions to disregard information (Condition 4) there was a strong, statistically significant recall advantage for the information learnt first (List 1). However, when instructed to ignore this information (Conditions 1 & 2) these instructions only had a significant effect on List 2 recall when given after both lists had been learnt (Condition 2). This finding is also the case for the discrimination data where performance was impaired relative to the control group only for subjects performing within Condition 2. If these findings are interpreted within an Interference theory framework, then the results suggest that instructions to disregard given prior to new learning have the effect of eliminating PI to the level of a control group who do not receive the initial List (Figure 1).

Although the results in relation to the effect of disregard instructions are themselves of interest, the main focus of this study was on differences in memory performance which could underlie Tolerance of ambiguity effects. With regard to this issue the results reveal that the ambiguity tolerant group show greater discrimination accuracy and higher Beta levels than the intolerant group and that 'Ambiguity tolerance' interacts with task characteristics in a memory 'editing' task, as follows:

Whereas the ambiguity intolerant group show no difference in List 1 intrusions at List 2 recall, across different instruction conditions, the ambiguity tolerant group show a significant increase in List 1 intrusions where instructions to disregard List 1 items follow the presentation of both lists (Condition 2). Also, whereas the ambiguity intolerant group show significantly better discrimination performance for List 2 over List 1 items, the ambiguity tolerant group discriminate List 1 and List 2 items equally well.

Discussion

Although previous studies of 'Ambiguity tolerance' have principally made use of judgments as a dependent variable, this study has sought to explore the question of whether there may be memory performance differences which could account for 'Ambiguity tolerance' effects.

The results from this study can be interpreted as support for the hypothesis that, in contrast to ambiguity tolerant individuals who tend toward unified impressions, ambiguity intolerant individuals compartmentalise information which relates to a single concept but which has been learnt on separate occasions. Thus such 'Tolerance of ambiguity' differences which may exist between individuals may well be attributable to differences in both the structure and availability of aspects of the underlying knowledge representation.

Acknowledgments

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