Cognition and Sex Differences

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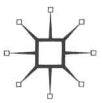

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1 Rationale, Issues and Overview

Introduction

The aim of this introductory chapter is to discuss the major rationales of this book, to identify some of the most relevant issues in the research discussed by the text and to make explicit the organizational framework of the book.

The conventional individual-differences approach considers task performance as the focus of the research, employing statistical tools such as factor analysis and meta-analysis. The next section of this chapter makes an argument for a *process-oriented* approach where the aim of the research is to identify and understand the individual differences in the underlying cognitive processes demanded by a particular task. The organization of this textbook adopts this perspective. The chapters in Part II, where the first major empirical findings are discussed, each begin with a brief outline of the cognitive processes discussed in that particular chapter. These chapters thus are cognitively driven, and explicitly attempt to place individual differences within a cognition framework.

In the subsequent components of this chapter, the issues relating to the use of the terms *sex* and *gender* will be discussed. While many social scientists would employ these terms synonymously, it is argued that sex and gender should not be considered as equivalent constructs in the psychological literature. Thus research will be discussed where gender, as (predominantly) a socially constructed process, may vary within the sexes. Consequently, the notion of gender as a within-sex variable emphasizes individual differences beyond those associated with any differences between men and women. The chapter is developed with a discussion of two issues highly pertinent to the understanding of individual-differences research. The socio-political context in which individual-differences research is carried out has led to some psychologists suggesting that such research should not be carried out. This component of the chapter identifies some of the issues associated with this debate. In addition, some of the methodological issues associated with individual-differences research will be considered, for example the inferential constraints associated with non-experimental research.

The final element of the chapter is a brief account of the organizational framework of the book. Part II of the book considers the individual differences associated with men and women in cognitive processing, for example perception, attention, imagery and memory. Part III emphasizes individual differences associated with within-sex differences, for example gender characteristics, hormonal influences and lifespan processes. Finally Part IV identifies the major theoretical approaches within the field – evolutionary, socio-cultural and, interactionist – before ending with a chapter which puts forward a synthesis of the theoretical accounts and suggests possible ways for the research.

Task Performance Versus Process Measurement

The conventional psychometric approach to individual differences emphasizes the relationship between performances across a number of tasks (see Deary 2001). Analysis of this form of data can be with factor analysis or with meta-analysis where individual differences in task performance across a number of research studies are summarized in a quantitative manner (see Rosenthal 1991). Examples of meta-analytic publications investigating sex differences in visuo-spatial cognition are Linn and Petersen (1985) and Voyer *et al.* (1995). Voyer *et al.* considered sex differences in three different spatial abilities: *mental rotation*, *spatial perception* and *spatial visualization*. The cognitive processes contributing to these tasks will be discussed in detail throughout Parts II and III.

One feature of the traditional approach is the use of factor analysis to identify cognitive tasks which share common cognitive resources. Table 1.1 gives a simplified schematic representation. The table identifies a set of verbal (V) and spatial (S) tasks and the correlation pattern which exists between the task performances.

Table 1.1 indicates that there appears to be only a relatively small correlation between all of the tasks; should this relationship be significant then this would be an indication of what is called 'little *g*', a general measure of intelligence. However, there appears to be a stronger correlation within the verbal tasks, indicated by the dotted circle pattern, and within the spatial tasks, indicated by the dashed circle pattern. This suggests the presence of two main factors. This pattern, evidenced in much of the earlier psychometric literature (Kline 1991), would suggest that intellectual ability is composed of verbal and spatial factors. A closer look at the pattern indicates that within the verbal and the spatial tasks there appear to be differences in the strength of the relationship. The correlation matrix suggests that the two verbal tasks, V1 and V3, are strongly related with one another but not so strongly with the V2 task. The S1 and S2 Tasks also show a strong correlation with one another but not so strongly with S3.

This finer pattern indicates that within the verbal and the spatial domain there are distinct forms of verbal and spatial abilities. This has been the pattern

Table 1.1 A schematic representation of the factor analysis process

Task labels	V1	S1	S2	V2	S3	V3
V1	–	+0.28	+.030	+0.52	+0.21	+0.78
S1		–	+0.75	+0.19	+0.43	+0.20
S2			–	+0.21	+0.48	+0.22
V2				–	+0.33	+0.51
S3					–	+0.18
V3						–

found in recent meta-analytic studies (McGee 1979; Linn and Petersen 1985; Voyer *et al.* 1995). Caplan and Caplan (1997b) identified close to 40 different measures of verbal ability discussed in the literature. The findings suggesting that verbal and spatial abilities are diverse and complex have led to the suggestion that a substantial number of individual-differences studies have employed tasks with dubious or unknown construct validity (Caplan and Caplan 1997b).

In contrast, much research has focused upon the underlying cognitive processes; thus Pezaris and Casey (1991) looked at the impact of concurrent verbal and spatial interference upon mental rotation task performance in young women. Their interest lay not in task performance *per se*, but in the strategies that the young women employed in the task. This is an example of individual-differences research which is 'process-oriented' (Halpern and Wright 1996). Another example of this approach to be discussed in Chapter 3 ('Attention and Memory') is the research by Loring-Meier and Halpern (1999), which looked at the performance of women and men in specific visuo-spatial imagery and working memory processes.

However, a brief historical consideration of many of the studies that have looked at men and women's cognitive performance does suggest that the 'process-oriented' approach is difficult to apply. The major reason for this is likely to arise from the complexity of the tasks traditionally given to the participants in the research. Without a fine task analysis and manipulation it may be possible to identify a difference in performance of men and women in a task but not know where in the cognitive demands these similarities or differences are occurring. An illustration of this difficulty can be derived from a consideration of an early sex-differences study on spatial memory.

Silverman and Eals (1994) discussed a 'spatial memory' task in which the women in the research achieved a higher performance level than the men.

The task involved the participants scanning an array of a large number of common objects for a fixed period of time; subsequently, a new display either showed the original display with some new objects, or the original display with some of the objects having exchanged position (see Chapter 3, Figure 3.6 for a more detailed view of this procedure). The participant's task was to either identify the new objects or identify the exchanged objects. What are the cognitive processes involved in this task procedure?

In the initial phase various cognitive processes appear to be at work: visual attention to the array, a visuospatial working memory representation of the objects and their location, a verbal working memory representation of the nameable objects. Subsequently (or concurrently), long-term memory representations of these visuospatial and verbal features will be constructed and finally there is retrieval from long-term memory of these features. Thus precisely which cognitive process or processes contribute to the findings of higher memory performance in women?

According to Eals and Silverman and others (Cherney and Ryalls 1999; Kimura 1999) the advantage for women is one of spatial memory, though these authors do not dissociate working memory processes from spatial long-term memory processes. Other authors with a slightly different task procedure (Postma and De Haan 1996) emphasize spatial working memory processes. James and Kimura (1997) attribute the advantage for women, in part, to their efficiency in the verbal representation of the objects in the array. Yet more authors (McGivern *et al.* 1997) attribute the difference in performance to an advantage in women's attention early in the task procedure. The diversity of these interpretations may be a direct consequence of the diverse cognitive demands of the task. In order to determine whether it is attention, working memory or long-term memory processes underpinning the observed differences in performance a research procedure with task analysis stages is required.

A final issue related to this approach lies in the conventional emphasis upon *differences* in task performance between women and men. However, when the emphasis is process-oriented, differences in task performance are not the only informative outcome or even the desirable one. A study by Hamilton (1995) employed a sample of women and men who undertook two visuospatial tasks: mental rotation and embedded figures (see the discussions of cognitive processes in perception and imagery task performance in Chapters 2 and 4). The results suggested a significant difference in performance in the former task but not in the latter. This dissociation of performance supports the suggestion that there is unlikely to be a generic spatial ability difference between men and women (Voyer *et al.* 1995). The presence *and* absence of individual differences in these two tasks focuses subsequent research attention on a consideration of the individual differences associated with the particular cognitive processes employed in these tasks. Thus the dynamic spatial processes that are important for mental rotation task