

Intuition-analysis cognitive style and learning preferences of business and management students

A UK exploratory study

Eugene Sadler-Smith

University of Plymouth Business School, Plymouth, UK

Keywords *Human resource development, Learning styles, Management education, Training, United Kingdom*

Abstract *The study is an attempt to provide empirical elaboration, in the context of business and management education, for the “onion” and cognitive control models of cognitive style. Using a sample of 226 business and management undergraduates the research explored the relationship between cognitive style (measured using the cognitive style index and learning preference. Using principal components analysis, three categories of learning preference were discerned (active, reflective and individual). Correlational analysis and one way analysis of variance revealed statistically significant relationships between preferences for reflective and individual methods and cognitive style. The results provide some support for the “onion” and cognitive control models; the implications for business and management education, training and development are discussed.*

Background

Introduction

Curry (1983), in her “onion” model, argued that learning style and cognitive style constructs may be grouped into three main types or layers resembling the skin of an onion. At the onion’s core is the “central personality” dimension, remote from external influences and stable over time. Overlying this central core are:

- (1) “cognitive personality style”: a relatively permanent and stable characteristic measured by instruments such as the embedded figures test (Witkin, 1962);
- (2) “information processing style”: a relatively stable set of responses to acquiring and assimilating information in a given learning situation (measured by means of instruments such as the learning styles Inventory (Kolb, 1984));
- (3) the outer layer of the onion represents the behavioural manifestations of the interaction between these inner layers and the external environment through the expression of, for example, preferences for particular types of teaching and learning methods, such as self-direction, collaboration and dependence (Grasha and Reichmann, 1975) and specific approaches

to learning in given environments and within particular assessment regimes, such as deep versus surface approaches to studying (Entwistle, 1988; Marton and Saljo, 1976).

Riding (1997) presents a “cognitive control” model (a theoretical elaboration of Curry) consisting of primary sources (knowledge, personality, gender and cognitive history), cognitive control (the wholist-analytical and verbal-imagery dimensions of cognitive style) and cognitive input (perception) and output (learning strategies). Like the onion model, it is an attempt to unify the relationship between apparently similar constructs. The aim of this paper is to examine, in the context of business and management education, the implicit proposition in the onion and cognitive control models, that learning preference is related to cognitive style. This has clear implications for:

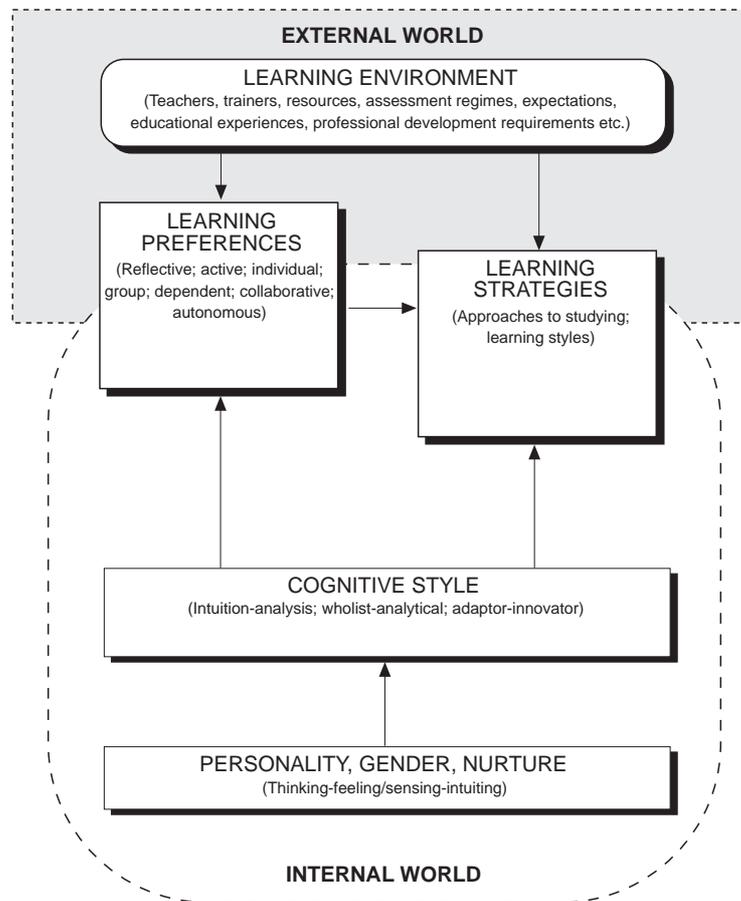
- the planning and design of business and management education;
- training and development in organisational contexts through the matching (or mismatching) of teaching and learning methods to the cognitive style of the learner;
- the development of stylistic versatility (by complementing style with strategies).

Learning preferences

Learning preferences may be defined as an individual’s propensity to choose or express a liking for a particular teaching or learning technique or combination of techniques (Sadler-Smith, 1996). From the work of Reichmann and Grasha, (1974) and Renzulli and Smith (1978) it is possible to synthesise three groups of learning preference:

- (1) dependence: preference for teacher-directed, highly structured programmes with explicit assignments set and assessed by the teacher;
- (2) collaboration: discussion-orientation and favouring group projects, collaborative assignments and social interaction;
- (3) independence: preference for exercising an influence on the content and structure of learning programmes within which the teacher or instructor is a resource (Sadler-Smith and Riding, 1999).

The learning preference construct has not been as widely researched as learning style, approaches to studying or cognitive style. Learning preferences represent the outer skin of the “onion” and as such they are the most easily accessible but least stable of the constructs and are the interface between the internal world and external learning environment. Like “learning styles” and “approaches” (which may be considered as varieties of learning strategy), preferences are ways of dealing with the external world (see Figure 1). They differ from learning strategies in that the latter are ways in which the individual acquires and assimilates information, whereas the expression and operationalisation of learning preferences are the ways by which the learner



Source: based on Curry (1983) and Riding (1997)

Figure 1
Learning preferences,
styles, strategies and
cognitive style

attempts (by accommodating her/his preferences) to adapt to or cope with the demands of the external learning environment.

Sadler-Smith (1997) found statistically significant correlations between learning preferences and learning style (learning styles questionnaire – Honey and Mumford, 1992) and approaches to studying (revised approaches to studying inventory – Entwistle and Tait, 1994) but not between learning preference and cognitive style (cognitive styles analysis – Riding, 1991). The present study will explore the latter, using an alternative model of cognitive style.

Cognitive style

Messick (1984, p. 5) described cognitive style as “consistent individual differences in preferred ways of organising and processing information and experience”. Sternberg and Grigorenko described it as representing “a bridge between what might seem to be two fairly distinct areas of psychological

investigation: cognition and personality” (Sternberg and Grigorenko, 1997, p. 701). A number of assumptions relating to cognitive style may be identified:

- (1) it is concerned with the form rather than the content of information processing;
- (2) it is a pervasive dimension that can be assessed using psychometric techniques;
- (3) it is stable over time;
- (4) it is bipolar;
- (5) it may be value differentiated (i.e. styles describe “different” rather than “better” thinking processes) (Sadler-Smith and Badger, 1998).

One model of cognitive style which satisfies these criteria for a “cognitive style” and lends itself to research in a business and management context is the intuition-analysis dimension (Allinson and Hayes, 1996). The style models of Allinson and Hayes and Honey and Mumford may be traced back to their origins in Jungian psychological types. Hurst *et al.* (1989) in a useful, but concise, summary, described the “types” in terms of information gathering modes (intuition versus sensation) and information evaluation modes (feeling versus thinking) to give four basic types (intuiting-feeling; intuiting-thinking; sensing-feeling; sensing-thinking). Intuition was defined by Bunge (1983, p. 248) as “that ill-defined ability to spot problems or errors, to “perceive” relations or similarities ... in short to imagine, conceive, reason or act in novel ways”. Analysis, on the other hand, is often presented as the antithesis of intuition: “to analyse ... is to exhibit [an object or system’s] components, environment (or context) and structure (organisation)” (Bunge, 1983, p. 219). Hurst *et al.* (1989) went on to speculate that differences in preferences for each type of thinking may be related to hemispherical differences in the brain: “sensing and thinking are left hemisphere related and intuition and feeling right hemisphere related” (Hurst *et al.*, p. 91). This echoed the views of Mintzberg (1976): “in the left hemisphere of most people’s brains the logical thinking processes are to be found ... in contrast the right hemisphere is specialised for simultaneous processing; that is it operates in a more holistic ... way”. More recently, Mintzberg (1994a, p. 114) has re-stated these ideas in the context of strategic planning, arguing that the planning function in organisations is populated by two types of person: the analytic (“left-brained”) thinker and the creative (“right-brained”) thinker. He expressed the view that organisations need both types in “appropriate proportions” (see also Leonard and Strauss (1997) on the “whole-brained organisation”). Like Hurst *et al.* (1989) and Mintzberg (1976), Allinson and Hayes (1996) speculated on hemispherical differences in the brain as a possible basis for cognitive style differences (stemming from the work of Sperry and others – see Nebes and Sperry (1971); they too use the term “intuition” to describe “right brain” thinking (i.e. immediate judgement based on feeling and the adoption of a global perspective) and “analysis” for “left brain” thinking (i.e. judgement based on

mental reasoning and a focus on detail). “Style” in this context is the dominance of one mode of thinking over the other and describes “different” rather than “better” approaches to learning, problem solving, etc.

It should be noted that the attribution of differences in analytical versus intuitive behaviour to hemispherical differences in brain functioning should, in the absence of firm neuro-physiological evidence, be treated metaphorically rather than literally (see Riding *et al.* (1997) for a neuro-physiological study of cognitive style). Finally, Allinson and Hayes’ intuition-analysis dimension of style may be considered to be broadly equivalent to the wholist-analytical dimension (Riding, 1991) and the adaptor-innovator dimension (Kirton, 1994), though there is a pressing need for concurrent validity studies.

Style, preferences and performance

Hayes and Allinson (1996) reviewed 19 studies which investigated the effects of matching styles to learning method and found that in 12 studies there was some support for the proposition that matching style and method contributed to improved learning performance. Fox (1984, p. 72) argued that “continuing educators must develop programmes that meet the needs of learners” and suggested that some participants do not “fit” with certain activities. Smith and Renzulli (1984) argue that congruence of style and method can have an effect on learner motivation and “investment” in the learning material. Equally important, matching can “help eliminate barriers to learning which arise when we [educators] fail to address the affective response various teaching modalities elicit from students” (Smith and Renzulli p. 74). Dunn (1984) reviewed several studies in which she found that where students were placed in academic situations where they were taught and/or tested in ways that matched or mismatched their self-reported preferences, those who were matched performed better than those who were mismatched. This led her to conclude that “their preferences must be their strength” (Dunn, 1984, p. 13). Miller (1991) took a somewhat different view: he argued that the analytic-holist model of style allows the possibility of individuals who are skilled at both analytical and holistic functioning – referred to as “versatile”. He went on to discuss the issues surrounding attempts to engender “versatility” in those already not predisposed towards it. However, his conclusions are that to do so in all students is a waste of time and is potentially damaging and dangerous (given that styles may be forms of psychological defence). He argued that extremely specialised students should be left alone but that teaching should be accommodated to these styles and that versatility is a reasonable goal in those who are already disposed to it. The challenge as far as Miller was concerned was to identify the specialised and the “proto-versatile” (Miller, 1991, p. 236). The “versatility” argument (perhaps through the mismatch) is echoed in the pleas from Mintzberg (1994) for balance in strategic planning teams and Leonard and Strauss (1997) to harness the “energy released by the intersection of different thought processes” to propel innovation (p. 121). The challenge, therefore, for business schools and human resource development practitioners, is to acknowledge the differences that exist

between individuals and use the differences constructively, for example, by giving careful consideration to when to “match”, when to “mismatch” and how to engender cognitive “versatility”.

At a more superficial level, the onion and cognitive control models suggest that cognitive style may exert some influence over preferences for different learning methods (for example role play versus lectures). Riding (1991) has argued that style may affect social behaviour, which may suggest that intuitives will tend to be dependent and gregarious and prefer collaborative learning situations, while analysts may be isolated and self-reliant. Hence, it may be expected that different business and management teaching and learning methods, with their varying degrees of social interaction and autonomy, would be viewed more or less favourably by different cognitive style groups. Similarly, with respect to the cognitive aspects of learning, Allinson and Hayes (1996) argued that analysts may prefer to pay attention to detail, focus on “hard” data, adopt a step-by-step approach to learning and are self-reliant. This suggests that analysts may prefer learning methods which allow opportunities for independent work with the opportunity to analyse data and reflect on information and experiences. Leonard and Strauss (1997) suggested that abstract thinkers (who share some of the attributes of analysts) will prefer to assimilate information from a variety of sources such as books, reports, videos, etc. Conversely, Allinson and Hayes (1996) argued that intuitives are less concerned with detail, adopt a global perspective and take an action-oriented approach to learning and problem solving. These “experiential” individuals will prefer to get information from “direct interaction with people and things” (Leonard and Strauss, 1997, p. 113). This may lead one to suggest that intuitives may prefer learning methods which are active, participatory and gregarious rather than analytical, reflective and self-referential. Sadler-Smith and Riding (1999) in a study of learning preferences and cognitive style (using the cognitive styles analysis (Riding, 1991)), found that wholists expressed a stronger preference for collaborative methods (role play and discussion groups) than did analytics. They attributed this to the gregarious nature and social dependence of the wholists. Clearly, one challenge for research in this field is to build on a growing empirical base.

The study

The study aimed to investigate the relationship between learning preferences and the intuition-analysis dimension of cognitive style in the context of business and management education and provide empirical elaboration for the onion and cognitive control models.

Sample and data collection

The sample consisted of 226 undergraduates studying a range of business and management degree programmes at a university business school in the UK. The sample was an opportunity sample and participation in the research was

voluntary. Data were collected by means of a questionnaire which consisted of three sections:

- (1) the cognitive style index (Allinson and Hayes, 1996);
- (2) a learning preferences inventory;
- (3) respondent data.

Cognitive style. This was measured by means of the cognitive style index (CSI) (Allinson and Hayes, 1996). The CSI is a paper and pencil inventory consisting of 38 questions scored on a three point "true-uncertain-false" scale. The theoretical maximum score is 76; the higher the score the more analytical is the respondent's style.

Learning preferences. Because of the limitations of existing measures a new questionnaire, the learning preferences inventory (LPI), was developed for the purposes of this study and is an extension of exploratory work reported in Sadler-Smith (1997) and Sadler-Smith and Riding (1999). The Reichmann Grasha (1974) instrument, the Rezler and Resmovic (1981) and Dunn *et al.* (1989) questionnaires appear to conflate notions of style and preference. The LPI consists of 13 items (see Table I); respondents are requested to indicate which teaching and learning methods they prefer in general according to a five-point Likert scale ranging from "definitely like" (scored five), through "neither like nor dislike" (scored three) to "definitely dislike" (scored one). The instrument's psychometric properties are discussed below.

Respondent data

Respondents' were requested to give their age, gender and programme of study and were assured of anonymity and confidentiality.

Item	Factor I	Factor II	Factor III
Group work		-0.72	
Role play exercises	0.59	-0.47	
Lecturer presenting facts and theories			0.46
Lecturer presenting examples			0.47
Self-study			0.76
Texts and journals			0.60
Computer-based methods			0.60
Analysis of cases	0.55		
Workshops and practical classes	0.78		
Problem solving exercises	0.64		
Giving presentations	0.42		
Individual work		0.72	
Seminars	0.59	0.44	

Table I.
Factor matrix for
the LPI

Results

Characteristics of the sample

The sample consisted of 128 (56.64 percent) males and 98 (43.36 percent) females; the mean age was 21.00. Respondents were a second year cohort in a single higher education institution in the UK; it is acknowledged therefore, that the characteristics of the sample are likely to introduce severe bias. This is compounded from an international perspective since the subjects have in the main experienced the UK's primary and secondary educational systems, which are likely to exert a considerable influence over their learning preferences (see Figure 1).

Item and factor analysis

The CSI has previously demonstrated construct validity through confirmatory factor analysis and correlational studies (see Allinson and Hayes, 1996). Its level of internal consistency is high, ranging from 0.84 to 0.92 and Allinson and Hayes (1996) report test re-test reliabilities of 0.90.

The LPI's factor structure was investigated by mean of a principal components analysis. Examination of the scree plot (Cattell, 1966) suggested that three factors (accounting for 42.2 percent of the variance) should be extracted. The three extracted factors were rotated to simple structure by means of a varimax rotation (the three factors were not inter-correlated). The resultant factor matrix with loadings of less than 0.4 suppressed is shown in Table I.

Factor I consists of methods which are active (for example role play exercises, workshops and practical classes) and participatory (for example giving presentations and seminars). Factor I was labelled "active". Factor II consists of methods which are reflective and didactic (for example, lectures) and self-directed (for example computer based and self-study methods). Factor II was labelled "reflective". Two items had high loadings (> 0.5) on Factor III – individual work loaded positively and group work loaded negatively. Factor III was labelled "individual".

Descriptive statistics

Cognitive styles. The level of internal reliability for the CSI was high (see Table III). CSI scores by gender are shown in Table II. Hayes *et al.* (1998) argue that gendered stereotypic thinking "suggests that intuition is a feminine characteristic whereas analysis is a masculine characteristic" and go on to test this view. In a comparison of style and gender, using a sample of under-

	n	Males		n	Females		df	t
		M	SD		M	SD		
CSI	128	43.27	9.56	98	45.41	9.69	224	-1.67*

Table II.
Cognitive style scores
by gender (* $p = 0.05$,
one tailed test)

graduate business and management students, they found highly significant gender differences ($p < 0.001$) in cognitive style, with females (43.84; SD, 14.02) being more analytical than males (M, M, 36.32; SD, 15.56). This was the converse of the stereotypical view of “female intuition”. Although in the present study females did generally score higher than males the differences were only marginally significant and hence style and gender may be considered independent in this context (see Table II).

There is some ambiguity in gender-related style differences. For example, Riding and Rayner (1998) argued that style is independent of gender. Complementary work using the CSI in a professional development context appears to suggest that while style and gender are independent they appear to interact in their effect on learning preferences. There is a need for further research into the relationship between style and gender and their combined effect on learning and workplace behaviours.

Learning preferences. The mean scores for each of the three learning preference scales identified were computed and are shown along with their inter-correlations in Table III. The levels of internal consistency (coefficient α) were as follows:

- (1) active (0.50);
- (2) reflective (0.59);
- (3) individual orientation (0.81).

While the latter was satisfactory, the α 's for active and reflective were low but considered acceptable for use in this exploratory study.

The three factors were not correlated among themselves. The general preference was in favour of reflective methods (M = 3.53; SD = 0.62), while individually-oriented methods were least preferred (M = 3.32; SD = 0.74), however, the observed differences were small.

Cognitive style and learning preferences

The lack of any important differences in the preferences expressed by the sample as a whole compounds the potential importance of any style-related differences, especially from the point of view of the planning and design of business and management education. The relationship between CSI score and

Table III.
Learning preferences means, standard deviations, inter-correlations, reliabilities and relationship with cognitive style

	CSI	Active	Reflective	Individual	M	SD
CSI	0.89	0.05	0.32***	0.25***	44.25	9.66
Active		0.50	0.10	-0.16*	3.43	0.60
Reflective			0.59	0.12	3.53	0.62
Individual				0.81	3.32	0.74

Note: Coefficient alphas are shown in bold along the diagonal. $223 \leq n \leq 226$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

learning preferences was explored by means of simple linear correlations. There were statistically significant correlations between CSI score and:

- (1) reflective methods ($r = 0.32; p < 0.001$);
- (2) individually oriented methods ($r = 0.25; p < 0.001$) – see Table III.

The effect of style was further investigated by means of a one way analysis of variance in order to test for any non-linear relationships. The sample was divided into three cognitive style groupings: intuitives ($0 < \text{CSI} < 39$); intermediates ($39 < \text{CSI} < 48$); analysts ($48 < \text{CSI} < 76$). Mean preferences for the three methods for each of the style groups are shown in Table IV.

The intuition-analysis model of style leads one to anticipate stronger preferences for active methods on the part of the intuitives. However, there were no significant differences in this regard, therefore the assertion that intuitives will prefer active/participatory methods was not supported. The model also leads one to anticipate that for:

- (1) reflective methods the analysts would express the strongest preferences and the intuitives the least strongest;
- (2) individually-oriented methods the analysts would express the strongest preferences and the intuitives the least strongest.

These data support both of these assertions (see Table IV). A two way analysis of variance (style by gender) did not reveal any statistically significant main effects for gender or interactions of gender and style in their effect on learning preferences.

Discussion

The onion model and cognitive control models (Curry, 1983; Riding, 1991) infer a relationship between cognitive style and learning preferences, albeit with the latter influenced by the learning environment and context. The present study has lent some support to the notion of learning preference being a correlate of cognitive style. With respect to analysts, the assertion that they would prefer reflective and individually oriented methods received support. With respect to the intuitives the assertion that they would express a dis-preference for reflective and individually-oriented methods also received support. Therefore, these data would suggest that there is a relationship between cognitive style

	Intuitives ($n = 71$)		Intermediates ($n = 65$)		Analysts ($n = 89$)		df	F
	M	SD	M	SD	M	SD		
Active	3.29	0.64	3.54	0.56	3.44	0.59	221	2.77
Reflective	3.31	0.66	3.53	0.56	3.70	0.58	221	8.32**
Individual	3.17	0.76	3.23	0.66	3.49	0.75	221	4.21*

Note: * $p < 0.05$; ** $p < 0.01$

Table IV.
Cognitive style and
learning method
preferences

and preferences for reflective and individually oriented methods. This may suggest that cognitive style manifests itself in learning situations as a preference for those methods which the learner unconsciously or consciously perceives as matching their preferred way of organising and processing information. Under such circumstances the learner may anticipate a benefit which may have a concomitant effect on motivation. The majority of empirical studies (Dunn, 1984; Hayes and Allinson, 1996) present evidence in favour of matching style and method. However, as noted earlier, some have argued that it is beneficial for the learner to consciously expose themselves to methods which do not match their preferred style in order to develop a wider range of learning skills (“learning-to-learn”) (Entwistle, 1988; Honey and Mumford, 1992) and gain a “meta-cognitive advantage”. The empirical evidence in favour of the mismatch of method and style is less robust than that which supports the concept of matching (Hayes and Allinson, 1996), although the latter is hardly unequivocal. It could be argued that mismatching learner and learning method is potentially valuable in the hands of a skilled facilitator with clearly formulated objectives and is perhaps one way in which learning-to-learn may be engendered.

The anticipated preference for participatory/active methods on the part of the intuitives did not receive support. This may suggest that: there is no simple and direct relationship between style and preference with respect to participatory/active methods; there are idiosyncrasies in the participatory/active methods used in the institution concerned which intervened to confound any relationship with style; the relevant scale of the LPI may be a crude and underdeveloped measure (it had the lowest level of internal reliability) of preference for participatory/active methods. The latter could be improved by the exclusion of those items which loaded ambiguously (i.e. “seminars”) or had the lowest factor loadings (i.e. “giving presentations”) – see Table I. The relationship between style and preference is worthy of further investigation, using undergraduate samples from a broader range of educational institutions, post-graduate and professional development students and, most importantly, randomly selected work-based samples. The extension of this work into international contexts (given the UK bias in the present study) in order to explore the cross cultural validity of the style and preferences constructs and their inter-relationships would also be potentially valuable.

Conclusion

The aim of this study was to examine the validity of the onion and cognitive control models and it is argued that limited support has been provided. Two central issues may be identified: the status and validity of the “matching hypothesis”; and the notion of learning-to-learn. The two issues are related in that if individuals achieve the latter the former becomes a redundant concept. A key aspect of learning-how-to-learn is strategy development. Riding and Sadler-Smith (1997, pp. 204-5) argued that individuals may adopt a three-stage approach to strategy development based on the fit between their cognitive style

and the demands of the learning situation. The first stage is sensing the extent to which the learner feels comfortable with the situation in terms of their own preferences. The second stage involves them, as they become more meta-cognitively aware, in selecting the most appropriate learning methods. The third stage is strategy development in which individuals attempt to make learning “easier” by translating, adapting or reducing the processing load imposed on them by the situation. This suggests that explicit acknowledgement of cognitive style and learning preferences (along with learning styles and approaches to studying), perhaps through comprehensive “profiling” of these attributes, may be an important step forward in bringing learners and management educators together in an understanding of each other’s styles and their mutual interdependence. This is crucial since one of the keys to efficient and effective performance in both the classroom and the workplace is the ability to balance intuition and analysis, since neither is sufficient by itself.

References

- Allinson, C.W. and Hayes, J. (1996), “The cognitive style index: a measure of intuition-analysis for organisational research”, *Journal of Management Studies*, Vol. 33 No. 1, pp. 119-35.
- Bunge, M.A. (1983), *Exploring the World: Epistemology and Methodology* (treatise on basic philosophy), D. Reidel, Dordrecht.
- Cattell, R.B. (1966), “The scree test for the number of factors”, *Multivariate Behavioural Research*, Vol. 1, pp. 245-76.
- Curry, L. (1983), *Learning Styles in Continuing Medical Education*, Canadian Medical Association, Ottawa.
- Dunn, R. (1984), “Learning style: state of the science”, *Theory into Practice*, Vol. 23 No. 1, pp. 10-19.
- Dunn, R., Dunn, K. and Price, G.E. (1989), *Learning Styles Inventory*, Price Systems, Lawrence, KS.
- Entwistle, N.J. (1988), *Styles of Learning and Teaching*, David Fulton, London.
- Entwistle, N.J. and Tait, H. (1994), *The Revised Approaches to Studying Inventory*, Centre for Research into Learning and Instruction, University of Edinburgh, Edinburgh.
- Fox, R.D. (1984), “Learning styles and instructional preferences in continuing education for health professionals: a validity study of the LSI”, *Adult Education Quarterly*, Vol. 35 No. 2, pp. 72-85.
- Grasha, A.F. and Reichmann, S.W. (1975), *Student Learning Styles Questionnaire*, University of Cincinnati Faculty Resource Centre, Cincinnati, OH.
- Hayes, J. and Allinson, C.W. (1996), “The implications of learning styles for training and development: a discussion of the matching hypothesis”, *British Journal of Management*, Vol. 7 No. 1, pp. 63-73.
- Hayes, J., Allinson, C.W. and Taggart, W.M. (1998), “Intuition, women managers and gendered stereotypes” (under review).
- Honey, P. and Mumford, A. (1992), *The Manual of Learning Styles*, Peter Honey, Maidenhead.
- Hurst, D.K., Rush, J.C. and White, J.E. (1989), “Top management teams and organisational renewal”, *Strategic Management Journal*, Vol. 10, pp. 87-105.

- Kirton, M.J. (1994), *Adaptors and Innovators: Styles of Creativity and Problem Solving*. Routledge, London.
- Kolb, D.A. (1984), *Experiential Learning*, Prentice Hall, Englewood Cliff, NJ.
- Leonard, D. and Strauss, S. (1997), "Putting your company's whole brain to work", *Harvard Business Review*, July-August, pp. 111-21.
- Marton, F. and Saljo, R. (1976), "On qualitative differences in learning. 1: outcomes and processes", *British Journal of Educational Psychology*, Vol. 46, pp. 4-11
- Miller, A. (1991), "Personality types, learning styles and educational goals", *Educational Psychology*, Vol. 11 No. 34, pp. 217-37.
- Mintzberg, H. (1976), "Planning on the left side and managing on the right", *Harvard Business Review*, July-August, pp. 49-58.
- Mintzberg, H. (1994), "The fall and rise of strategic planning", *Harvard Business Review*, January-February, pp. 107-14.
- Messick, S. (1984), "The nature of cognitive styles: problems and promises in educational research", *Educational Psychologist*, Vol. 19, pp. 59-74.
- Nebes, R.D. and Sperry, R.W. (1971), "Cerebral dominance in perception", *Neuropsychologica*, Vol. 9 No. 247, p. 53.
- Reichmann, S.W. and Grasha, A.F. (1974), "A rational approach to developing and assessing the construct validity of a study learning styles scale inventory", *Journal of Psychology*, Vol. 87, pp. 213-23.
- Renzulli, J.S. and Smith, L.H. (1978), *The Learning Styles Inventory: a Measure of Student Preference for Instructional Techniques*. Creative Learning Press, Mansfield Centre, CT.
- Rezler, A.G. And Rezmovic, V. (1981), "The learning preferences inventory", *Journal of Allied Health*, February, pp. 28-34.
- Riding, R.J. (1991), *Cognitive Styles Analysis*, Learning and Training Technology, Birmingham.
- Riding, R.J. (1997), "On the nature of cognitive style", *Educational Psychology*, Vol. 17 Nos 1-2, pp. 29-50.
- Riding, R.J. and Rayner, S.G. (1998), *Cognitive Styles and Learning Strategies*, Fulton, London.
- Riding, R.J. and Sadler-Smith, E. (1997), "Cognitive style and learning strategies: some implications for training design", *International Journal of Training and Development*, Vol. 1 No. 3, pp. 199-208.
- Riding, R.J., Glass, A., Butler, S.R. and Pleydell-Pearce, C.W. (1997), "Cognitive style and individual differences in EEG alpha during information processing", *Educational Psychology*, Vol. 17 Nos 1-2, pp. 219-34.
- Sadler-Smith, E. (1996), "Learning styles: a holistic approach", *Journal of European Industrial Training*, Vol. 20 No. 7, pp. 29-36.
- Sadler-Smith, E. (1997), "Learning style: frameworks and instruments", *Educational Psychology*, Vol. 17 Nos 1 and 2, pp. 51-63.
- Sadler-Smith, E. and Badger, B. (1998), "Cognitive style, learning and innovation", *Technology Analysis and Strategic Management*, Vol. 10 No. 2, pp. 247-65.
- Sadler-Smith, E. and Riding, R.J. (1999), "Cognitive style and instructional preferences", *Instructional Science*, in press.
- Smith, L.H. and Renzulli, J.S. (1984), "Learning style preferences: a practical approach for classroom teachers", *Theory into Practice*, Vol. 23 No. 1, pp. 44-50.
- Sternberg, R.J. and Grigorenko, E.L. (1997), "Are cognitive styles still in style?", *American Psychologist*, July, pp. 700-12.
- Witkin, H.A. (1962), *Psychological Differentiation: Studies of Development*, Wiley, New York, NY.