The Cognitive Style Index

Technical Manual and User Guide

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Introduction

In recent years, there has been a growing interest in cognitive and learning style, but a major problem facing researchers and practitioners has been a shortage of valid and reliable assessment instruments convenient for adoption in organisational settings. The Cognitive Style Index (CSI) is a psychometric measure that meets this need. It was designed to be used primarily with managerial and professional groups, but has also been applied successfully with students and non-managerial employees.

The CSI is a 38-item self-report questionnaire. Each item has 'true', 'uncertain' and 'false' response options, and scores of 2, 1 or 0 are assigned to each response with the direction of scoring depending on the polarity of the item. The nearer the total score to the maximum of 76, the more 'analytical' the respondent, and the nearer to the minimum of zero, the more 'intuitive' the respondent.

There is evidence that knowledge of a person's cognitive style is valuable in selection, placement, careers guidance, task design, team composition, conflict management, mentoring and training and development. The CSI should prove useful in each of these applications.

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Theoretical Background

Cognitive style is an individual's preferred way of gathering, processing and evaluating data. It influences how we scan our environments for information, how we organise and interpret it, and how we integrate our interpretations into mental models and subjective theories that guide our behaviour.

Many dimensions of cognitive style have been highlighted in the literature. Hayes and Allinson (1994) identified 29 of these, including, for example, field dependence – field independence, convergence – divergence, reflection – impulsivity, serialism – holism and rationality – intuition. Armstrong (1999) extended the list to 54, and, more recently, Coffield *et al* (2004) evaluated 71 measures of cognitive and learning style that represent a wide variety of theoretical models. While certain authors (e.g. Globerson and Zelniker 1989; Streufert and Nogami 1989) argue that this multiplicity of descriptors reflects the sheer complexity of cognition, others claim that many, if not most, are simply different conceptions of a generic dimension that is associated with the traditional notion of 'the dual nature of human consciousness' (Robey and Taggart, 1981). Nickerson *et al* (1985) describe one of the elements of consciousness as analytic, deductive, rigorous, constrained, formal and critical, and the other as synthetic, inductive, expansive, unconstrained, divergent, informal, diffuse and creative. Similarly, Ornstein (1977) differentiates between analytic thinking which implies processing information in an ordered, linear sequence, and holistic thinking which involves viewing the whole situation at once in order to facilitate the synthesis of all available information. These approaches essentially refer to the rational and intuitive sides of the individual. In keeping with established terminology, however, these modes of cognition are labelled 'analytic' and 'intuitive' respectively.

Models of Cognitive Style

The duality of consciousness has been viewed in different ways. Some have conceived it as a simple dichotomy in which a person is deemed to be either basically analytic or intuitive, an approach consistent with the type theory of personality. This perception has now, however, largely fallen out of favour. Human attributes can rarely be thought of as simply being one thing or another. Rather, a person is predisposed toward, or has a preference for, a way of thinking or mode of behaviour that falls somewhere along a continuum. Many, therefore, view intuitive and analytic cognition as representing the poles of a single dimension. This suggests that the cognitive style of a particular individual may fall at any point on the scale. Those whose style is positioned toward the extremes would, in most circumstances, tend to favour the one mode of thought to the virtual exclusion of the other while those positioned toward the middle area would be comfortable drawing upon a combination of analysis and intuition in their problem solving and decision making. This perspective

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views cognitive style essentially as a personality trait which may be thought of as a single factor in statistical terms, and suggests that the more analytical an individual, the less intuitive he or she will be, and *vice versa*. A study by Hodgkinson and Sadler-Smith (2003) suggested that analysis and intuition as measured by the CSI could, in fact, be two separate, though correlated, dimensions, the implication being that a person may be not just high on one and low on the other (as suggested by the continuum model), but also high on both or low on both at the same time. Later, they reported evidence to suggest that the instrument may even yield three factors (Hodgkinson *et al*, 2009). The balance of independent research evidence, however, appears to support the one-factor perspective (see section on Factor Analysis below), and therefore the idea of the CSI as a measure of a single dimension was retained. Indeed, it is noteworthy that only a small minority of researchers have adopted the approach advocated by Hodgkinson and his colleagues since their findings were published. Aside from the statistical debate, to regard analysis and intuition as independent dimensions would be to deny a centuries-old perception of individual differences in human thought processes that can be traced back at least to the writings of Aristotle, as well as sacrificing the most parsimonious explanation of cognitive style. This is not to deny the idea of 'dual processing' as the integration of analytic and intuitive thinking is often called. Rather, there will be individual differences in the tendency to favour a particular combination of the two approaches. It is the various combinations that represent the different cognitive styles measured by the CSI.

Cognitive Continuum Theory

The single trait approach is consistent with Cognitive Continuum Theory (Hammond *et al*, 1987), a framework for linking cognitive style to task performance that has been highly influential in recent years. Hammond and his colleagues propose two continua: one for cognitive mode, ranging from analysis at one end to intuition at the other; one for tasks, ranging from the analysis-inducing to the intuition-inducing. They contend that individuals 'oscillate' between the poles of the cognitive continuum in order to respond to the cognitive demands of the task. The greater the correspondence between the cognitive style used and the task demands, the better the task performance is likely to be. Associated with the idea of a cognitive continuum is the notion that individuals will have a preference for, or disposition towards, a particular cognitive mode. As indicated above, it is this preference, disposition or 'style' that is measured by the CSI. It is argued that it is the tendency to favour a specific cognitive style that may reduce the correspondence between cognitive mode and task demands and thus hinder task performance.

The intuition-analysis dimension assessed by the CSI is depicted in Figure 1. Five notional styles representative of the full range are identified. At the extremes are the pure cases of 'intuition' and 'analysis' respectively. The full exercise of either precludes the adoption of the other. The cognitive

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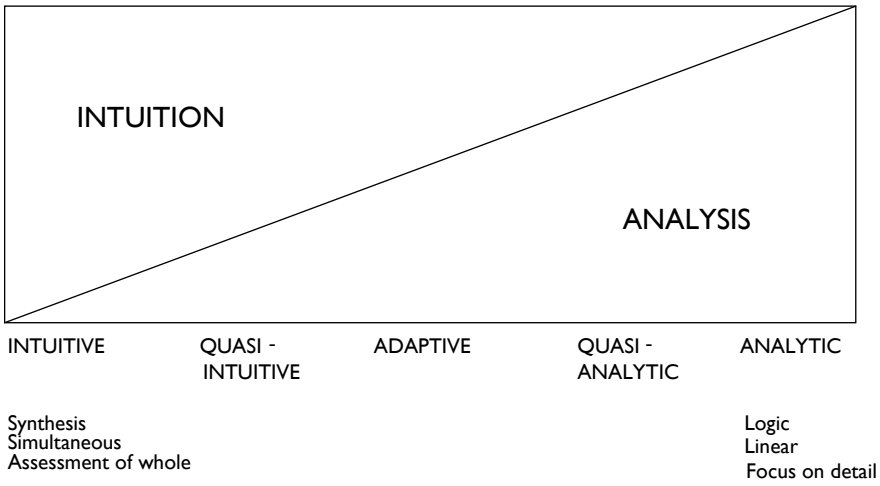
style of most people, however, involves elements of both intuition and analysis. In the middle range, the 'Adaptive' style implies a balanced blend of the two cognitive modes. Either side of this are the 'Quasi-Intuitive' and 'Quasi-Analytical' styles, each of which denotes a tendency towards, but not the full adoption of, one of the extreme cognitive modes. A distinction should be made here between the Quasi-Analytic style and Hammond *et al*'s idea of 'quasi-rationality' (likened to common sense). In Cognitive Continuum Theory, the latter refers to the middle area on the cognitive style continuum. It is felt, however, that the Latin term *quasi* is more indicative of 'a tendency toward' the construct to which it is attached.

FIGURE 1

A Continuum of Cognitive Style



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Design and Development

The first step in the measurement of cognitive style was to write four or five statements about approaches to problem solving or decision making for each of the 29 dimensions identified in the literature by Hayes and Allinson (1994). Items were worded so that some reflected an analytic and some an intuitive orientation with regard to the dual consciousness model of information processing. For the purpose of item analysis, a final pool of 129 statements was administered to 66 managers in a large construction company (all men) and 225 undergraduate management students in a British civic university (145 men and 80 women). Respondents were asked to indicate whether or not the items were indicative of their own attitudes or behaviour. A 'true', 'uncertain', 'false' response mode was adopted throughout. The central category allowed subjects to indicate genuine uncertainty on the grounds that the extreme categories did not apply consistently. This method of response also overcame the problem associated with Likert scales of five or more points that some respondents tend towards the extremes while others have a habit of avoiding them (Kline, 1993). For all items, at this stage, a score of 2 was assigned for a response of true, 1 for uncertain and 0 for false. Item selection criteria were *p* values (the proportion of respondents choosing particular responses) and item-total correlations (the correlation of each item score with the aggregate score of the remainder). Items were retained which, for both the construction managers and management students, had *p* values, at each scale extremity, no greater than 0.7 and no less than 0.3 (a criterion of discriminative ability), and item-total correlations of at least 0.3 (a criterion of test homogeneity).

38 items met the item analysis selection criteria to form the final version of the CSI. These derived from 18 of the dimensions initially identified in the literature (see Table 1). 21 were worded in such a way that a response of 'true' indicated an analytical orientation. The scoring of the remaining 17 was reversed so that the nearer the total CSI score to the maximum of 76, the more analytical the respondent, and the nearer to the minimum of zero, the more intuitive the respondent. Items were arranged in random order on the final form.

In later validation studies, the questionnaire was completed by 226 managers and supervisors in a national brewing company (121 men and 105 women), 74 teachers from various primary schools (15 men and 59 women), 202 undergraduate business and economic students at a British civic university (134 men and 68 women), 130 miscellaneous managers from a range of organisations (89 men and 41 women) and 22 professionals participating in a human relations training workshop (9 men and 13 women). Students were considered acceptable surrogates for work-based subjects on the grounds that, in psychometric analysis, it is the relationship between items rather than the level of mean scores that is important.

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Table 1: Cognitive style dimensions from which CSI items were derived

Intuitive	Analytic	CSI Items
Active	Passive	23, 12, 31
Ambiguity	Clarity	9
Cautious	Risk taking	6, 17, 21, 33, 35
Cognitive simplicity	Cognitive complexity	4
Diverger	Converger	29
Field dependent	Field independent	38
Holist	Serialist	3
Impulsive	Reflective	11, 13, 16, 22, 27, 34
Innovator	Adaptor	5, 36
Intuition	Sensing	20, 26, 37
Intuitive	Rational	1, 25
Intuitive	Systematic	10, 18, 32
Less attention to detail	Rigour	19, 28
Low tolerance of incongruity	High tolerance of incongruity	24, 30
Lumper	Splitter	15
Personal	Impersonal	14
Scanning	Focusing	2, 7
Wholist	Analytic	8

Factor Analysis

If the CSI is to be regarded as a valid measure of the generic dimension of cognitive style hypothesised in the literature, its internal structure should represent a single factor in statistical terms. It is, however, difficult to demonstrate this through the factor analysis of items, for two reasons: firstly, inter-item correlations tend to be low, often around only 0.2, with little variance (Kline, 1993); and secondly, items as single variables tend to be unstable (Nunnally, 1978). Consequently, a clear factor structure is unlikely to emerge. In order to overcome this, Cattell (1973) proposes the factor analysis of groups or 'parcels' of items, each around four to eight in number, which constitute, to all intents and purposes, homogeneous scales. According to Cattell (1974), these give a ‘more accurately determined, unique simple structure solution’.

Cattell and Burdsall (1975) argue that to create parcels by visual inspection of items is 'too subjective and depending on possibly half conscious and almost certainly insufficiently informed stereotypes of a particular experimenter'. Factor analysis of items for the student sample was used initially, therefore, to provide a rough indication of item clusters, and, on this basis, six parcels (one of eight items and five of 6 items) were identified. Confirmatory factor analysis (maximum likelihood method)

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substantiated the hypothesised single factor solution for five of the seven samples studied. This accounted for over half the variance in each case. An exploratory principal components analysis of the parcels yielded a single factor solution for all seven samples.

As indicated above, Hodgkinson and his colleagues suggest that the CSI may measure two or, on the evidence of their subsequent research, even three factors. Replications of their first study by Lofstrom (2005) and Backhaus and Liff (2007a) fail to confirm this, however, while replications of our own analysis by Sadler-Smith, Spicer and Tsang (1998), Murphy *et al* (2001) and Van den Top (2010) support the original, single factor explanation. The most sophisticated and rigorous analysis appears to be that of Hamad (2012) who directly compared our one-factor model with the two- and three-factor models of Hodgkinson and colleagues. Applying the Structural Equation Modelling technique, the single factor approach was found to be significantly superior to the two- and three-factor approaches on all fit indices. On this basis, the multidimensional models were rejected, and the application of the CSI as it was originally conceived was recommended. It is also of interest that, in a study of trainee teachers, Evans and Waring (2008) found that when the Hodgkinson model was applied, 70% of respondents scored high and low on the analytic and intuitive dimensions in either order on the basis of median splits, as opposed to high or low on both. Furthermore, in a study of founding SME owner-managers, Brigham and Mitchell (2010) obtained a correlation between analysis and intuition of -.64 when experimenting with the two-factor method of scoring, the strength of the correlation leading them to question the extent to which the underlying information systems might actually differ in the way that the two-dimensional model suggests.

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Administration and Scoring

The CSI is available online and can be completed by respondents unsupervised. For each item, respondents are asked to indicate if they feel that the statement is true or false about them, or if they are uncertain whether it is true or false. It is expected that in cases where the statement is perceived to be sometimes true and sometimes false, this will evoke the response of uncertain. It should be emphasised to respondents that the questionnaire is not a test of ability, and there are no right or wrong answers. Respondents should be asked to work quickly, giving their first reaction in each case, and to complete every item. There is no time limit, and when the instrument is administered in a group setting, each person should be permitted to finish in their own time. Most people will complete the CSI in 10 minutes or less, and rarely will anyone require more than 15 minutes.

A single, total score is obtained for the CSI. As previously outlined, the one-factor solution emerging in most factor analyses, indicates that it would be inappropriate and unnecessary to identify separate subscales or sub-scores. The CSI is scored automatically and a profile report populated with the appropriate score and cognitive style of the respondent.

As shown in Table 2 below, for a response of 'True' (**T**), two points are given if an item is 'analytic' (e.g. 'I am most effective when my work involves a clear sequence of tasks to be performed'), and zero is given if an item is 'intuitive' (e.g. 'I am inclined to scan through reports rather than read them in detail'). For a response of 'False' (**F**), two points are given if an item is 'intuitive', and zero is given if an item is 'analytic'. In all cases, one point is given for a response of 'Uncertain' (**?**). The maximum possible total, therefore, is 76, and the minimum is zero.

Table 2: Scoring Key

		SCORING POINTS	
RESPONSE	**KEY**	**Analytic items**	**Intuitive items**
True	T	2	0
Uncertain	?	1	1
False	F	0	2

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The Five Styles

Boundaries for the five notional styles associated with CSI scores specified in Figure 1 were defined as the 20th, 40th, 60th and 80th percentiles in the distribution obtained from a sample of 1180 British managers and professionals. The score range for each style is indicated in Table 3.

Table 3: CSI score ranges for the five cognitive styles

Style	Score range
Intuitive	0 – 28
Quasi-Intuitive	29 – 38
Adaptive	39 – 45
Quasi-Analytic	46 – 52
Analytic	53 – 76

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Reliability

The reliability of a measure is the extent to which it is unaffected by random influences. Two types of reliability are usually identified: temporal stability (or test-retest reliability) and internal consistency. Temporal stability is estimated by correlating scores obtained on two separate occasions from the same group of people while internal consistency is indicated by the degree of inter-correlation between the items of which the measure is comprised. Both types of reliability are expressed in terms of a correlation coefficient. The most widely used indicator of internal consistency is the alpha coefficient (Cronbach, 1951) which is, in effect, the average of correlations that are computed between the scores on two halves of the instrument when the full set of items is split in half in every possible way. Nunnally's (1976) criterion of acceptable internal consistency is an alpha coefficient of 0.7 or above.

The temporal stability and internal consistency of the CSI, along with norms derived from over 100 research studies, are shown in Appendix 1. For 53 (88%) of the 60 samples for which reliability results are available, the alpha coefficient met Nunnally's criterion of acceptability. In the seven cases where this was not achieved, the samples were made up of respondents from countries in which the first language is not English, and who completed either an English or a translated version of the questionnaire. It seems likely that failure to fully comprehend all items, owing to difficulty with English language or inadequate translation, led to these lower alpha scores. Coefficients ranged from 0.32 to 0.92 with a median of 0.84. On this evidence, the internal consistency of the CSI appears to be excellent. It can be seen that test-retest coefficients, estimating temporal stability, were computed for four of the samples. In each case, the coefficient is high, ranging from 0.78 to 0.92, which strongly suggests that scores on the CSI tend to be consistent over time, all other things being equal.

Validity[1]

The validity of an instrument is the extent to which it measures what it is supposed to measure. In evaluating a psychological test, there is particular concern with construct validity and criterion validity. Construct validity is the degree to which the instrument measures the theoretical variable or construct that it was intended to measure. Criterion validity is how far it correlates with variables with which it would be expected to correlate. These criteria may be assessed at the same time as the instrument is administered (providing evidence of concurrent validity) or on a subsequent occasion (providing evidence of predictive validity).

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Construct Validity

Variables with which the CSI would be expected to be associated on theoretical grounds fall into three categories: cognitive/learning styles, personality and ability.

Cognitive/Learning Styles[1]

Table 4 highlights seven separate studies of the relationship between CSI scores and other measures of cognitive/learning styles. Our own survey of management students (Allinson and Hayes, 1996) revealed that a CSI analysis orientation correlated positively with the analysis dimension (learning through reflection and reason), and negatively with the action dimension (learning from immediate insight resulting from experience), assessed by Honey and Mumford's *Learning Styles Questionnaire*. Sadler-Smith (1999b), using Entwistle and Tait's *Approaches to Learning Inventory*, discovered that the more analytic the CSI scores of a cohort of business students, the more likely they were to favour deep and strategic approaches to learning. Backhaus and Liff (2007b), administering the same inventory to an equivalent group of US students, confirmed these findings as well as demonstrating a relationship between analytic thinking and metacognitive awareness (the ability to regulate and self-monitor one's level of learning). Sadler-Smith (1999a) also found that the more analytic the scores of a different group of business and management students on the CSI, the more reflective and individual-oriented their styles as measured by the *Instructional Preference Inventory*. Arikian's (2001) study of US college students confirmed a clear relationship between intuition indicated by the CSI and the intuitive decision making style measured by Agor's (1986) scale. A study of Turkish undergraduate business students (Tanova, 2003) showed that those with analytic CSI scores were more likely to prefer teacher-dependent and collaborative modes of learning. Finally, Vance *et al* (2007), using their self-developed *Linear-Nonlinear Thinking Style Profile* with another group of US business administration students, discovered that the more analytic their CSI scores, the more likely respondents were to rely on external information sources and linear decision making, and the more intuitive their CSI scores, the more likely they were to prefer internal information sources and nonlinear decision making. It is also noteworthy that Evans, Harking and Young's (2008) application of Evans' *Teaching Styles Questionnaire* with Canadian public school teachers showed that analytic CSI scores were consistent with a structured, formal and cautious (but less sociable) approach to teaching.

[1] Parts of this section draw upon the paper Allinson, C. W. & Hayes, J. (1996). The Cognitive Style Index: A measure of intuition-analysis for organisational research. *Journal of Management Studies*, *33*, 119-135. Used with permission of the publisher.

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Table 4: Relationships between the CSI and other measures of cognitive/learning/ teaching style

(listed in alphabetical order by author then date of publication)

Source	*Sample*[1]	*Correlate*	*n*	*r* (or *t*†)
Allinson & Hayes (1996)	Management students	Learning styles (Honey & Mumford's *Learning Styles Questionnaire*)	190	
		Action		-.81***
		Analysis		.33***
Arikian (2001)	US college students	Intuitive decision making style (Agor's *AIM Survey*)	106	-.67***
Backhaus & Liff (2007)	US business students	Preferred approaches to studying (revised version of Entwistle & Tait's *Approaches to Studying Inventory*)	222	
		Deep approach		.22**
		Surface approach		.09
		Strategic approach		.36**
		Metacognitive		.19**
		Lack of direction		-.05
		Academic self-confidence		.07
		Collaborative		-.07
Evans, Harkins & Young (2008)	Canadian public school teachers	Teaching styles (Evans' *Teaching Styles Questionnaire*)	122	
		Structure		.30**
		Formality		.41***
		Caution		.68***
		Sociable		-.25**
Sadler-Smith (1999a)	Business & management students	Learning preference (*Instructional Preference Inventory*, self developed)	226	
		Active		.05
		Reflective		.32***
		Individual		.25***
Sadler-Smith (1999b)	Business students	Learning preference (Entwistle's *Approaches to Studying Inventory*)	130	
		Achieving		.24**
		Meaning		.28**
		Reproducing		-.04
		Collaborative		-.13
Tanova (2003)	Turkish undergraduate business students	Learning preference (self developed measure)	127	
		Dependence		.20*
		Independence		ns
		Collaboration		.20*
Vance, Groves, Paik & Kindler (2007)	US business administration students	Thinking styles (*Linear-Nonlinear Thinking Style Profile*, self developed)	80	
		External information sources		.31**
		Inner information sources		-.25**
		Linear decision making		.37**
		Nonlinear decision making		-.35**

[1]Samples are British unless otherwise stated

*** $p < .001$

** $p<.01$

* $p<.05$

ns Not significant at the .05 level

(2-tailed tests)

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Personality

Table 5 summarises the results of seven independent studies of the relationship between CSI scores and aspects of personality. An investigation of construction managers (Allinson & Hayes, 1996), using Cattell's *16 Personality Factor Questionnaire* demonstrated a link between analytic thinking, in CSI terms, and submissiveness, conscientiousness, shrewdness, following self image, introversion and subduedness, and between intuitive thinking and dominance, expediency, forthrightness, undisciplined self-conflict, extroversion and independence. The correlation between the CSI and data obtained using the *Myers-Briggs Type Indicator* (MBTI) was also examined for a group of participants in a human relations training workshop (Allinson & Hayes, 1996). In this case, the dichotomous categories deriving from the MBTI were converted to continuous scales for the purposes of correlation. In light of the results of similar studies, it was hypothesised that CSI scores would correlate positively with the introversion and thinking poles, and negatively with the intuitive and perception poles of the four MBTI scales. Findings confirmed these expectations so that analytic thinkers appear likely, on the basis of Hirsh and Kummerow's (1989) interpretation of the MBTI, to prefer a work setting which is quiet, private and impersonal, oriented towards careful routines, governed by logic, and clearly structured and organized while intuitive thinkers will prefer a setting which is activity oriented, offers new experiences, provides opportunities for relationships and is flexible and open to change. These findings were corroborated by Vance *et al* (2007) in their study of US business administration students in respect of the sensing and intuitive poles of MBTI dimensions, but not the feeling and thinking poles. In a further study of business students (Allinson & Hayes, 1996), a weak but significant correlation was found between CSI scores and bureaucratic orientation as measured by Gordon's *Work Environment Preference Schedule.* This suggests that analysts will subscribe to the bureaucratic norm and prefer specific guidelines to follow, favour formal work relationships, value the security of organisational identification and be prepared to accept authority while those with an intuitive style are more likely to prefer freedom from rules and regulations, favour personalized relationships, avoid close commitment to the organization and be prepared to question authority. In a study of top managers in Spanish small/medium size businesses, Acedo and Florin (2007) discovered that the more intuitive the CSI score the greater the individual's tolerance of ambiguity and disposition to be proactive. Similarly, in the education sector, Zarankin (2009), in a survey of US upper level management undergraduates, found analytic thinking to be associated with an orientation towards learning avoidance (owing to factors such as fear of failure and low self determination) and dishonesty (specifically, giving false information in negotiations). On the other hand, Mitteness, Cardon and Sudek (2010) highlighted the fact that low (intuitive) CSI scores correlated significantly with preparedness, extraversion and regulatory focus (each assessed using existing or self-developed measures) while Chaffey, Unsworth and Fossey (2012) in administering the *Swinburne University Emotional Intelligence Test* to Australian occupational therapists in the mental health sector, found a clear link between emotional intelligence and an intuitive orientation on the CSI. This held for all

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subscales, *viz.* emotional recognition and expression, understanding external emotions, direct cognition of emotions, emotional management and emotional control.

Table 5: Relationship between the CSI and personality

(listed in alphabetical order by author then date of publication)

Source	***Sample***[1]	***Correlate***	***n***	***r* (or *t*†)**
Allinson & Hayes (1996)	Construction managers	Personality (Cattell's *16PF Questionnaire*)	64	
		Submissive-dominant		-.34***
		Expedient-conscientious		.39***
		Forthright-shrewd		.30**
		Undisciplined self-conflict-following self image		.45***
		Introversion-extroversion		-.22*
		Subduedness-independence		-.31**
Allinson & Hayes (1996)	Business students	Bureaucratic orientation (Gordon's *Work Environment Preference Schedule*)	62	.27*
Allinson & Hayes (1996)	Workshop participants	Personality (*Myers-Briggs Type Indicator*)	20	
		Extroversion-introversion		.57**
		Sensing perception-intuitive perception		-.45*
		Feeling judgement-thinking		.57**
		Judgement-perception		-.41*
Acedo & Florin (2007)	Top managers of Spanish small/medium size businesses	Tolerance of ambiguity (Lorsch & Morse's scale)	218	-.15*
		Proactive disposition (Sitkin & Weingart's scale)		.25*
Chaffey, Unsworth & Fossey (2012)	Australian occupational therapists	Emotional intelligence (Palmer & Stough's *Swinburne University Emotional Intelligence Test*)	124	
		Emotional recognition and expression		-.33**
		Understanding emotions, external		-.29**
		Emotions direct cognition		-.56**
		Emotional management		-.49**
		Emotional control		-.24**
		Overall		-.56**
Mitteness, Cardon & Sudek (2010)	US 'angel' investors	Personality (various existing and self developed measures)	240	
		Enthusiasm		-.11
		Preparedness		-.17*
		Social perception		-.09
		Extraversion		-.22**
		Neuroticism		-.03
		Regulatory focus		-.19**

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Vance, Groves, Paik & Kindler (2007)	US business administration students	Personality (*Myers-Briggs Type Indicator*)	80	
		Sensing		.48**
		Intuitive		-.45**
		Feeling		.05
		Thinking		-.02
Zarankin (2009)	US upper level Management undergraduates	Learning avoid orientation (e.g. fear of failure, low self determination)	120	.24**
		Deceit (giving false information during negotiations)		.23*

[1]Samples are British unless otherwise stated

*** $p < .001$
** $p<.01$
* $p<.05$
ns Not significant at the .05 level
(2-tailed tests)

Ability

The only study of the relationship between CSI scores and ability has been a survey of the performance of 201 business and economics students on the Watson-Glaser Critical Thinking Analysis test (CTA) Form C (Allinson & Hayes, 1996). Bearing in mind Kirton's (1978) assertion that there is an orthogonal relationship between cognitive style and ability, it was hypothesised that the correlation between CSI and CTA scores would be close to zero. The statistically significant negative correlations in respect of all but one of the five CTA subtests (inference, recognition of assumptions, deduction and interpretation) were, therefore, contrary to expectations. Notwithstanding Kirton's contention, however, it might be argued that analysts would perform relatively well on the CTA, since it is purported to measure 'careful, analytical reasoning' (Watson & Glaser, 1991), and that correlations would be positive. An explanation of the actual findings may be that the imposition of a 40-minute time limit favoured the ability of the intuitivist to apply rapidly previously developed frames of reference, and disadvantaged the more cautious and systematic analyst.

Concurrent Validity

If the CSI has concurrent validity, it should be capable of discriminating between groups which are presumed to differ in cognitive style. Areas that have received particular attention from researchers are gender, job level, occupation, culture and entrepreneurship.

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Gender

Although there has been a long Western tradition of viewing rational thinking as masculine and intuition as feminine (Hayes, Allinson & Armstrong, 2004), surveys conducted before the development of the CSI produced varying results, some confirming the stereotype of female intuition (e.g. Agor, 1986), others suggesting that men may be more intuitive than women (e.g. Kirton, 1989). Table 6 shows that among 32 studies comparing gender differences in CSI scores, 13 yielded statistically significant differences, females scoring higher (more analytic) than males in all cases. It is noteworthy, however, that all but two of these involve student samples (all undergraduates) while 11 of the remaining 19 focus mainly on managerial and professional groupings. In eight cases, the raw CSI scores of women are, in fact, lower (more intuitive) than those of the men with whom they were compared. In broad terms, it may be reasonable to conclude that cognitive style differences between men and women at university are diluted, or even reversed, when individuals enter the management roles or professions for which they have been educated. In a previous review of gender comparison studies using the CSI (Hayes, Allinson & Armstrong, 2004), it was concluded that findings support the 'structural' and 'gendered culture' approaches to understanding behaviour in organisations. The structural perspective argues that work behaviour of men and women is shaped by factors that relate to male domination of the opportunity and power structures in organisations rather than by organisational members' individual characteristics. The gendered culture perspective suggests that women conform to the male values that dominate organisational cultures and define appropriate behaviour.

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Table 6: CSI scores by gender

(listed in alphabetical order by author then date of publication)

Source	*Sample*[1]	*Male*			*Female*				
		n	*M*	*SD*	*n*	*M*	*SD*	*df*	*t* (or *F*†)
Allinson & Hayes (1996)	Management students	106	36.32	15.56	109	43.84	14.02	213	3.73***
Allinson & Hayes (1996)	Brewery managers	121	41.21	12.21	105	45.62	11.66	224	2.77**
Allinson & Hayes (1996)	Teachers	15	35.73	10.36	59	44.27	13.69	72	2.25*
Allinson & Hayes (1996)	Business students	133	40.26	12.82	68	44.34	10.42	199	2.27*
Allinson & Hayes (1996)	Miscellaneous managers	89	40.62	12.11	41	37.00	13.01	128	1.54
Allinson & Hayes (2000)	Russian managers	37	44.51	9.54	34	43.56	9.86	69	0.41
Allinson & Hayes (2000)	Singaporean managers	50	40.12	12.97	31	44.00	12.58	79	1.32
Allinson & Hayes (2000)	Australian management students	38	39.13	9.90	47	38.15	12.85	83	0.40
Allinson & Hayes (2000)	German management students	19	31.11	10.71	17	40.71	10.20	34	2.75*
Allinson & Hayes (2000)	Management students	70	37.39	13.99	58	44.00	11.36	126	2.90**
Allinson, Chell & Hayes (2000)	Entrepreneurs	130	34.28	13.87	19	30.26	14.60	147	1.17
Atay & Artan (2005)	Turkish postgraduate business students	78	44.81	6.90	74	44.19	6.22		0.34†
Armstrong, Allinson & Hayes (2004)	Management students	218	41.23	11.66	203	44.32	11.72	419	2.71**
Backhaus & Liff (2007)	US Business students	104	39.15	8.28	118	44.67	12.28		3.87**
Doucette *et al* (1998)	Canadian law students	124	41.79	13.51	160	45.20	13.11	1	4.58†*
Doyle, Fisher & Young (2002)	Canadian entrepreneurs	64	43.50	14.50	52	42.30	14.00	1, 114	0.18†
Fitzgerald & Young (2002)	Canadian EMBA/MBA students	67	37.70	11.90	55	37.9	11.70	6,62	0.01†
Hayes, Allinson & Armstrong (2004)	Mangement students in a new university	128	41.23	11.66	203	44.32	11.72	419	2.71**
Hill *et al* (2000)	Managers and staff	24	40.33	15.15	24	39.50	13.59	46	0.20
Hill *et al* (2000)	Finnish managers and staff	52	43.60	12.82	42	42.48	15.53	92	0.38
Hill *et al* (2000)	Polish managers and staff	94	43.14	11.86	49	39.78	10.90	141	1.65
Lofstrom (2005)[2]	Finnish employees	101	41.85	11.93	107	43.71	10.46	206	1.19
MacGillivary (1999)	Canadian tourism/hospitality students	13	37.20	10.50	96	42.80	12.50	107	1.53
Meric & Capen	US undergraduate business students	162	40.40	10.90	124	44.20	11.70	284	2.83**

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Moore, O'Maiden & McElligott (2003	Irish computer systems students	111	42.67	11.61	34	45.50	10.72	58.7	1.32
Murphy, Doucette *et al* (1999)	Canadian lawyers	344	45.96	12.83	180	47.07	12.15	1, 522	0.93†
Murphy *et al* (1998)	Canadian business students	33	39.40	10.20	53	44.40	12.20	1,87	3.87†*
Murphy, MacGillivary *et al* (1999)	Canadian business, tourism & hospitality students	60	42.60	10.98	185	44.80	11.33		1.68†
Pereira (2011)	Public sector professionals	46	39.50	12.93	38	43.37	12.29	82	1.40
Sadler-Smith (1999a)	Business & management students	128	43.27	9.56	98	45.41	9.69	224	1.67*
Sadler-Smith, Allinson & Hayes (2000)	Human resource professionals	48	36.48	14.29	67	39.01	14.62	119	0.95
Tanova (2003)	Cypriot business administration students	75	44.40	8.20	52	45.80	8.10	125	0.90

[1]Samples are British unless otherwise stated

[2]Item scores converted from 5-point to 3-point scale

*** $p < .001$
** $p<.01$
* $p<.05$
(2-tailed tests

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Job level

Mintzberg's (1976) hypothesis that intuition increases with seniority has found favour in the literature, the general view being that the uncertainty and time pressures associated with higher management positions call for a decisive, experience-based approach rather than elaborate analysis. Table 7 provides empirical support for this idea with senior managers scoring higher on intuition than junior colleagues in five of the eight studies in which the CSI was adopted. Whether appointment or promotion to relatively senior positions is due to selective recruitment of those who think intuitively, or the adoption of an intuitive cognitive style in response to the demands of these positions, has yet to be determined.

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Table 7: CSI scores by job level

(listed in alphabetical order by author then date of publication)

Source	*Sample*[1]	*Job levels*	*n*	*M*	*SD*	*Significance level*
Allinson & Hayes (1996)	Construction managers	Directors & senior managers	23	35.04	13.90	*P*<.05
		Middle & junior managers	41	41.20	41.06	
Allinson & Hayes (1996)	Brewery managers	Senior & middle managers	109	40.75	11.59	*P*<.01
		Junior managers & supervisors	115	45.67	12.27	
Atay & Artan (2000)	Turkish postgraduate business students (managers)	High income	72	44.78	5.73	
		Medium income	53	43.25	6.60	*P* >.05
		Low income	26	46.73	7.95	
Chaffey, Unsworth & Fossey (2012)	Australian occupational therapists	1 Experienced[3]	83	34.07		
		2 Intermediate	24	38.79		*P*<.05
		3 Novice[1]	26	45.71		
Fitzgerald & Young (2002)	Canadian EMBA/MBA students	Upper managers	13	36.90	12.52	
		Middle managers	29	37.10	11.30	*P* >.05
		Lower managers	18	34.60	12.70	
Lofstrom (2005)[2]	Finnish employees	1 Executives/Managers [2,3]	74	37.53	12.64	
		2 White collar employees [1]	51	43.78	10.66	*P*<.001
		3 Blue collar workers [1]	83	46.78	8.14	
Murphy, Doucette *et al* (1999)	Canadian lawyers	Partners	172	47.14	12.84	*P* >.05
		Associates	121	46.85	12.42	
Sadler-Smith, Spicer & Tsang (2000)	Local government employees	1 Senior managers	62	33.94	10.80	
		2 Middle managers	130	39.11	13.24	*P*<.001
		3 First line managers	113	41.24	13.64	
		4 Staff	196	46.65	12.28	

[1]Samples are British unless otherwise stated

[2]Item scores converted from 5-point to 3-point scale

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Occupation

It might be expected that through selective recruitment or socialization there will be differences in cognitive style between those employed in different occupations or job functions as a result of varying degrees of uncertainty and volatility in their working environments (Agor, 1986). In a study of managers across a range of organisations (Allinson & Hayes, 1996), personnel managers were significantly more intuitive than production, marketing and financial managers. This is consistent with findings reported by Kirton (1989), who concluded that personnel managers tend to have a relatively innovative (cf. intuitive) orientation, and those of Agor (1986) whose study revealed that people working in organizational development, a sub-function of personnel, are significantly more intuitive than financial managers. Although there have been no studies comparing occupations directly, mean CSI scores for the samples listed in Appendix 1 suggest that those likely to favour relatively divergent, unconstrained thinking (e.g. entrepreneurs and employees in the creative arts) tend to score towards the intuitive end of the CSI scale while those likely to adopt a more disciplined, systematic approach (e.g. accountants and lawyers) tend towards the analytical pole.

Culture

International differences in cognitive style have traditionally been seen in terms of an East-West dichotomy. According to Redding (1980), Western thinking tends to be analytical with a focus on the sequential links between cause and effect whereas the Eastern approach is inclined toward an intuitive examination of the whole universe of events as a system of interdependent parts. In order to test this proposition, a number of separate studies were conducted based on managers (n = 394) and students (n = 360) from ten countries representative of all categories in Hickson and Pugh's (1995) classification of national cultures (Allinson & Hayes, 2000). Among managers, UK respondents were more intuitive (had lower CSI scores) than those from India, Jordan, Nepal, Russia and Singapore respectively. It was also found that respondents from Singapore were more intuitive than those from Jordan and Nepal. Among students, the findings suggested that German males were more intuitive than males from Australia, France, Hong Kong and the UK, and that British females were more analytic than females from Australia and France. It is noteworthy that, among the UK groupings, whereas there was no significant difference between the CSI scores of male students and male managers, female students were significantly more analytic than female managers, a finding consistent with previous evidence concerning gender (see above). Overall, it seemed that the most intuitive groups were located in Pugh and Hickson's Anglo, North European and European Latin categories while the most analytic were in the Developing Countries and Arab categories.

It can be concluded that it may be more fruitful to categorise countries in terms of their stage of industrial development rather than the hemisphere in which they are located. At the time of the survey, organisations in the developing nations still tended to resemble traditional bureaucracies

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capable of responding to relatively stable external environments, and requiring rational (analytical) approaches to decision making. Those in advanced economies, on the other hand, had experienced a shift towards post-bureaucratic structures demanding rapid, holistic (intuitive) management thinking. Results of subsequent studies are consistent with these findings. Sadler-Smith, Spicer and Tsang (2000) discovered that the CSI scores of owner-managers from Hong Kong were higher (more analytic) than those of their UK counterparts. Savvas, El-Kot and Sadler-Smith (2001) found that the scores of postgraduate management students from Hong Kong and Egypt were higher than an equivalent group from the UK. Papavero (2005) highlighted the fact that Chinese software engineers were more analytic than US software engineers. Zhang (2005), in a study of students commencing masters degrees in a British business school, observed that the mean CSI score for those from China was higher than that for their UK colleagues, a difference that was maintained when the comparison was replicated six months later. And Wraight (2006) found that, among undergraduate students at a US university, Asian-Americans were more analytic than Latinos.

Entrepreneurship

Apart from gender, the area that has received most attention from researchers using the CSI is entrepreneurship. A study by Allinson, Chell & Hayes (2000) revealed that owner-managers of high growth firms were significantly more intuitive than managers in the general population, a finding consistent with the idea that intuition is a necessary quality for those operating in an environment characterised by incomplete information, time pressure, ambiguity and uncertainty. It was also found, however, that this difference disappeared when scores were compared with those of senior managers and executives specifically. In relatively pressured work settings, they too, it seems, need to achieve intuitive leaps in order to grasp the whole problem. The tendency for entrepreneurs to exhibit an intuitive style was corroborated by Brigham and Sorenson (2008) who obtained lower CSI scores for founding owner-managers of US high-technology firms than for members of the general population and for managers in large organisations. Similarly, Armstrong and Hird (2009) found that individuals who had demonstrated the ability to create a business venture were more intuitive than members of the UK population in general. Another approach has been to examine the relationship between cognitive style and entrepreneurial drive, a personality dimension comprising elements of innovation, risk taking, cognition and strategic posture. Using the *Carland Entrepreneurial Index*, a popular measure of the construct, both Doyle, Fisher and Young (2002) and Armstrong and Hird (2009) report statistically significant, negative correlations with CSI scores, thus demonstrating an association between intuitive thinking and the tendency towards entrepreneurship. Other researchers have reported evidence to suggest that the most experienced entrepreneurs are more intuitive than those who are relatively inexperienced. Brigham and Sorenson (2008) in the USA, for example, found among family business owners that portfolio entrepreneurs (owners of two or more businesses simultaneously) and serial entrepreneurs (owners of a series of businesses, one at a time)

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were more intuitive than novice entrepreneurs (those with no previous experience) while among founding owner-managers of high-technology firms, portfolio entrepreneurs were more intuitive than novice entrepreneurs. Similarly, Bolanos (2007) found that Mexican entrepreneurs at the pre-incubation (planning) and incubation (startup) stages of business development were less intuitive than those running established businesses in the post-incubation period.

Another area of research is that pursued by Brigham and his colleagues in the USA who examined the impact of the interaction between cognitive style, measured by the CSI, and various organisational factors on workplace outcomes. In a study of family business owners, Brigham, Sorenson and Di Castro (2004) found that cognitive fit/misfit (congruence/incongruence between cognitive style and firm formalisation) affected owner job satisfaction, intention to exit and perceived fit on skills and abilities. Positive outcomes occurred for those who were analytic in more formal work environments, and those who were intuitive in less formal work environments. In a subsequent study of owner-managers of small high-technology firms, Brigham, Di Castro and Shepherd (2007) obtained similar findings with regard to the effect of congruence/incongruence between cognitive style and organisation structure on job satisfaction and intention to exit. In this case, however, they also found that both satisfaction and intention to exit were significantly associated with actual turnover (principal no longer with the firm) over a five-year period. Later, Brigham and Mitchell (2010), again in a study of owner-managers of technology-oriented SMEs, found that cognitive style, level of formalisation and their interaction (cognitive fit/misfit) were significantly associated with firm growth over the five-year period. It was shown, for example, that the more intuitive the owner-manager's cognitive style, the higher the growth, while at higher levels of formalisation, firms with more intuitive founders had greater growth than firms with more analytic founders.

Additionally, Acedo and Galan (2011), in a study of Spanish small business owner-managers, demonstrated that the more intuitive the cognitive style, the greater the tolerance of ambiguity and tendency towards proactivity while Van den Top (2010), in a survey of Dutch SMEs, found that the more analytic the chief executive, the more the parent firm pursued exploitation (improving existing products) and ambidexterity (the combination of exploitation and innovation with new products).

Other correlates

Concurrent validity has also been demonstrated through other correlational evidence. Hypothesised relationships between CSI scores and a number of variables were examined (Allinson & Hayes, 1996). Analytic thinking was found to be associated with job satisfaction at the relatively bureaucratic junior levels in a brewing company and perceived warmth of job climate among female teachers involved in routine basic grade work in primary schools. Intuitive thinking, on the other hand, was more evident among older, more experienced managers across a range of organisations. Intuition was also found to

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be associated with task-centred and socio-emotional behaviours during the application of Bales' interaction process analysis (Armstrong & Priola, 2004), and with industry-related knowledge and the comprehension mode of information acquisition among US technology professionals (Corbett, 2007). In contrast, an analytic orientation was linked to transactional leadership style among Australian female managers (Downey, Papegeorgioua and Stough, 2006), and positive reactions to structured job interviews in a sample of Taiwanese employment interviewers (Chen, Tsai & Hua, 2008). Finally, in a study of the decision making performance of young adults in Hong Kong, Fan (2008) discovered that analytic thinkers sought more information, processed decisions more quickly and had more confidence in their decisions than their intuitive colleagues. The latter, however, were more accurate in their rating of items and more flexible in their decision making.

Predictive Validity

Academic performance

It is perhaps inevitable, given the widespread assessment of cognitive and learning styles among students, that academic performance has been a key criterion when CSI scores have been used as predictors. On the whole, the evidence is clear cut: regardless of the subject taught, analytic thinkers score more highly than their intuitive colleagues. This proved to be the case in surveys of grade point averages of US business students (Backhaus and Liff (2007b) and Hong Kong undergraduates (Ma, Sun & Ma, 2012), and in an analysis of state examination results of Irish tourism/hospitality students (Moore, O' Maiden & McElligott, 2003). In a more detailed study of psychology students, Smith and Whitley (2002) examined assessment outcomes under different modes of learning. Results showed that analysts performed significantly better than intuitives when the mode of delivery was CD-ROM, web-supported learning or web-based independent learning. The only case in which intuitive thinking prevailed was when students were taught by means of lectures accompanied by e-mail summaries, an unexpected finding bearing in mind the usual preference of analytic thinkers for structured methods of delivery. In a similarly wide ranging analysis, Armstrong (2000) examined assessment grades for academic modules as well as overall degree results for management and business administration undergraduates. As expected, analytic thinkers achieved higher grades for long-term, solitary tasks involving careful planning and analysis of information. Contrary to expectations, however, they also performed better than their colleagues with lower CSI scores on tasks believed to be more suited to an intuitive style. This pattern was repeated for final degree class. The reason for the general tendency of high scorers on the CSI to outperform their intuitive colleagues is not clear although it potentially owes something to the nature of assessment tasks in modern education.

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Medical prognosis

Other evidence of the predictive validity of the CSI has been provided by Ruikes-van der Ploeg (2011) in her longitudinal study of 29 patients admitted to a Dutch rehabilitation centre with acquired brain damage. The research focused on the evaluation of predictors of recovery that were measured before a treatment period of eight weeks of cognitive rehabilitation with respect to communication, psychosocial adjustment and cognitive function. It was found that analytical thinkers had the highest motivation for treatment, and that CSI score was the key predictor of psychological adjustment (the more analytic the patient, the better the adjustment). Findings led to the conclusion that "... application of the CSI in future investigation of learning and rehabilitation in patients with acquired brain injury is recommended". The study is in the process of being replicated with a larger sample (Ruikes-van der Ploeg, 2012).

Impact

The CSI has been used in hundreds of studies ranging from those conducted for PhD and Masters degrees to major, funded research projects. It has also been applied in a number of practical settings. There is substantial evidence to suggest that it may now be regarded as the leading instrument of its type.

Psychometric properties

The CSI was top-rated in a widely publicised review of learning and cognitive styles conducted by Coffield *et al* (2004) for the Learning and Skills Development Agency, a UK government-sponsored body. In their survey of 71 theoretical models developed over a period of around 50 years, they conducted a detailed evaluation of the 13 most well known and most promising measuring instruments associated with those models, drawing on empirical evidence obtained by investigators who were independent of their originators. They found the CSI to have "the best psychometric credentials" (Coffield *et al*, 2004), and to be the only one that "can be trusted to give statistically meaningful and consistent results" (Moseley, 2004). Table 8 shows that the CSI alone met all key psychometric criteria. Coffield himself (quoted in Stringer, 2005) describes it as the "most robust" of all those available, and "well regarded as a means of asking pertinent questions about how adults think, behave and learn in the world of work".

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Table 8: Thirteen learning styles models matched against minimal criteria

	Internal consistency	Test-retest reliability	Construct validity	Predictive validity
Jackson's Learning Styles Profiler	-	-	-	-
Riding's Cognitive Styles Analysis	×	×	×	×
Sternberg's Thinking Styles Inventory	×	×	×	×
Dunn and Dunn's instrument of learning styles	×	×	×	✓
Gregorc's Style Delineator	×	×	×	✓
Honey and Mumford's Learning Styles Questionnaire	×	✓	×	×
Kolb's Learning Style Inventory	-	✓	×	×
Entwistle's Study Skills Inventory For Students	✓	-	✓	×
Herrman Brain Dominance Instrument	-	✓	✓	-
Myers-Briggs Type Indicator	✓	✓	×	×
Apter's Motivational Style Profile	✓	✓	-	✓
Vermunt's Inventory of Learning Styles	✓	✓	✓	×
Allinson and Hayes' Cognitive Style Index	✓	✓	✓	✓

✓ Criterion met **×** Criterion not met **-** No evidence either way or issue still to be settled

The evaluation in all cases is 'external', meaning an evaluation which explored the theory or instruments associated with a model and which was not managed or supervised by the originator(s) of that model.

Source: Coffield, F., Moseley, D., Hall, E. & Ecclestone, K., *Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review*, London: Learning and Skills Research Centre, 2004. Reproduced with permission.

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Research applications

A review of cognitive style research in the two decades up to 2007 (Cools, Armstrong & Sadler-Smith, 2010) revealed that the CSI "has been used very intensively after its publication in 1996", and was the most widely adopted measure of all in academic studies, being applied in 26 per cent of those reported in peer reviewed journals. It should be borne in mind that the instrument was available to investigators for only 12 years of the period covered by the survey, and that its adoption appears to have gained momentum in recent years with the likelihood that its share of research applications has increased significantly since 2007. In a further review of the distribution of individual papers presented at the Education, Learning, Styles, Individual differences Network (ELSIN) conference of 2009, Evans, Cools and Charlesworth (2010) found that in almost a third of the empirical studies reported, the CSI was the preferred choice of instrument for the measurement of cognitive style.

Practical applications

Managers, consultants and educationalists have used the CSI in a variety of practical settings. A number of examples are provided below.

Ladbrokes, a British-based betting and gaming company and the largest retail bookmaker in the world, has used the CSI to help develop its trading team which includes traders, odds compilers and liability managers. They are all very competent specialists with an encyclopaedic knowledge of, and a passion for, particular sports which enable them to determine odds (prices), continually modify these odds, and manage liabilities leading up to the start of an event. The company has found that the trading skill set has changed with the advent of new developments such as bet-in-play, which offers odds on 'immediate' outcomes as an event is in play (such as the outcome of a single game in tennis, a corner kick in soccer or an 'over' in cricket) and spread betting. A major change for many members of the team has been the transformation of their role into a true 'trader' role which involves creating markets and then trading those markets using whatever methods are available, including betting exchanges. A workshop explored how cognitive style could affect trader performance. The first step involved members of the trading team reviewing the nature of the tasks they performed. They discovered that while there were some elements of their work that were well defined and involved a careful rational analysis of data, there were others that involved making decisions in fast changing, complex situations where there was never sufficient time to collect and analyse all the facts. They also recognised that the trend was for more of their work to involve rapid decision making in circumstances where there were few hard facts and/or insufficient time for careful analysis. The second part of the workshop involved looking at how members of the team were responding to this shift. Some reported that they often had a sense of what was required and that they were prepared to act on this sense of knowing, but others reported that they did not feel comfortable acting on such gut feelings in case they were nothing more than ill-informed guesses. This led to a discussion of

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the role of analysis and intuition and the steps that team members could take to make better use of their intuitions. Some of the steps they considered included paying more attention to intuitions and keeping a log of 'gut feelings' in order to monitor their reliability.

The *Open University*, the leading distance learning university in the UK, has used the CSI with over 1500 students on the learning unit 'Understanding Systems: Making Sense of Complexity' to help them move away from a reductionist, anthropocentric way of thinking towards a more holistic and eco-centric worldview. The course director reports that the first part of block 2 of the unit emphasises the use of intuition, visual communication and surfacing values as key skills required in the initial exploration of complex situations (Berardi, 2011). One of the first activities invites students to explore their personal cognitive style (using the CSI) to prepare them to go beyond a logical approach to modelling complex situations. In subsequent activities, students engage with significant amounts of factual information and are encouraged to allow intuitive faculties to reveal relational patterns and explore these through discussions with fellow students. Later activities converge on more rational, mathematical and analytical skills in order to support (or question) intuitive insights. An outcome of this learning process is that students come to appreciate that the maintenance of an appropriate balance between qualitative, intuitive sense making and quantitative data analysis and validation can make a positive contribution to their thinking about systems.

A public sector support unit, based in a university, provides a range of complex intelligence products to support evidence based analysis. The unit also provides education and training to undergraduates, postgraduates and a range of professionals in the field. It is staffed by a multidisciplinary team with specialist expertise in a variety of functions. The widespread evidence of the reliability and validity of the CSI prompted the director to use it for assessing the thinking styles of the team as part of the activities planned for an initial 'away day'. Objectives were to understand the team as individuals and how their modes of thinking impact upon the team as a whole; explore the unit's culture and values; examine the roles within the team; explore and agree better ways to work as team; and use the CSI and other psychometric tools to help address objectives. The CSI gave individual team members insight into their own cognitive style, so that each gained a better understanding of how they gather, process and evaluate information, and how this preference affects how they learn, solve problems and make decisions. Because members shared the profiling results with each other, they were able to understand better the variation of cognitive style within the team and how this affected the way individuals worked together. The CSI also highlighted development needs for some individuals in that in order to be successful in

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a team whose core business is rigorous, systematic analysis and evaluation, those at the more intuitive end of the spectrum need to work hard at developing more analytical approaches to their work. This knowledge gave senior managers a better understanding of some of the managerial challenges inherent in managing those whose cognitive style is largely intuitive.

At *Marquette University, Milwaukee, Wisconsin, USA* the Executive MBA degree caters for a wide range of managers and professionals including, in recent years, finance and accounting personnel, customer service specialists, doctors (MDs), veterinarians, airline pilots, a college professor, a dentist and IT staff. At the outset, students are allocated to cohort groups in which they remain for the entire 17-month, full-time programme. An initial 'immersion week' involves the teaching of team building to assist in getting students up and running in their cohort groups. It also includes completion of the CSI and the NEO-FFI personality inventory. Students discuss their personal results on both instruments within groups, and, on that basis, seek to identify potential strengths and weaknesses for the group as a whole. They also identify possible remedies for the resolution of issues that are thought likely to develop. The discussion forms the basis of a team report to be submitted at the end of the first semester which includes the results of the psychometric exercise, events during the semester, the handling of problems and goals for the next phase. Individual students also submit a personal reflection in which they analyse their own contributions and challenges with the team during the semester, and develop goals for addressing them in the next period. Student feedback on the CSI is typically very positive with recognition of how their different ways of thinking influence work habits and, potentially, study habits (some students having been out of formal education for a very long period).

A large UK based construction company employed *Miall Campbell Associates Ltd* to run training and personal development programmes for managers and executives, and address specific problems arising in the day to day operation of the organisation. One case concerned the resolution of interpersonal conflict between senior managers. An Operations executive had a very dysfunctional relationship with his Financial 'right hand man' who eventually left the company owing, in large part, to their very poor working relations. Both parties had completed the CSI during a training programme, and it was noted that while the Operations executive scored 30, and would therefore be classed as Quasi-Intuitive, the Financial executive scored 52, thus falling into the Quasi-Analyst category. A replacement Financial executive was recruited, and a similarly dysfunctional relationship began to emerge.

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This new 'right hand man' sought advice from the consultant on how to handle the situation. As a first step, he completed the CSI, and, like his predecessor, proved, with a score of 48, to be a Quasi-Analyst. On this basis, the consultant drew the Financial executive's attention to the difference between intuitive and analytic thinking, and explained that the Operations executive was not deliberately attacking his work and systems, but was simply uncomfortable with the apparently pedantic, analytical approach that contrasted sharply with his own propensity to take risks and rely on 'gut feeling' in situations where rapid decision making or problem solving seemed necessary. The Financial executive developed ways of presenting information and choices in a fashion that was congruent with intuitive thinking, and cultivated his own ability to absorb a large number of ideas at once. The relationship improved markedly thereafter, and the pair worked well together for a number of years.

Translations

Several researchers have translated the CSI for use with respondents whose first language is not English. Known translations include those in Arabic, Chinese, Dutch, Finnish, French, German, Greek, Italian, Norwegian, Polish, Russian, Slovenian, Spanish, Thai and Turkish.

Age of respondents

Although designed for use with adults, the instrument has been administered successfully to high-school pupils as young as 15 years of age (e.g. Song *et al*, 2005).

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Suggested Use[2]

Improving person-job fit

There is evidence to suggest that selection placement and transfer decisions that produce a good fit between cognitive style and the cognitive demands of a job will facilitate the development of the competencies necessary for effective performance. This approach requires both person and job to be assessed in commensurate terms, a process in which the CSI could play a part. Driver (1987) supports this proposition by suggesting that executive jobs which require multi-channel attention patterns to permit the rapid tracking of a great deal of complex information might be performed most effectively by people who have cognitive styles which match this requirement. Robertson (1985) makes a similar point with reference to the link between cognitive style and attention deployment. He argues that some people may be more susceptible to cognitive narrowing and become blind to alternative courses of action when under pressure, and therefore may not be effective when required to respond to a critical situation that requires simultaneous attention to several sources of information (such as a flight deck emergency faced by an airline pilot). He also notes that susceptibility to cognitive narrowing would not inhibit effective performance on some types of tasks which require operators to process information in a serial, step by step fashion and divide their attention between a relatively small number of sensory and motor activities.

The CSI might also have a role to play in career counselling. People may be attracted to those jobs where they feel that they have the abilities necessary to develop the performance skills required to master task demands. In other words, their perceptions of their own cognitive style may influence job preferences. The consequences of choices based on these preferences may be dependent on the accuracy of the individual's assessment of his or her own competencies and assessment of the cognitive demands of the job environment. Career counselling which takes this into account may contribute to both satisfaction and performance.

There will always be situations in which it is almost impossible to achieve an ideal fit between person and job. In these cases, it may be useful to consider the possibility of either changing the cognitive demands of the job or modifying the cognitive competencies of the job holder. Driver (1987) refers to the possibility of altering the demands by providing buffers against factors such as uncertainty and complexity. He suggests, for example, that secretaries could be trained to recognise optimal workloads and shield their managers from overload by acting as filters. Robertson (1985) argues that there is considerable scope for redesigning many computer based jobs to provide a better fit with the cognitive styles of job holders.

[2] Parts of this section draw upon the paper Hayes, J. and Allinson, C. W. (1998). Cognitive style and the theory and practice of individual and collective learning in organisations. *Human Relations*, *51*, 847-871. Used with permission of the publisher.

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Many IT systems have been designed to accommodate a universal model of human-information processing which may be inappropriate for many operators. Robinson refers to the possibility of designing systems which allow operators to select from a variety of operational modes, each of which is designed to match a particular cognitive style.

Another approach to improving the person-job fit is to modify the cognitive style of the organisational member. This not only promises to assist in the development of performance competencies in mis-matched situations, but also offers the possibility of coping with changes (such as new job demands encountered through job transfer, promotion or changes to the current role) that undermine an earlier 'fit'. There has been a long standing debate regarding the extent to which cognitive style is malleable. It has often been regarded as a stable preference for a particular mode of information processing, but Messick (1984) argues that while people learn to use a variety of specialised problem solving and cognitive strategies that are consistent with their general cognitive style, they may also be able to shift to less congenial strategies in order to perform particular tasks. Rush and More (1991) found that it is even possible to *train* people to modify their cognitive style. Those with intuitive cognitive styles were successfully taught to gain access to the restructuring skills brought to problem solving situations by analytics. While there has been little worthwhile research on the malleability of cognitive style, the evidence that does exist supports the possibility of promoting stylistic versatility through training. The CSI provides a means of assessing the extent to which this has been achieved.

Improving the effectiveness of training

Enhanced cognitive outcomes from training may be achieved if the CSI scores of learners are matched with the cognitive style orientation of the cognitive activity. 19 studies (mostly in an educational rather than a work setting) were reviewed which tested this matching hypothesis, and it was found that 12 of them offered support for the proposition that matching has a positive effect on cognitive performance (Allinson & Hayes, 1996). If these results can be replicated in a work setting they will be of interest to training specialists for two reasons: they could provide an explanation for why some trainees perform less well than others of similar ability, and they could offer the possibility of predicting cognitive difficulties. In reporting these findings, attention is drawn to other benefits such as the possibility of developing a range of activities, each designed to offer the same content in a way that matches different cognitive styles, or the design of a single activity that accommodates a range of cognitive styles.

Several studies were also reviewed which indicated that matching the cognitive style of the trainee with the cognitive style of trainer is linked to the development of positive attitudes towards the

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other, and suggested that these findings naturally lead to the question of whether matching for cognitive style would have any effect on learning performance (Allinson & Hayes, 1996). The only studies that have considered this possibility, all conducted in educational settings, found that matching led to improved performance for analytics while mis-matching led to improved performance for intuitives. A possible explanation for this result is that intuitive teachers fail to provide the structure that intuitive learners need.

Improving team composition

Information about team members' cognitive styles and the level of task structure could be used by managers to help them think about team composition. One approach could be to bring together people who have similar CSI scores in order to achieve the kind of match between cognitive style and team tasks that will promote learning and effective team performance. For example, some groups might have to work on structured tasks that require careful attention to detail and high levels of accuracy whereas others might have to work on unstructured tasks, respond quickly and creatively to constantly changing demands and make decisions in circumstances where there is incomplete information. A danger associated with creating homogeneous groups of like-minded people is that they may develop an entrenched way of thinking that could inhibit divergent thinking, and undermine the team's ability to maintain performance when faced with new tasks that might be incongruent with members' cognitive styles. Homogenous teams could, however, be effective over the short term, and therefore be used to help select members of temporary task groups and the like.

Improving interpersonal relationships within teams

A profile of the CSI scores of team members could be used to increase awareness of possible communication difficulties, and help them recognise the value of contributions from others who have a different approach to thinking.
Outcomes of a team discussion to explore the impact of cognitive style on interpersonal relationships might be better communication and improved mutual understanding which, in turn, could have a positive impact on creativity, the quality of decision making and team performance.

Improving task performance of individuals and teams

The CSI could be used to compare an individual's or team's cognitive style profile with the information processing requirements of the tasks that they have to perform. All tasks and problems can be located on a continuum of "structuredness". At one end are unstructured 'judgemental' tasks for which there are no widely accepted decision rules or objective criteria of success, and at the

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other end are ‘intellective’ tasks that involve a definite, objective criterion of success to which well established decision rules can be applied. Intuitive thinking is most effective when applied to unstructured problems. Analytic thinking, on the other hand, is most effective when applied to structured tasks. Where there is a match, it will be easier for the individual or team to attend to and interpret relevant information, and use it to perform effectively. Where there is a mismatch, the individual or some or all team members may fail to attend to or interpret important information and this will undermine performance. How this kind of information can be used in a team context is illustrated by the ‘Ladbrokes’ case cited earlier.

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Appendix 1

Norms and Reliability Data for the Cognitive Style Index

(listed by mean score in descending order)

Source	*Sample* 1	*n*	*Mean*	*SD*	*Alpha*	*Test-retest*
Vallelado González *et al* (2008)	Spanish business administration students	96	54.23	11.02	0.86	
Fan (2008)	Western young adults	50	52.94	7.04		
Sadler-Smith, Spicer & Tsang (2000)	Hong Kong owner-managers	98	50.07	8.9	0.79	
Chen, Tsai & Hua (2008)	Taiwanese employment interviewers	292	48.23	8.84	0.76	
Allinson & Hayes (2000)	Nepalese managers	39	48.07	7.04	0.56	
Allinson & Hayes (2000)	Jordanian managers	38	48.05	8.96	0.73	
So & Smith (2002)	Hong Kong/Australian accounting students & professionals	87	47.6	10.3		
Park & Black (2007)	US biology graduate students	30	47.37	12.84		
Allinson & Hayes (1996)	Workshop participants	22	46.67	16.13	0.92	
Sadler-Smith, Spicer & Tsang (2000)	Local government staff	196	46.65			
Acedo & Galan (2011)	Spanish entrepreneurs (SME owner/managers in export industry)	110	46.63	8.37		
Allinson, Armstrong & Hayes (2001)	Middle/junior managers (electronics)	64	46.53	14.03		
Murphy, Doucette *et al* (1999)	Canadian lawyers	524	46.34	12.68	0.85	
Savvas, El-Kot & Sadler-Smith (2001)	Hong Kong postgraduate public sector management students	18	46.33	11.14	0.85	
Will (2009)	Hong Kong undergraduate freshmen	1203	46.33	8.31	0.74	
Armstrong & Hird (2009)	Managers (non-entrepreneurs)	44	46.2	11.2		
Allinson & Hayes (1996)	Financial managers	13	45.46	13.06		
Bolanos (2007)	Mexican 'pre-incubation' entrepreneurs	28	45.04	7.3	0.57	
Wraight (2006)	US undergraduate students	228	44.99	12.46	0.86	
Tanova (2003)	Cypriot business administration students	127	44.9	8.1	0.69	
Sadler-Smith, Spicer & Tsang (2000)	Business & management students	101	44.6	12.19	0.84	
Hmieleski & Corbett (2006)	US college students	430	44.53	11.85	0.85	
Atay & Artan (2005)	Turkish postgraduate business students	152	44.51	6.56		
Savvas, El-Kot & Sadler-Smith (2001)	Egyptian MBA students	20	44.35	12.47	0.43	
Murphy, MacGillivary *et al* (1999)	Canadian business, tourism & hospitality students	245	44.3	11.26	0.82	
Armstrong (2004)	Management students	118	44.2	11.1		

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Source	*Sample*1	*n*	*Mean*	*SD*	*Alpha*	*Test-retest*
Zarankin (2009)	US upper level Management undergraduates	120	44.1	11.49		
Allinson & Hayes (2000)	Russian managers	71	44.06	9.64	0.78	
Savvas, El-Kot & Sadler-Smith (2001)	Hong Kong postgrad counselling students	29	43.9	11.08	0.84	
Allinson & Hayes (2000)	Indian managers	59	43.83	12.27	0.85	
Doucette *et al* (1998)	Canadian law students	284	43.71	13.37	0.87	
Vance, Groves, Paik & Kindler (2007)	US business administration students	80	43.67	11.69	0.78	
Savvas, El-Kot & Sadler-Smith (2001)	Business & management students	52	43.52	10.96	0.81	
Allinson, Armstrong & Hayes (2001)	Middle/junior managers (engineering)	78	43.36	11.25		
Moore, O'Maiden & McElligott (2003)	Irish computer systems students	145	43.34	11.43		
Sadler-Smith (1999b)	Business students	130	43.27	12.01	0.84	
Allinson & Hayes (1996)	Brewery managers	226	43.26	12.11	0.84	
Savvas, El-Kot & Sadler-Smith (2001)	Egyptian business & management students	45	43.2	8.15	0.32	
Hill *et al* (2000)	Finnish managers and staff	94	43.1	14.03		
Young, Doyle & Fisher (2002)	Canadian entrepreneurs	117	42.9	14.1	0.86	
Papavero (2005)	Chinese software engineers	314	42.84	9.6		
Lofstrom (2005)2	Finnish employees	208	42.75	11.25	0.84	
Alsvik (2011)	Norwegian Ministry of Defence employees	186	42.73	11.23	0.82	
Armstrong (2000)	Management students	421	42.72	11.78		
Evans, Harkins & Young (2008)	Canadian public school teachers	122	42.7	13.1		
Armstrong & Priola (2004)	Students emerging as 'followers' in a team exercise	89	42.55	10.91		
Allinson & Hayes (1996)	Teachers	74	42.54	13.47	0.85	
Savvas, El-Kot & Sadler-Smith (2001)	Greek business & management students	48	42.52	8.15	0.64	
Murphy *et al* (1998)	Canadian business students	89	42.5	11.8	0.83	.89 (n=79)
Allinson & Hayes (unpublished)	Health visitors (female)	39	42.13	12.78	0.86	
MacGillivary (1999)	Canadian tourism/hospitality students	109	42.1	12.3	0.85	
Backhaus & Liff (2007)	US business students	222	42.09	10.93	0.79	
Bolanos (2007)	Mexican 'incubation' entrepreneurs	22	42.05	7.63	0.61	
Hill *et al* (2000)	Polish managers and staff	143	41.99	11.61		
Frampton *et al* (2006)	Australian IT architects	40+	41.85	10.3		
Park & Black (2007)	US psychology graduate students	31	41.77	10.74		
Armstrong, Allinson & Hayes (1997)	Business admin students	101	41.74	13		.82 (n=65)
Allinson & Hayes (1996)	Business students	202	41.64	12.19	0.86	
Allinson & Hayes (2000)	Singaporean managers	81	41.61	12.89	0.85	
Armstrong & Priola (2001)	Management students	100	41.42	11.51		

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Source	*Sample*	*n*	*Mean*	*SD*	*Alpha*	*Test-retest*
Allinson & Hayes (2000)	Hong Kong management students	31	41.52	10.91	0.83	
Pereira (2011)	Public sector professionals	84	41.25	12.72		
Sadler-Smith, Spicer & Tsang (2000)	First line managers (local government)	113	41.24	13.64	0.89	
Brigham, Sorenson & De Castro (2004)	US family business owners	159	40.68	12.25		
Allinson & Hayes (1996)	Production managers	17	40.59	9.89		
Papavero (2005)	US software engineers	158	40.45	11.5		
Allinson & Hayes (1996)	Marketing managers	26	12.62	40.42		
	Management students	128	40.38	13.23	0.88	
Allinson & Hayes (1996)	Management students	225	40.32	15.18	0.91	.90 (n=30)
Hill *et al* (2000)	Managers and staff	48	39.92	14.24		
Savvas, El-Kot & Sadler-Smith (2001)	Postgrad management certificate students	28	39.71	16.07	0.91	
Armstrong, Allinson & Hayes (1997)	University lecturers	11	39.64	9.1		
Allinson & Hayes (1996)	Miscellaneous managers	130	39.48	7.08	0.85	
Sadler-Smith, Spicer & Tsang (2000)	Owner-managers	104	39.29	12.22	0.84	
Zhang (2005)	Chinese postgraduates in a UK business School	144	39.22	9.37		.62 (n=125)
Sadler-Smith, Spicer & Tsang (2000)	Middle managers (local government)	130	39.11	13.24	0.87	
Allinson & Hayes (1996)	Construction managers	66	38.98	14.21	0.89	
Allinson & Hayes (2000)	Australian management students	85	38.59	11.57	0.83	
Armstrong & Hird (2009)	Entrepreneurs	131	38.5	14.6		
Groves, Vance & Paik (2007)	US actors & accountants	63	38.41	13.89	0.88	
Allinson & Hayes (1996)	IT managers	40	38.28	12.09		
Mitteness, Cardon & Sudek (2010)	US 'angel' investors	240	38.2	12.24		
Corbett (2007)	US technology professionals	380	38.01	12.8		
Sadler-Smith, Allinson & Hayes (2000)	Human resource professionals	136	37.89	14.05	0.89	
Fitzgerald & Young (2002)	Canadian EMBA/MBA students	122	37.8	11.8		
Allinson & Hayes (2000)	French management students	80	37.79	9.81	0.77	
Van den Top (2010)	Dutch CEOs of SMEs	250	37.79	10.35	0.77	
Armstrong, Allinson & Hayes (1997)	University lecturers	19	37.68	12.84		
Sadler-Smith, Spicer & Tsang (2000)	Personnel practitioners	201	37.46	14.21	0.89	
Chaffey, Unsworth & Fossey (2012)	Australian occupational therapists	124	37.14	14.81		
Savvas, El-Kot & Sadler-Smith (2001)	MBA students	21	36.95	11.43	0.82	
Allinson & Hayes (2000)	German management students	36	35.64	11.41	0.83	
Fan (2008)	East Asian young adults	50	35.98	7.06		
Bennett (2010)	Employees in the creative arts	38	35.13			
Savvas, El-Kot & Sadler-Smith (2001)	Postgrad management diploma students	27	34.56	12.06	0.84	
Brigham & Mitchell (2010)	US entrepreneurs (SME founding owner/managers)	121	34.34	13.99	0.89	

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Source	*Sample*	*n*	*Mean*	*SD*	*Alpha*	*Test-retest*
Zhang (2005)	Postgraduate students in a business school	44	35.25	11.34		.79 (n=36)
Bolanos (2007)	Mexican 'post incubation' entrepreneurs	9	34.11	9.57	0.71	
Sadler-Smith, Spicer & Tsang (2000)	Senior managers (local government}	62	33.94	10.8	0.81	
Allinson, Chell & Hayes (2000)	Entrepreneurs	156	33.76	13.8	0.88	
Allinson & Hayes (2000)	British managers (Exec MBA students)	106	33.26	14.07	0.89	
Armstrong & Priola (2004)	Students elected as leaders in team exercise	11	32.27	12.72		
Brigham, de Castro & Shepherd (2007)	US entrepreneurs in high-tech companies	159	32.06	12.63		
Allinson & Hayes (1996)	Personnel managers	15	31.07	12.49		
Downey, Papageorgiou & Stough (2006)	Australian managers (female)	176	30.2	11.94		
La Pira & Gillin (2006)	Australian serial entrepreneurs	21	25.38	7.39		
La Pira (2010)	Australian and British and entrepreneurs	30	24.9	7.2		

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