Cognadev Technical Report Series

10

25th June, 2018

Cognitive complexity and cognitive styles: implications for strategic work

This study investigates the nature of the proposed holonic model of information processing constructs on which the Cognitive Process Profile (CPP) is based, and what distinguishes low and high information processing competency groups in terms of their preferred cognitive styles, functional area of employment, and educational qualifications.

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Executive Summary

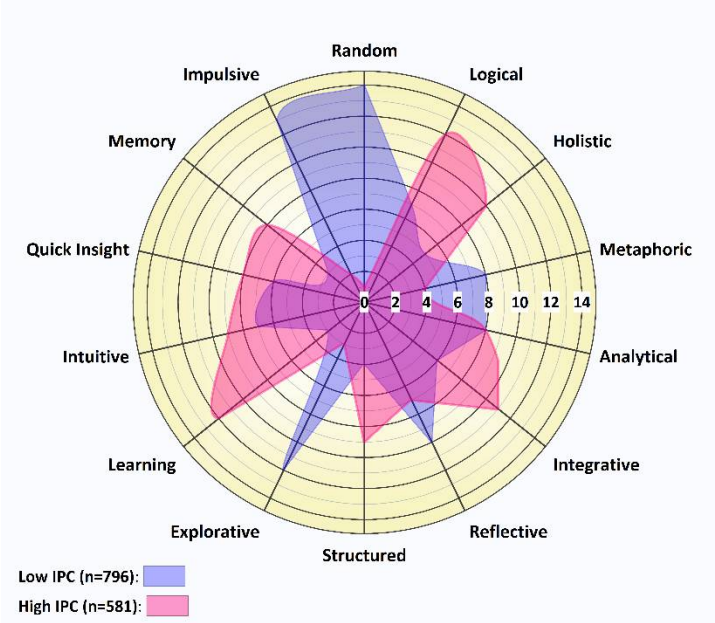
- This research study investigates the nature of the proposed holonic model of information processing constructs on which the Cognitive Process Profile (CPP) is based and its implications for strategic work. This is done by determining the relationship between high versus low levels of information processing competence (as a measure of cognitive complexity), and cognitive styles (as a measure of cognitive preferences associated with the inherent altitude and inclusivity of the proposed holonic model).

- Two groups of cases were selected from a large database of 60.752 cases, based upon their information processing scores (IPCs).

- **Low IPCs**; contains individuals who score *at or below* the 25th percentile (the lower quartile) on every one of the 14 CPP IPCs (n = 796).

- **High IPCs**; contains individuals who score *at or above* the 75th percentile (the upper quartile) on every one of the 14 CPP IPCs (n = 581).

- The median ranked styles across all 14 CPP styles of the two groups were then compared, where the lowest (1) ranked style is the least preferred, and the highest (14) is the most preferred/utilised.



Overall Conclusion

These findings support the altitude and inclusiveness of processing constructs of the proposed holonic model of processing and indicates the cognitive styles best suited to complex work environments. The implication of this finding is that the Logical, Integrative, Holistic and Learning styles are the best suited to the cognitive requirements of strategic roles in organisations.

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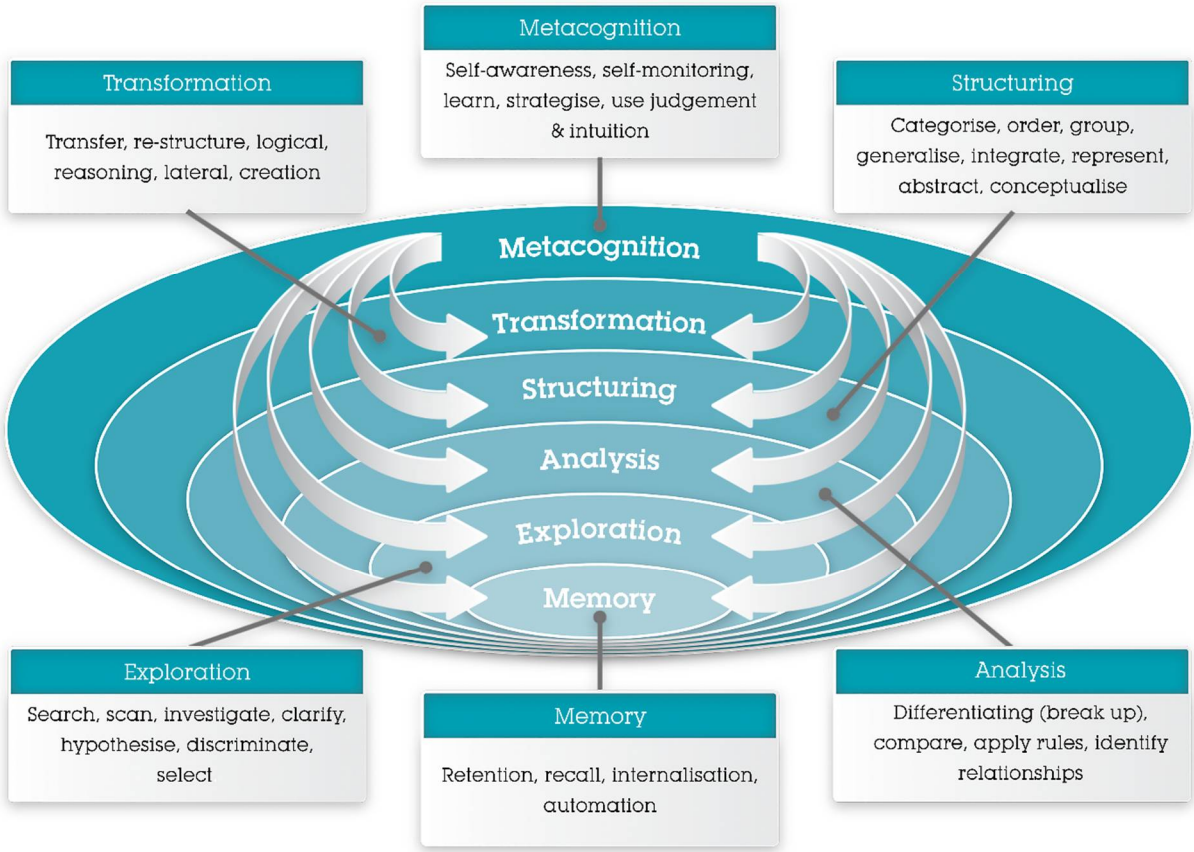
1. The Cognitive Process Profile (CPP) assessment

The CPP measures a person's cognitive preferences and capabilities by means of a simulation exercise which was designed to externalise and track thinking processes according to thousands of measurement points. The results are analysed by an expert system and automated reports are generated. The CPP primarily measures the following constructs: information processing competencies, cognitive styles, units of information, learning potential, a suitable working environment, as well as cognitive strengths and development areas.

1.1 The theoretical model of thinking processes

The CPP is based on a self-contained theoretical model of thinking processes. The Cognadev Information Processing model is holonically organised in that the various thinking processes are represented as a "soft hierarchy" of increasingly complex and inclusive operations. A *holon* refers to a system which consists of various subsystems, each of which incorporates and transcends underlying subsystems. The thinking processes incorporated in the CPP model can be regarded as functional information processing categories. The theoretical model of thinking processes on which the CPP is based, can be depicted graphically, as shown in Figure 1.

Figure 1: Cognadev Information Processing model: The holonic structure of the model



1.1.1 Information processing constructs

Each of these information processing constructs consists of a number of sub-constructs, all of which are guided by the application of metacognitive criteria. For example, the processing construct of

Exploration consists of sub-processes including scanning, searching, focusing, hypothesising, investigating, discriminating, selecting and eliminating information. The metacognitive criteria that guide exploration activities are those of clarity, relevance and depth. A high score on the information processing construct of Exploration, indicates the effectiveness by which a person investigates unfamiliar information.

Not all the information processing constructs measured, indicate effectiveness in thinking, though. Some processes such as Quick closure and Assumptions amongst others, may actually indicate ineffective thinking strategies or an absence of metacognitive awareness.
The various metacognitive criteria responsible for the effective application of each of the processes are shown below in Figure 2.

Figure 2: Cognadev Information Processing model: The metacognitive criteria that guide thinking processes

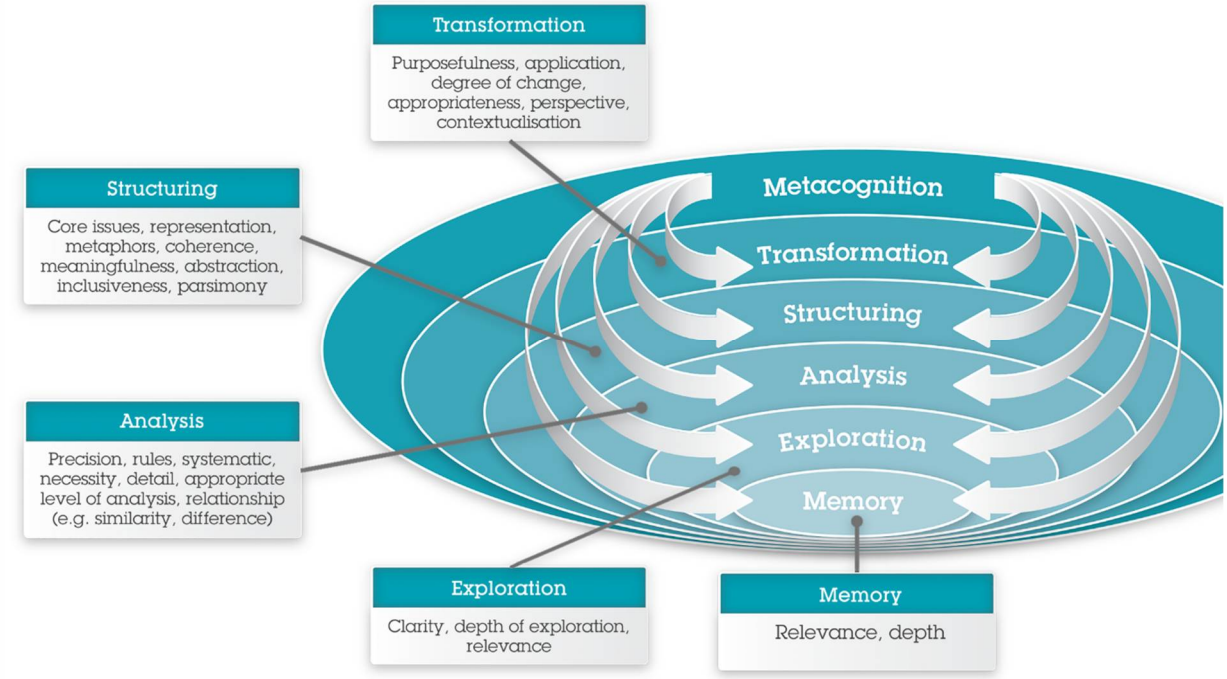


Table 1 lists the competencies and their descriptions.

Table 1: The Information Processing Competencies assessed within the CPP

Competency	Description
Use of memory	Reliance on memory
Memory strategies	Effectiveness of memory strategies
Pragmatic	Practical orientation (clarification of tangible information)
Exploration	The effectiveness, depth and width of exploration
Analysis	Working in a detailed and systematic manner to subdivide information and determine interrelationships between elements
Rules	A focus on rules
Categorisation	Creating external order, categories and reminders
Integration	Synthesis of ambiguous / discrepant / fragmented information
Complexity	The preferred level of complexity and unit of information
Logical reasoning	The disciplined, logical deployment and following through of reasoning processes
Verbal conceptualisation	Unusual / flowery / creative and / or abstract verbalisation and conceptualisation
Judgement	Capitalising on intuitive insights to clarify unstructured and vague information
Quick insight learning	Grasping new concepts and acquiring knowledge and understanding relatively quickly
Gradual improvement learning	A preference for practical or experiential learning

The CPP estimates the magnitude of these competencies as integers varying between 0 and 100; these are actually T-scores assigned to a raw competency score using the general CPP norm-based lookup-table.

2. Cognitive Styles

The cognitive styles as measured by the CPP primarily describe the cognitive preferences a person shows in dealing with unfamiliar information. However, it is highly likely that the person will generally apply those same stylistic preferences in familiar contexts also. Cognitive styles can be described as broad cognitive response tendencies and should be understood as the most frequent behaviour during the assessment.

The definition of the particular styles may not be exactly what is generally in layman's terms associated with the title word. Logical style, for example, implies disciplined thinking in a consequential and process-based manner to transform information structures or to identify implications and consequences. This goes beyond the meaning of the layman's term "logical".

A person's stylistic preferences can be magnified by certain personality and environmental factors as well as value orientations. An example is the Reflective style, which may indicate a level of caution, a risk avoidant personality trait, internalised cultural values or possible exposure to high risk or punitive environments where mistakes are not tolerated. Certain stylistic tendencies are also reinforced or adopted in certain educational and work environments. Examples include the highly analytical requirements of certain financial and scientific career fields, or the creative, intuitive, at times even random, ideas-oriented approaches required by arts and, to some extent, the social sciences. Preferences for the application of particular styles, can thus be rooted in cognitive "values" or habitually applied metacognitive criteria. Included are the tendencies to strive for accuracy; the habit to suppress reactive responses in favour of being reflective; or the tendency to create certainty by approaching tasks in an ordered and structured manner.

Other than the information processing constructs, such as Exploration, which indicates effectiveness of processing, cognitive styles such as the Explorative Style, may merely indicate the tendency to explore irrespective of the effectiveness involved. Typical cognitive styles which fall into this category include the Explorative, Structured, Reflective, Random or Trail-and-Error and Memory styles. The Intuitive and Analytical styles can partly be grouped into this category as well.

However, the Logical, Integrative, Holistic and Learning styles, presuppose effectiveness of approach. These styles also involve dealing with complexity in an "inclusive" and metacognitively aware manner. Again, the Analytical and Intuitive styles can to some extent be added into this category.

To some extent the various stylistic preferences echo the holonic nature of the proposed information processing model.

Some examples of the CPP cognitive styles are presented below.

Table 2: Three example Cognitive Styles assessed within the CPP

Logical Style

- Tends to look for logical evidence
- Is self-aware and rigorously monitors own reasoning processes
- Follows reasoning processes through in a rule-based manner
- May apply convergent or divergent reasoning
- Tends to verify or falsify arguments logically
- May prefer to focus on complex issues and long-term implications
- Tends to be a disciplined and critical thinker
- May pursue complex cognitive challenges
- May focus on detail in an analytical manner

Analytical Style

- Has a precise, detailed approach
- Works systematically and pays attention to rules
- Enjoys pulling information apart and subdividing issues
- Analyses, compares and categorises various elements
- Identifies relationships between different elements

Trial-and-Error (Random) Style

- Has a vague and unsystematic approach to problem-solving
- Tends not to plan or monitor information processing approach
- May show an undirected action approach
- Not likely to be focused on the task or goal
- May lack self-awareness, motivation or flexibility
- Likely to prefer structured and familiar information or environments
- May not systematically analyse, structure or reason about issues

3. Investigating the nature of the holonic structure of thinking processes

The holonic nature of the proposed processing model reflects a progression towards greater complexity, inclusiveness and metacognitive awareness at higher levels of processing. In terms of the altitude inherent to the holonic model, Integrative and Transformational styles (as reflective of integrative and logical reasoning processes) can thus be expected at higher levels of organisation on the holonic model than those of the Explorative and Analytical styles. The more complex styles can therefore be expected to be associated with greater information processing competence.

Evidence for the altitude and inclusivity of the holonic processing model can be investigated by differentiating between individuals with **high versus low processing competence** and comparing this to **stylistic preferences** to determine the degree of inclusiveness or altitude of both the proposed processes of the information processing model, as well as the associated styles.

3.1 Information processing competencies (IPCs) groups and styles

For the purposes of the current analysis, a sample of the most recently acquired 60,572 cases of CPP data were used, selecting two clearly discrete groups from within this dataset according to a simple filter:

- **Low IPCs**; contains individuals who score *at or below* the 25th percentile (the lower quartile) on every one of the 14 IPCs (n = 796).

- **High IPCs**; contains individuals who score *at or above* the 75th percentile (the upper quartile) on every one of the 14 IPCs (n = 581).

Table 3: The descriptive statistics and interquartile ranges for the IPCs in the total sample

	Descriptive Statistics - CPP dataset, n=60,572					
Variable	Valid N	Mean	Median	Lower Quartile	Upper Quartile	Std.Dev.
Pragmatic	60572	54.0	55	44	66	14.68
Analytical	60572	52.3	55	42	64	14.99
Rule-Oriented	60572	52.0	50	41	62	14.95
Categorisation	60572	50.1	49	40	60	14.40
Quick Insight Learning	60572	51.5	51	40	62	15.20
Integration	60572	53.2	56	43	64	14.04
Complexity	60572	54.2	57	42	66	14.73
Logical Reasoning	60572	54.6	57	43	67	15.43
Verbal Conceptualisation	60572	53.7	55	44	65	14.35
Use of Memory	60572	51.2	50	39	63	15.09
Memory Strategies	60572	51.6	51	41	64	14.87
Exploration	60572	52.6	53	42	63	14.42
Gradual Improvement Learning	60572	54.1	56	44	65	13.36
Judgement	60572	50.9	53	41	62	14.68

Table 4: The descriptive statistics for the IPCs in the Low IPC group

Variable	Group=Low IPC Descriptive Statistics					
	Valid N	Mean	Median	Minimum	Maximum	Std.Dev.
Pragmatic	796	32.3	33	10	44	7.52
Analytical	796	30.9	31	1	42	6.71
Rule-Oriented	796	28.8	28	12	41	5.81
Categorisation	796	27.0	27	0	40	8.09
Quick Insight Learning	796	22.5	23	3	39	6.09
Integration	796	26.5	27	8	43	6.25
Complexity	796	27.2	27	14	42	4.93
Logical Reasoning	796	27.5	27	9	43	5.62
Verbal Conceptualisation	796	30.4	30	10	44	7.74
Use of Memory	796	30.0	31	6	39	6.54
Memory Strategies	796	28.9	29	11	41	6.94
Exploration	796	28.6	28	8	42	6.86
Gradual Improvement Learning	796	30.9	31	10	44	8.25
Judgement	796	27.1	28	0	41	9.12

Table 5: The descriptive statistics for the IPCs in the High IPC group

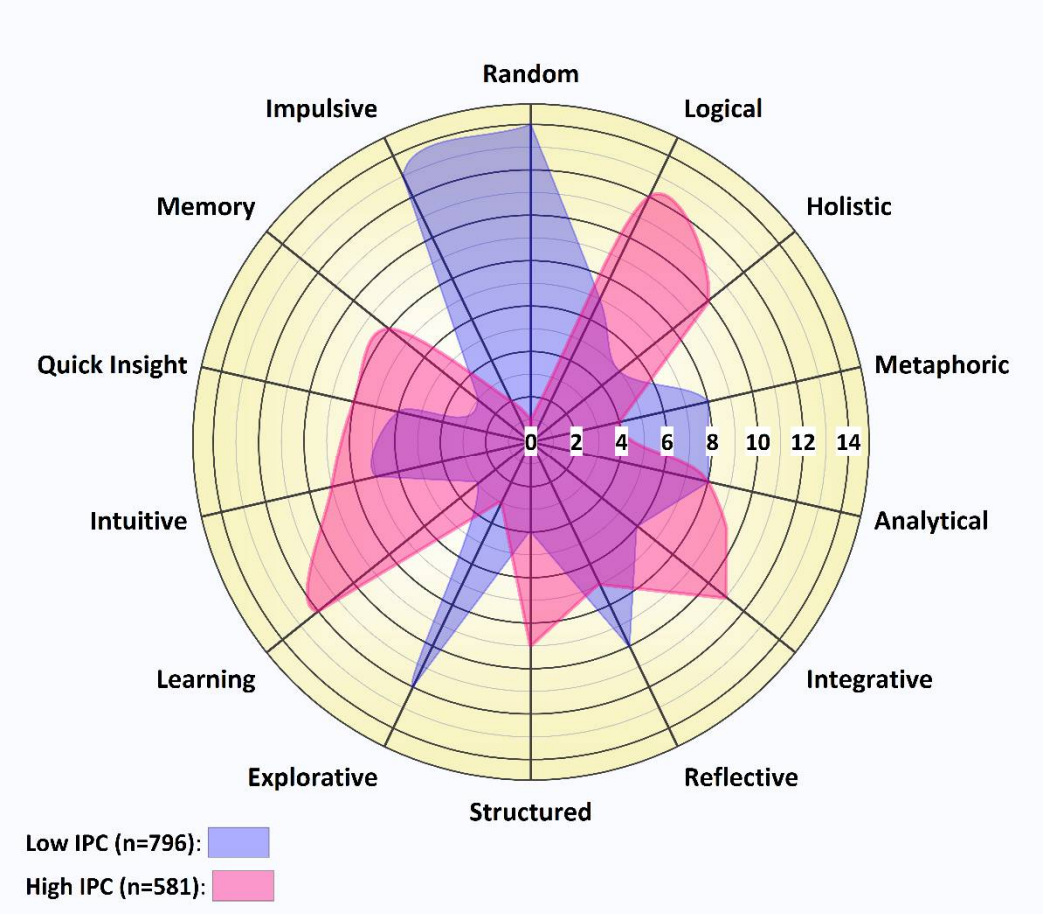
Variable	Group=High IPC Descriptive Statistics					
	Valid N	Mean	Median	Minimum	Maximum	Std.Dev.
Pragmatic	581	74.5	75	66	88	5.09
Analytical	581	69.5	69	64	100	4.97
Rule-Oriented	581	80.1	81	62	95	6.42
Categorisation	581	73.4	74	60	90	6.22
Quick Insight Learning	581	76.8	76	62	94	6.27
Integration	581	73.5	73	64	87	4.37
Complexity	581	74.6	75	66	86	3.66
Logical Reasoning	581	75.6	75	67	94	3.82
Verbal Conceptualisation	581	71.8	72	65	91	4.58
Use of Memory	581	72.3	71	63	91	5.71
Memory Strategies	581	75.6	76	64	88	5.26
Exploration	581	76.4	76	63	93	5.39
Gradual Improvement Learning	581	70.1	69	65	85	3.97
Judgement	581	70.7	70	62	88	5.00

The median ranked styles across all 14 styles of the two groups were then compared, where the lowest (1) ranked style is the least preferred, and the highest (14) is the most preferred/utilised.

Table 6: The medians of the ranked styles for both Low and High IPC groups

	Median ranked cognitive styles	
	1 Low IPC group, n= 796	2 High IPC group, n= 581
Random	14	1
Logical	7	12
Holistic	5	10
Metaphoric	8	4
Analytical	8	8
Integrative	6	11
Reflective	10	7
Structured	4	9
Explorative	12	3
Learning	3	12
Intuitive	7	9
Quick Insight	6	8
Memory	3	8
Impulsive	13	2

Figure 3: Polar plot of the medians of the ranked styles for both Low and High IPC groups



In terms of the available biodata associated with each group, Tables 7-10 provide the % of cases in each group associated with particular biodata classifications. These biodata fields are self-reported, and reflect a classification constructed from free-response fields (except for the Highest Level of Educational Qualification), so some overlap between field-categories may be observed.

Table 7: The functional employment area associated with members of the low and high IPC groups

Summary Table: Percentages of Column Totals (Low & High IPC groups) Marked cells have counts > 20			
Functional Area	Group Low IPC	Group High IPC	Row Totals
Human Resources	7.25%	3.35%	5.64%
Technical / Engineering / Research	9.47%	16.14%	12.23%
Accounting / Finance	16.72%	44.65%	28.27%
Administration / Operations	22.63%	9.01%	17.00%
Marketing / Sales / Service	15.38%	4.40%	10.84%
Management	20.41%	17.61%	19.25%
Manufacturing / Construction	2.81%	1.47%	2.25%
Political	0.59%	0.00%	0.35%
Teaching / Training	2.07%	1.47%	1.82%
Distribution	0.74%	0.21%	0.52%
Creative / Media	1.92%	1.68%	1.82%
All Grps	58.63%	41.37%	

The high IPC group is associated with specialist-skill/technical roles, including accounting

Table 8: The highest level of educational qualification associated with members of the low and high IPC groups

Summary Table: Percentages of Column Totals (Low & High IPC groups) Marked cells have counts > 20			
Highest Level Of Education	Group Low IPC	Group High IPC	Row Totals
10 year schooling	9.32%	2.08%	6.25%
12 year schooling	14.94%	3.64%	10.15%
Diploma(s) / Certificate(s)	31.80%	7.97%	21.69%
Degree	23.50%	29.46%	26.03%
Multiple Degrees / Postgraduate	20.43%	56.85%	35.88%
All Grps	57.57%	42.43%	

As might be expected, the high IPC group has many more degreed/multiple degreed individuals.

Table 9: The ages (grouped) of the members of the low and high IPC groups

Summary Table: Percentages of Column Totals (Low & High IPC groups) Marked cells have counts > 20			
Age Group (yrs)	Group Low IPC	Group High IPC	Row Totals
20-29	9.68%	43.04%	23.57%
30-39	35.10%	41.05%	37.58%
40-49	36.52%	14.29%	27.26%
50-59	17.68%	1.45%	10.92%
60 and above	1.03%	0.18%	0.68%
All Grps	58.36%	41.64%	

Interestingly, the high IPC group is predominantly younger than the low IPC group.

Table 10: The gender percent frequencies of the low and high IPC groups

Summary Table: Percentages of Column Totals (Low & High IPC groups) Marked cells have counts > 20			
Gender	Group Low IPC	Group High IPC	Row Totals
M	59.42%	59.55%	59.48%
F	40.58%	40.45%	40.52%
All Grps	57.81%	42.19%	

3.2 What can we conclude?

Styles that largely reflect the use of less inclusive processing skills, were associated with lower levels of processing competence. For example, by comparing the Explorative and Analytical style preferences, it seems that the Analytical style is associated with greater complexity and altitude than Explorative style and therefore of a more inclusive nature within the proposed holonic structure of the model.

The Analytical and the Logical styles are closely related as both reflect a detailed, rule-based and rigorous approach to problem solving. In the case of the Analytical style, the emphasis is on subdividing information in a detailed and systematic manner to better understand the interrelationships between elements. In the case of the Logical style the emphasis is on following a rule-based approach through to identify consequences and implications or to restructure, transfer, transform or contextualise a solution. From the results obtained in this study it seems that a preference for a logical style is associated with greater complexity and altitude than that associated with an Analytical style.

In the case of the Structuring, Integrative, Holistic and Metaphoric styles, all are involved in meaningfully conceptualising information. The Integrative and Holistic styles are closely related as some of their building blocks overlap. The two approaches do, however, differ in that the Integrative style is largely associated with an interest in coherence and abstraction, whereas the Holistic style is aimed at providing simple contextual solutions of practical utility. It was found that the Integrative and Holistic styles reflect a greater degree of inclusiveness and altitude than the Structuring and Metaphoric styles.

These findings support the altitude and inclusiveness of processing constructs of the proposed holonic model of processing and indicates the cognitive styles best suited to complex work environments. The implication of this finding is that the Logical, Integrative, Holistic and Learning styles are the best suited to the cognitive requirements of strategic roles in organisations