Cognitive Styles in HCI Education and Practice

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This project examines the cognitive profile of the HCI professional with the view of providing a benchmark against which to compare HCI students. 134 professionals responded to an online survey which captured their individual cognitive style using Hayes and Allinson's Cognitive Style Index and Blazhenkova & Kozhevnikov's Object-Spatial Imagery and Verbal Questionnaire. Some of these were HCI practitioners in the field, some were educators, and some were both practitioner and educator. It was expected that successful HCI practitioners would fall somewhere within the 60% of the population who are categorised as "quasi intuitive", "adaptive" or "quasi analyst" and that they would score more highly as an object-imager than an engineer or computer scientist, and more highly as a spatial-imager than a visual artist. Preliminary results partially support this. The profile of the educator is clearly distinct from that of the practitioner professional which may have implications for the delivery of the curriculum.

Human Computer Interaction, HCI, CSI, OSIVQ, cognitive profile.

1. INTRODUCTION

The study of Human-Computer Interaction (HCI) first emerged in the late 1970s, and whilst it was originally a specialism within the computer science field, it has now evolved to encompass many different areas, including engineering, information management, psychology and design, as well as information technology subjects (Carroll, 2013; Myers, 1998). Our research project has so far examined the cognitive style of HCI students in the UK, India, Namibia, Mexico and China (Abdelnour-Nocera et al., 2013; Austin et al., 2012) and has identified a tension between HCI as design subject and as an engineering subject. It also noted that some schools' selection policies favour students with an aptitude for engineering subjects, therefore reducing the number of potentially 'ideal' HCI professionals.

This phase of the project now moves on to examine the profile of the HCI professional working in the field either as a practitioner or educator with the view of providing a benchmark against which to compare the HCI students.

Within the field of cognitive style research, there is a diverse range of theoretical backgrounds and domains of application (Cassidy, 2004; Coffield et al., 2004). However, when selecting a tool to measure a relationship between cognitive style and the study of human computer interaction, the range of candidate theories is constrained by the characteristics of interactive systems. In this situation, it is appropriate to consider models which investigate the visualiser - verbaliser

spectrums as this corresponds to the medium being investigated, and in addition, the intuitive/holistic – analytical spectrum is appropriate as this correlates to the approach taken when evaluating systems for usability.

The Object-Spatial Imagery and Verbal Questionnaire - OSIVQ - (Blazhenkova and Kozhevnikov, 2008) suggests a three dimensional model of cognitive style: object imagers who prefer to construct pictorial images, spatial imagers who prefer schematic representations and verbalizers who prefer to use verbal-analytical tools, whereas the Cognitive Style Index (Allinson and Hayes, 1996) – the CSI – tests whether the subject tends more towards an intuitivist (right brain dominant) or analyst (left brain dominant) . Together, these two instruments provide a profile that matches the skills required to work within the field of HCI.

2. CONTEXT

The multidisciplinary nature of HCI and its rapid growth against the constantly changing backdrop of technology presents educators with a number of challenges, particularly when considering curriculum design. Recent research has centred on the practices and underpinning philosophies of both education and practice in order to identify a global curriculum (Churchill et al., 2013). This research intends to investigate the extent to which the cognitive style of the professional, whether practitioner or educator, determines the approach to practice in the field.

HCI practitioners act as an interface between the developer and the users during the development of a computer application or website. As such, they need analytical skills to understand the functionality of the website or application, but at the same time, they need to be able to see the 'whole picture' and put themselves in the shoes of the user. Some HCI evaluation techniques such as heuristic evaluations require an analytical approach. Others, such as the production of a persona need a more intuitive approach. In addition, whilst the developer may be more concerned with the functionality of the application, the HCI practitioner also needs to balance the need for the interface to be user friendly, and the layout, appearance and aesthetics of the interface will contribute to this.

Therefore the following assumptions are explored in relation to the cognitive style of the HCI professionals who have participated in this study:

Assumption 1: It is expected that the HCI practitioner will score more highly as an object-imager than an engineer or computer scientist, and more highly as a spatial-imager than a visual artist.

Assumption 2: It is expected that more than 60% of HCI professionals will fall somewhere within the categories of "quasi intuitive", "adaptive" or "quasi analyst".

3. METHOD

Professionals were invited to complete an online survey in order to capture their cognitive style.

3.1 Population and sample characteristics

The target population was HCI professionals who work either as a practitioner in the field, or as an educator, for example, a university lecturer. It was recognised that some practitioners also teach, and some educators also practice, so subjects were asked to categorise themselves as either practitioner, educator or both. Participation was invited either directly, for example by canvassing conference attendees, or indirectly via Linked In discussions, or specialist mailing lists, thereby restricting respondents to those who have an interest in HCI. Responses were received from 134 professionals (M=61, F=73) from Europe, North and South America, Asia, South Africa and Australia. Of these respondents, 31 were either non-nationals of the country in which they were based, or had a different nationality at birth, reflecting the diversity of the global marketplace. Of these, 70 were HCI practitioners in the field, 29 were educators, and 35 classified themselves as both practitioner and educator.

3.2 Procedure

Participants were directed towards an online survey which collected some demographic information, and then delivered the OSIVQ and the CSI. The demographic information included their age, gender, role (practitioner, educator or both), the country in which they are based, together with nationality, and nationality at birth, if different, and a brief description of their roles and employment history. 71 participants indicated they were willing to participate further, and provided contact details.

4. RESULTS AND DISCUSSION

The subjects were categorised as practitioners (those working in the field of HCI), educators (those who teach the subject) or 'both' – many practitioners also teach, and many educators also practice. The data was analysed firstly by considering each of the three groups independently, and then by considering those subjects that fell into the category of 'both' firstly as an educator, and then as a practitioner. This was achieved by creating two new variables. The first variable contained values for the practitioners and 'both' combined (All-Pract, n=105), and the educators. The second variable contained values for the educators and 'both' combined (All-Ed, n=64), and the practitioners.

4.1 Discussion of OSIVQ

The OSIVQ produces a profile with the dimensions of object imager (OI), spatial imager (SI) and verbalizer (V) which can be compared with the average profiles produced by 4 particular groups: scientists and engineers, visual artists, linguists and historians, and the general population.

A one-way between subjects ANOVA was conducted to compare the OSIVQ scores for each of the groups of practitioner, educator, 'both', All-Pract and All-Ed. No significant differences were observed between any of the roles ($p>0.05$), although there are differences between these subjects and the scores published for the general population.

When the averages of the whole cohort ($n=134$) are compared with published averages for both scientists/engineers and for visual artists, it can be seen that the visual-object ability of this cohort ($OI=3.37$) is marginally higher than for scientists/engineers ($OI=3.28$), but lower than visual artists ($OI=4.14$), and their visual-spatial ability ($SI=3.20$) is closer to the average profile of the scientist/engineer ($SI=3.28$) than the average profile of the visual artist ($SI=2.8$).

The verbal ability of the cohort ($V=3.07$) is significantly higher than the average profile of both

the scientist/engineer ($V=2.81$), the visual artist ($V=2.69$) and the general population ($V=2.90$), but lower than the average profile of linguists and historians ($V=3.48$). See figure 1.

Although this supports the assumption that the HCI professional will score more highly as an object imager than an engineer or computer scientist and more highly as a spatial-imager than a visual artist, the differences in the visual object ability are not sufficiently marked to be of particular interest.

Figure 1: OSIVQ Profile

It is, however, interesting to note that whilst the profile of the HCI professional is close to that of the scientists and engineers in respect of both the visual object and visual spatial ability, their verbal ability is higher, perhaps reflecting the communication skills which are required both as a practitioner and an educator.

4.2 Discussion of CSI

The CSI tests whether the subject tends more towards an intuitivist (right brain dominant) or analyst (left brain dominant). It is expected that 20% of the population as a whole would fit into each of the following 5 categories: Intuitive, Quasi-Intuitive, Adaptive, Quasi-Analytical and Analytical. Intuitivists are seen to 'be relatively nonconformist, prefer an open-ended approach to problem solving, rely on random methods of exploration, remember spatial images most easily, and work best with ideas requiring overall assessment' whilst analysts 'tend to be more compliant, favour a structured approach to problem solving, depend on systematic methods of investigation, recall verbal material most readily and are especially comfortable with ideas requiring step by step analysis'. Adaptive subjects are equally comfortable with either approach. (Allinson and Hayes, 1996).

The expectation was that as the HCI professional makes use of tools and techniques that require both analytical and intuitive approaches, that they would be more likely to fall within the range of quasi-intuitive to quasi-analytical than the general population. Whilst more than 60% of the sample did indeed fall within the range, this distribution (65%) was less extreme than had previously been

observed when examining the cognitive profile of HCI students (79%) (Abdelnour-Nocera et al., 2013). See comparison in Figure 2.

A one-way between subjects ANOVA was conducted to compare the CSI scores for each of the groups of practitioner, educator and 'both'. However, no significant effect was observed ($p>0.05$). The same test was run for the two newly created variables; the first represents the practitioners and 'both' combined (All-Pract) and the educators, and the second represents the educators and 'both' combined (All-Ed) and the practitioners. Whilst there was still no significance observed for the All-Ed group, there was an observed difference when All-Pract and educators were compared. [$F(1,132)=3.974$, $p=0.048$], suggesting that the profile of the educator who does not practice is different to that of the practitioner.

Figure 2: CSI profile of HCI students and professionals

Interestingly, the profile of the educator has fewer intuitivists and more analysts amongst its rank. 34% educators fall into the spectrum of the intuitive and quasi intuitive combined, compared with 46% of practitioners and 54% of those who enjoy both roles. At the other end of the scale, more educators fall into the category of quasi analysts and analysts (45%) than practitioners (33%), or those who enjoy both roles (29%).

Further investigation is needed to determine the reasons for this difference in profile. However, the fact that HCI is often taught as an option within a computing course may suggest that HCI lecturers are computer scientists who have become interested in the subject rather than HCI specialists who have joined the faculty specifically to teach subjects of this nature. As the profile of the practitioner and 'both' is similar, and distinct from that of the educator, it suggests that those professionals who fall into this category are practitioners who have moved into teaching after having practiced in the field. However, as the number of subjects for each of these roles is small (educators=29, both=35), more data is needed before any sound conclusions can be drawn.

4.3 Implications for HCI education

As there appears to be a contrast between the cognitive style of the student and that of the educator, this may have implications for the delivery of the curriculum. It would be unwise to come up with any firm conclusions at this stage of the study, but it may be that educators favour analytical techniques, and may not value the intuitive to the same extent as the practitioner. This may have implications with both the delivery and assessment of particular topics, such as task analysis and GOMS, or interviews and focus groups, and it may be that the educator needs to consider this when planning the curriculum.

4.3 Limitations of study

The size of the sample collected is fairly small, and unbalanced, with more practitioners than educators participating in the survey. The small number of educators in particular has made it difficult to come to any reliable conclusions regarding the cognitive profile of the HCI professional. This will be addressed in future studies as more data is collected. To address this, further professionals will be invited to participate in this study at intervals throughout the next 12 months. In addition, interviews of all three categories of professional will be conducted in order to determine whether there are any additional patterns or themes evident within the groups.

The concerns regarding the validity of self-report surveys are well documented (Arnold and Feldman, 1981; Podsakoff and Organ, 1986), and there are additional difficulties when subjects are remote, and do not necessarily have English as the first language. The CSI makes heavy use of idiom; to mitigate this, notes have been added to explain the expressions. The OSIVQ may also cause the respondents difficulty; the complexity of the vocabulary and sentence structure, particularly when questions are phrased negatively, has been noted previously (Austin, 2010).

5. CONCLUSIONS

The results of this study appear to be supportive of our initial assumptions, and in addition have found that whilst the object and spatial imager profiles of the HCI professional are similar to that of an engineer or scientist, their verbal abilities are stronger. In addition, there appears to be a clear difference between the profile of the practitioner and that of the educator, with the educator being more analytical in their approach.

However, more data is required before we can confirm or reject these assumptions. In addition, it

is expected that once we enter the qualitative phase of this project, the interviews will produce sufficiently rich data to contribute towards the profile of the professional.

6. REFERENCES

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