Comparing the Cognitive Profile of the HCI Professional and the HCI Educator

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Abstract
Previous research into Human-Computer Interaction (HCI) education has focussed mainly on the curriculum, pedagogy and the gap between education, and little is known about the cognitive profile of the HCI practitioner or educator, or how their individual differences impact upon practice in the field or the classroom. This research intends to address this gap by investigating the cognitive style of HCI practitioners, educators, and those with both roles.

315 professionals responded to a global online survey which captured their individual cognitive style using the Allinson and Hayes Cognitive Style Index (CSI) which tests whether the subject tends more towards an intuitivist or analyst, and the Object-Spatial Imagery and Verbal Questionnaire (OSIVQ) which 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. Together, these two instruments provide a profile that matches the skills required to work within the field of HCI. The respondents included practitioners in the field (N=179), educators (N=61), and some who were both practitioner and educator (N=75).

A one-way between-groups ANOVA and MANOVA was performed to investigate differences in the role of the professional, and the CSI and OSIVQ profiles respectively, followed by the Welch t-test to compare their OSIVQ scores with the published normative values.

The ANOVA comparing the CSI scores for each of the groups revealed a statistically significant difference of $F(2, 312) = 3.35$, $p= 0.38$ and post-hoc comparisons using the Tukey HSD test indicated that the mean score for the educators was significantly different from that of the 'both' group. The practitioners did not differ significantly from either the educators or 'both'. This may in some part be explained by the fact that very often HCI is taught by an academic with a computer science background rather than an HCI specialist, but further investigation is needed in this area.

The MANOVA used the three constructs of the OSIVQ as dependent variables. No significant difference was found between the groups. However, the t-tests comparing the professional against the normative data revealed that whilst there was no significant difference between the object imager score of the HCI professional and the scientist, there was a difference between the spatial imager score of the HCI professional and the visual artist, perhaps again reflecting the computer science background of many professionals.

24 survey respondents have been interviewed and the resulting data will form the basis of a thematic analysis to extend the cognitive profile, and to identify the predominant technological frames of operation. Applying this concept of technological frames to the domain of HCI, will help to make sense of the adoption and application of knowledge, tools and techniques amongst this community.

In order for the curriculum to meet the needs of the market, the educator needs to understand the practitioner in order to produce graduates equipped for the role. Finally, as HCI is delivered in a multidisciplinary environment, should it not also be taught by a multidisciplinary team?

Keywords
HCI education, CSI, OSIVQ

Introduction

Previous research into Human-Computer Interaction (HCI) education has concentrated mainly on the curriculum, pedagogy and the gap between education and practice (Churchill, Bowser, & Preece, 2013; Douglas, Tremaine, Leventhal, Wills, & Manaris, 2002; Hewett et al., 1992). However, there has been little focus on looking at the profile of the HCI professional. This research intends to address this gap by examining the profile of both the HCI practitioner and the HCI educator. This paper focusses particularly on elements of cognitive style.

The study of HCI first emerged in the late 1970s when it was often referred to as Human Factors, 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). The term HCI translates literally to Human-Computer Interaction. However, many people who use the social networking features of a smart phone or devices such as the ticket machine at a railway station would not consider themselves to be computer users. As a result, this term is used less in practice, and the meaning has been extended to refer to interaction with other devices such as mobile phones, and other 'smart' devices. Very often the term User Experience (UX) is used instead, and at times the terms are used interchangeably, although there are differences between the two terms. HCI is generally considered to be focused on the tasks and the goals of the user, whereas UX extends this definition to include an emotional response, affected by the characteristics of the system and the context of use (Hassenzahl & Tractinsky, 2006).

HCI is studied in university courses both at undergraduate and postgraduate level in order to explore, understand and aid in improving the usability and user experience of interactive systems and products; it is now a well-established and important subject in computing, technology and design courses throughout the world.

However, 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 and it is recognised that what the practitioner and the educator value are not always the same (Churchill et al., 2013). At a time when there is a skills shortage, and yet universities are cutting back on HCI contact hours in an attempt to become more efficient, it becomes increasingly important to make the curriculum effective and relevant.

This research extends the earlier studies of Churchill et al (2013) by considering not only educators and practitioners, but also those who are both educators and practitioners. It seeks to build up a profile of the professional, focusing on elements of cognitive profile, as well as elements of personality, and technological frames of operation (Orlikowski & Gash, 1994).

Rationale

Little is known of how individual differences of the professional, whether practitioner or educator, can influence the content and approach to both teaching and practice. The tools and techniques used in the field do not take into account the different cognitive styles of either the educators or practicing professionals, and it is not known whether the cognitive preferences of the educator influence the content and delivery of the curriculum.

The aim of this research is to provide a better understanding of HCI practitioners and HCI educators by identifying the similarities and differences between them, and the potential impact upon curriculum design, delivery and practice. A better understanding of this will serve to support the educational experience of the students and to strengthen the HCI curriculum.

Both survey and interview data are used to investigate the extent to which the individual differences of the professional, whether practitioner or educator, determine the approach to practice in the field, or ascribe particular significance to tools or techniques when delivering the curriculum.

The focus of this paper is the survey data and cognitive style, with particular reference to the Cognitive Style Index (Allinson & Hayes, 1996) and the Object-Spatial Imagery and Verbal Questionnaire (Blazhenkova & Kozhevnikov, 2008).

Cognition and HCI

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.

The first phase of this project used a survey to gather data relating to cognitive style. Within the field of cognitive style research, there is a diverse range of theoretical backgrounds and domains of application (Cassidy, 2004; Coffield, Moseley, Hall, & Ecclestone, 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 the technology in question.

The Cognitive Style Index - CSI - (Allinson & Hayes, 1996) was considered appropriate as it investigates the intuitive/holistic – analytical spectrum, which correlates to the approach taken when evaluating systems for usability; the Object-Spatial Imagery and Verbal Questionnaire - OSIVQ - (Blazhenkova & Kozhevnikov, 2008) was selected as it investigates the visualiser - verbaliser spectrums which correspond to the medium being investigated.

It is, however, noted that whilst these constructs contribute towards a profile that matches the skills required to work within the field of HCI, they only provide a partial profile, and a fuller profile will be developed once the interview data has been analysed.

The Cognitive Style Index

The Allinson and Hayes Cognitive Style Index – the CSI – consists of a series of 38 questions with a possible response of true-uncertain-false to test whether the subject tends more towards an intuitivist (right brain dominant) or analyst (left brain dominant). 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 & Hayes, 1996).

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. 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.

The Object-Spatial Imagery and Verbal Questionnaire

The OSIVQ, validated at the Psychology Departments of Rutgers-Newark and George Mason University, suggests a three dimensional model of cognitive style – object imagers (OI) who prefer to construct vivid pictorial images, spatial imagers (SI) who prefer schematic representations and verbalizers (V) who prefer to use verbal-analytical tools. It asks respondents to assess their object, spatial and verbal ability using a 45 question Likert style multiple choice test with a scale of 1 to 5. Scores for each dimension are produced by averaging the scores of questions that relate to each dimension. This provides a profile 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 (Blazhenkova & Kozhevnikov, 2008).

The expectation was that as many HCI professionals contribute towards the interface design, they would score more highly than computer scientists and engineers as object imagers, and as they also need to understand the architecture and functional design, they would score more highly than visual artists as spatial imagers.

Method

The target population of this study is the HCI professional who works either as a practitioner in the field, or as an educator, for example, a university lecturer. 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. Participants were directed towards an online survey which collected some demographic information, and then delivered the Object-Spatial Imagery and Verbal Questionnaire - OSIVQ - (Blazhenkova & Kozhevnikov, 2008) and the Cognitive Style index - CSI - (Allinson & Hayes, 1996).
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.

315 professionals responded (M=153, F=162), providing some demographic data and completing the CSI and the OSIVQ. These were made up of practitioners in the field (N=179), educators (N=61), and some who were both practitioner and educator (N=75). The respondents ranged in age from 22 to 79, and there were representatives from 36 countries covering Europe, North and South America, South Africa, Asia and Australia/Oceania. 48 of the respondents were not nationals of the country in which they practice.

A one-way between-groups ANOVA and MANOVA was performed to investigate differences in the role of the professional, and the CSI and OSIVQ profiles respectively. This was followed by the Welch t-test to compare their OSIVQ scores with the published normative values (Blazhenkova & Kozhevnikov, 2008).

Results and discussion

Cognitive Style Index

Respondents to the survey completed the CSI which measures the extent to which an individual is an analytical or intuitive thinker.
A one-way between subjects ANOVA was conducted to compare the CSI scores for each of the groups of practitioner, educator and ‘both’ revealing a statistically significant difference of $F(2, 312) = 3.35$, $p = 0.038$ (Figure 1).

	Statistic[a]	df1	df2	Sig.
Welch	3.350	2	124.306	.038
Brown-Forsythe	3.574	2	174.752	.030

a. Asymptotically F distributed.

Figure 1: Robust Tests of Equality of Means for the CSI

Post-hoc comparisons using the Tukey HSD test indicated that the mean score for the educators was significantly different from that of the 'both' group. The practitioners did not differ significantly from either the educators or 'both' (Figure 2).

(I) Role	(J) Role	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Practitioner	Educator	-3.070	1.784	.199	-7.27	1.13
	Both	2.848	1.655	.199	-1.05	6.75
Educator	Practitioner	3.070	1.784	.199	-1.13	7.27
	Both	5.918*	2.074	.013	1.03	10.80
Both	Practitioner	-2.848	1.655	.199	-6.75	1.05
	Educator	-5.918*	2.074	.013	-10.80	-1.03

*. The mean difference is significant at the 0.05 level.

Figure 2: Tukey HSD Multiple Comparisons Test CSI

Further investigation is needed to determine the reasons for this difference in profile, and this will be explored in more depth in the next phase of the project. However, the fact that HCI is often taught as an option within a computing course may suggest that HCI lecturers are often 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. Although no significant difference was found between the role of the educator and the practitioner, the difference between the educator and those who enjoy both roles is interesting and may suggest that educators are less likely to practice than practitioners are to educate.

The initial expectation was that the HCI professional would be more likely to fall within the range of Quasi-Intuitive to Quasi-Analytical than the general population. Interestingly, only the practitioner fell into this category, with 66% falling into this range, with those who are both educators and practitioners appearing to be more intuitive and less analytical than those who are solely educators or practitioners. This warrants further investigation, and it may be that the interviews will shed further light.

Object-Spatial Imagery and Verbal Questionnaire

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 four particular groups: scientists and engineers, visual artists, linguists and historians, and the general population.

A one-way between-groups multivariate analysis of variance was performed to investigate differences in the role of the professional (practitioner, educator or both), and the OSIVQ profile. This used the three constructs of the instrument as dependent variables, namely Object Visualiser, Spatial Visualiser and Verbaliser. The independent variable was Role. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity. No serious violations were observed with the exception of multicollinearity, where a very low correlation between the three dependent variables was observed. No significant difference was found between the three groups, necessitating no further consideration of the univariate results: (Wilks' Lambda = .96, F(6, 620) = 1.90, p = .079. (Figure 3)

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.988	8835.090[b]	3.000	310.000	.000	.988
	Wilks' Lambda	.012	8835.090[b]	3.000	310.000	.000	.988
	Hotelling's Trace	85.501	8835.090[b]	3.000	310.000	.000	.988
	Roy's Largest Root	85.501	8835.090[b]	3.000	310.000	.000	.988
Role	Pillai's Trace	.036	1.904	6.000	622.000	.078	.018
	Wilks' Lambda	.964	1.899[b]	6.000	620.000	.079	.018
	Hotelling's Trace	.037	1.894	6.000	618.000	.080	.018
	Roy's Largest Root	.023	2.407[c]	3.000	311.000	.067	.023

a. Design: Intercept + Role

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

Figure 3: OSIVQ Multivariate Tests

T-tests were also conducted to test the assumption that as HCI professionals contribute towards the interface design, they would score more highly than computer scientists and engineers as object imagers, and as they also need to understand the architecture and functional design, they would score more highly than visual artists as spatial imagers. The t-tests comparing the professional against the normative data revealed that whilst there was no significant difference between the object imager score of the HCI professional and the scientist, there was a difference between the spatial imager score of the HCI professional and the visual artist, perhaps again reflecting the computer science background of many professionals (Figure 4).

Group	Spatial Imager: Professional	Spatial Imager: Artist
Mean	3.2000	2.9200
SD	0.6600	0.6500
SEM	0.0372	0.0731
N	315	79

Figure 4: Comparison of spatial imager score of HCI professional and visual artist

Limitations of study

The limitations with this approach are acknowledged. The concerns regarding the validity of self-report surveys are well documented (Arnold & Feldman, 1981; Podsakoff & 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).

Next steps

96 survey participants indicated they were willing to participate further, and provided contact details which has resulted in 24 interviews conducted either via Skype or face to face. This forms the basis of a thematic analysis to extend the cognitive profile, and to identify the predominant technological frames of operation. Technological frames (Orlikowski & Gash, 1994) refer to the concept of shared cognitive frames used to make sense of technology, in this case HCI. Various groups share a particular interpretation of what a

technology means; this interpretation may vary from group to group and will structure their interaction with that technology. Applying this concept of technological frames to the domain of HCI, will help to make sense of the adoption and application of knowledge, tools and techniques amongst the diverse members of this community.

General themes emerging include not only the diversity of the field, but an embracing of that diversity; the value of the analytical; the value of communication; the frustration that current education provision does not meet the needs of the employer; and the influence of internal politics within an organisation, a theme which is particularly evident amongst the educators in relation to the squeezing of HCI contact time.

The different technological frames of the practitioner and the educator become more apparent in their definition of the term HCI, with practitioners offering succinct and pragmatic descriptions of the term, and educators providing more of an emotional response, demonstrating a passion and enthusiasm for the subject. Interestingly, those who enjoy both roles appear to exhibit some frustration regarding the gap between the theory and the application, and research and application. It is not yet clear in which frame this group belongs or whether they are a frame of their own, but the analysis of the CSI did determine a difference between 'both' and the 'educator' so this may be an indication that this group should continue to be considered separately. Also evident is the ability of the academic to suppress their intuitive tendencies when required to perform analytical tasks, and feeling comfortable with either approach.

The analysis of the interviews is not yet complete, and it is anticipated that the outcome of the qualitative phase of the investigation will address some of the unanswered questions above, particularly regarding the difference between the educator and the professional who also teaches.

Conclusion

The themes emerging from the interview data are starting to paint a distinct picture of the differing profiles of the professional. Recognising and accepting the differences between educator and practitioner could be the first step towards identifying the particular skills required to practice in the field, and may support the factoring of those changes into a curriculum that will support the practice. Until educators understand who the practitioner is, they will not be designing courses that meet the need of the market, and equally, unless educators recognise how they differ from the practitioner, they may not deliver what the market needs. It is already recognised that the curriculum does not match practice, and one reason for this may be that the educator is influenced by their own research interests and slants the curriculum to reflect this.

Equally, it is recognised that the subject is diverse and multidisciplinary. In the field this is perceived as a positive, yet in the university, the subject is rarely delivered by a multidisciplinary team, raising the question, should HCI be delivered by computer scientists to computer science students?

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