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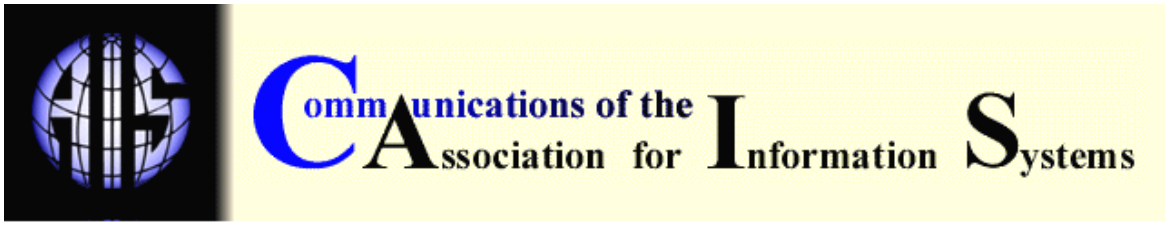

THE ROLE OF HUMAN-COMPUTER INTERACTION IN MANAGEMENT INFORMATION SYSTEMS CURRICULA: A CALL TO ACTION

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ABSTRACT

This article presents a multifaceted case for the inclusion of the important Human-Computer Interaction (HCI) subject matter at both the graduate and undergraduate levels of the Association of Information Systems (AIS) model curricula. Based on the presentations and discussions during a panel at the 2003 Americas Conference on Information Systems (AMCIS), we first present the rationale for incorporating HCI materials in Management Information Systems (MIS) curricula. Second, we present a list of relevant and important HCI knowledge and skills that our students need for effective careers. Third, given the limited number of credit hours available to each MIS program, we explore several strategies and options for the integration of HCI into current and future MIS courses. Finally, drawing upon teaching experiences of the authors, we provide pedagogical suggestions for teaching HCI to undergraduate and graduate students.

Keywords: human-computer interaction (HCI), human factors, management information systems (MIS), model curriculum

I. INTRODUCTION

Human-Computer Interaction (HCI) is interdisciplinary in nature and is studied by researchers, educators, and practitioners from disciplines such as computer science, psychology, management information systems, information science, and human factors engineering. Special interest groups in HCI existed for some time in computer science and human-factors engineering.

As technology develops and changes at an ever-increasing rate, HCI becomes increasingly important. A fast-growing HCI special interest group (SIGHCI) was recently established by the Association for Information Systems (AIS) in 2001. AIS SIGHCI meets twice a year at the Americas Conference on Information Systems (AMCIS) and the International Conference on Information Systems (ICIS). Members of AIS SIGHCI are particularly concerned with HCI issues that have relevance and importance in the Management Information Systems (MIS or IS) context.

MIS-oriented HCI issues have been visited and addressed since the MIS discipline began. Over the years, MIS scholars:

- posited that information systems failures can be attributed to the lack of emphasis on the human/social aspects of system use [Bostrom and Heinen, 1977],
- pointed out the need to attend to user behavior in information technology research [Gerlach and Kuo, 1991],
- and tied a user-factor life cycle to the systems development life cycle [Mantei and Teorey, 1989].

In today's world of fast development and deployment of technology, HCI factors are even more critical and fundamental. HCI goals include: ensuring system functionality and usability, providing effective user interaction support, and enhancing a pleasant user experience. The overarching goal is to achieve both organizational and individual user effectiveness and efficiency. To reach these goals, managers and developers need to be knowledgeable about the interplay among users, tasks, task contexts, information technology (IT), and the environments in which systems are used. As educators, our role is to equip the next generation of managers, designers, and implementers of information systems with the knowledge and skills of HCI so that they can integrate them with many other aspects of the MIS.

To meet the needs of the business world, many IS programs started to integrate HCI courses into their IS curriculum. Chan et al. [2003] present a strong case for the inclusion of HCI topics in the Masters-level curriculum. Their position is premised upon the importance of HCI to web development and e-commerce solutions. We concur with them, but expand the position to include the need for HCI in both the undergraduate and graduate curricula. We echo the need for HCI in web-based development but believe that HCI concepts need to be incorporated in all information systems, not just the web environment.

Despite the articulated need for HCI, the current AIS model curricula do not include HCI materials or courses at the undergraduate level [IS 2002], although one elective HCI-oriented track is optional at the graduate level [MSIS 2000].

The objectives of this article are:

1. to make a case for the coverage of HCI materials in both the undergraduate and graduate MIS model curricula, and
2. to present strategies that address the incorporation of HCI materials into existing or new IS courses.

In addition, we share some pedagogical methods for teaching HCI.

In Section II we define Human Computer Interaction (HCI) from the Management Information Systems (MIS) perspective. Throughout the article, the term HCI is used to represent the Management Information Systems-based human computer interaction focus and the term CHI is used to represent the Computer Science-based computer human interaction focus. We then present a framework for understanding HCI. This framework includes the aspects of the human,

the technology, the interactions that are relevant for study and understanding, the task that humans need to undertake, and the context where the interaction occurs. In Section III we present the current AIS model curricula at both the graduate and undergraduate level. In Section IV we outline strategies for integrating HCI into the MIS Curriculum. Finally, in Section V, pedagogical approaches for the separate course in HCI are articulated.

II. HCI AS AN INTEGRAL PART OF MIS

MANAGEMENT INFORMATION SYSTEMS

To make the case that HCI is an integral part of MIS, one must first define what MIS is, a difficult task in itself. To begin with, journals, societies, and even departments within universities are not in agreement on the definition of MIS or even whether MIS is the appropriate term. Computer information systems (CIS), business computing science (BCS), information systems (IS), information science, information technology (IT), information management (IM), decision support systems (DSS), electronic data processing (EDP), and information resource management (IRM) are among many terms that could be substituted for MIS under various circumstances. For simplicity, MIS or IS will be used to represent these various terms. Baskerville and Myers [2002] revisit the notion of MIS as a reference discipline, indicating the maturity of the MIS field despite the various terms used.

Davis [1974] gave one of the earliest definitions of MIS, in which he described MIS as 'an integrated man/machine system for providing information to support the operation, management, and decision-making functions in an organization'. Ahituv and Neumann [1986] defined MIS as "the systematic study of information systems. An information system is a set of components (people, hardware, software, data, and procedures) that operate together to produce information that supports the operation and management functions of an organization." Laudon and Laudon (2003) considered MIS as "the study of information systems focusing on their use in business and management."

The main unifying aspect of MIS and also the chief factor that distinguishes MIS from computer science is its business orientation. Many MIS departments are housed within colleges of business. MIS graduates seek employment as application programmers, business analysts, project managers, and business.

The MIS orientation is a broad systems orientation rather than a narrow concern for algorithms and software programs. Several fields contribute to the discipline of MIS including

1. sciences such as systems theory, control theory, mathematical economics, decision theory, management science, and statistics;
2. technology such as electrical engineering, and computer science, and
3. social and behavioral sciences such as sociology, cognitive psychology, management, organizational psychology, economics, political science, psycholinguistics, organizational behavior, and philosophy.

HUMAN-COMPUTER INTERACTION

The definition of Human-Computer Interaction depends on the situational context and the referent discipline being considered. To begin a coherent argument for the inclusion of HCI in the IS Curricula, we first define HCI within the IS context. A previous CAIS article by Zhang et al. [2002, p. 2] provides a useful starting point for understanding HCI in IS.

> *In the Information Systems field, HCI issues are explored from a distinctive perspective: MIS researchers and educators take managerial and/or organizational issues into consideration. Human factors (sic HCI) in Information Systems:*

> *". . . is the scientific study of the interaction between people, computers, and the work environment. The knowledge gained from this study is used to create information systems and work environments which help to make people more productive and more satisfied with their work life." [Beard & Peterson, 1988, p. 12-13.]*
>
> *Human Computer Interaction studies in MIS are concerned with the ways humans interact with information, technologies, and tasks, especially in business, managerial, organizational, and cultural contexts.*

Zhang et al. [2002, p. 20] examined three IS journals including *Management Information Systems Quarterly (*MISQ*), Information Systems Research* (ISR), and the *Journal of the Association of Information Systems* (JAIS) and found that in 2000-2001, the percent of total articles that could be classified as having an HCI focus was around 33%. This data shows a tremendous interest in HCI research by MIS scholars.

THE IMPORTANCE OF HCI

In his AMCIS 2003 keynote speech entitled "The Future of the Internet," J. R. Patrick stressed the significance and importance of HCI considerations for business applications. He provided a surprising number of examples of Internet interfaces that were poorly designed, incomplete, and frustrating to the user. He concluded that businesses must pay attention to the functionality and usability of Internet-based tasks, because the young consumers of tomorrow's markets will insist on doing business on the Internet and will be intolerant of dysfunctional and unusable systems. Patrick's call for an emphasis on the usefulness and usability of information systems from the perspective of the user is just the most recent in a long line of such suggestions.

As early as the first volume of *MIS Quarterly*, Bostrom and Heinen [1977] suggested that information systems failures could be attributed to "faulty design choices" (p.17) resulting from the lack of emphasis on the human/social aspects of system use. Gerlach and Kuo [1991] argued that software designers need to expand their focus beyond functional requirements to include behavioral needs of the users. Perhaps the problem is one of inexperience on the part of designers and on the part of an ever-expanding set of users [Galletta 2004]; highly experienced designers could reasonably be expected to know that they should pay closer attention to usability and users' needs. Results of the many studies on technology acceptance demonstrate the importance of both the perceived usefulness and the perceived ease of use for user acceptance of IS [Davis, 1989; Venkatesh & Davis, 1996, Venkatesh et al., 2003.]

Much of the impetus for integrating HCI into IS comes from industry. The role of the IS professional in industry has changed and indicates a need for understanding human-computer interaction. Programmers in the early days of computing were isolated from the rest of the organization and spent most of their time interacting with the computer rather than other members of the organization or even with other programmers. They were focused on developing well-defined, transaction-based systems, rather than on systems analysis and information requirements determination. Programmer/analysts could begin the coding task after a minimal analysis was performed. They did not need to spend hours and hours of their time in determining what the current system did and how to design a replacement system because all the systems were new.

Modern systems development is quite different because the IS function and staff members serve an interactive role in the business organization.

1. Programmers and analysts now spend much more time interacting with users and with each other.

2. The systems being developed today are more complex, forcing IS staff to spend a great deal of time interacting with users to determine what informational and decision-making needs exist.

3. Development approaches such as prototyping are based on iterative feedback from users on the functionality and usability of the systems as they are being developed.

4. Information is seen as an important asset by top management.

5. Information Systems are seen, in many (but not all)[1] firms, as being strategic rather than just having an operational role in the organization.

6. The computer, itself, is now an integral part of the job of all white-collar workers, both office-support staff and knowledge workers.

III. HCI TOPICS IN THE IS MODEL CURRICULA

In this section, we demonstrate the uniqueness of the HCI topics that are relevant to MIS. To begin, we briefly describe the CHI curriculum within ACM.

COMPUTER-HUMAN INTERACTION

The Association for Computing Machinery (ACM) is the largest association founded for academic and practitioner computing specialists. ACM includes several special interest groups (SIG) that address the needs of computing specialists. SIGCHI is the special interest group on computer-human interaction.

Although CHI is one of the more recent SIGs of the ACM, it is ACM's largest SIG, with 4,387 members as of 2003 [ACM, 2003], 700 more members than the next largest. General awareness that the technical efficiency of computer algorithms can often be limited by a poorly designed and implemented user interface is increasing.

ACM SIGCHI offers its own model curriculum [Hewett et al, 1996]. The model curriculum defines CHI [p. 2 of Chapter 2] as:

> *. . . a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.*

It identifies the content of the ACM CHI curriculum as:

1. The Nature of HCI
2. Use and Context of Computers
   a. Human social organization and work
   b. Application areas
   c. Human-machine fit and adaptation
3. Human Characteristics
   a. Human information processing
   b. Language, communication, and interaction
   c. Ergonomics
4. Computer System and Interface Architecture
   a. Input and output devices
   b. Dialogue techniques
   c. Dialogue genre
   d. Computer graphics
   e. Dialogue architecture

[1] For a conflicting view, see Carr[2003]

5. Development Process
   a. Design approaches
   b. Implementation techniques
   c. Evaluation techniques
   d. Example systems and case studies
6. Project Presentations and Examinations

UNIQUENESS OF IS-ORIENTED HCI

Many AIS SIGHCI members also belong to ACM SIGCHI. However, just as the need for the existence of MIS within business programs is necessary and appropriate as an alternative and complement to Computer Science, the existence of HCI in business programs is necessary and appropriate as an alternative and complement to CS-based CHI. The introduction of differently focused HCI materials in MIS programs is a natural evolutionary development and comes as a consequence of the recognition of the importance of HCI to the overall success of IS and, ultimately, to businesses themselves.

The goals of HCI are similar to the goals of CHI. However, the organizational context is much more important to HCI and the focus of interest is not confined merely to the interface between the computer and the user. HCI researchers work to understand the relationships and variables that impact human technology interaction within an organizational and/or managerial setting through empirical evidence. This understanding is used:

1. to help IS professionals develop more usable and therefore more successful systems,
2. to help make IS users (managers, employees, and customers) more productive and satisfied with IS,
3. to enhance organizational effectiveness as an outcome of productive users and IS professionals,
4. to provide researchers with cohesive and cumulative knowledge in order to extend the boundaries of scholarly theory, and

In summary, HCI focuses on increasing user effectiveness and improving user computer experiences with organizational systems. It does so by enhancing the user interface through an understanding of the tasks and organizational contexts in which HCI occurs.

BROAD HCI RESEARCH TOPICS

HCI is more than just the user interface. From a user's perspective, the computer user interface is what a user sees of the system. Thus many times, the user interface and a computer system mean the same thing. From developers or IT project managers' perspectives; however, there is a big difference between the user interface and a computer system. To avoid any confusion, we take the position of treating the user interface as the representation of the entire system to the users. We consider HCI to be broad, including any interactions humans (developers and users) may have with the systems during their entire lifecycle. Thus HCI research systems development, implementation, acceptance, use and impact [Zhang et al., 2002; Zhang, 2003; Zhang & Li, 2004].

Zhang and Li [2004] present a research framework, shown in Figure 1 that captures broad HCI issues and concerns. In a nutshell, the framework considers five components and the interplay among them: Human, Technology, Interaction, Task, and Context. There can be different ways of understanding humans in general and their specific characteristics pertinent to their interaction with IT. One way of examining humans is as shown in Figure 1. Technology can be broadly defined including hardware, software, applications, data, information, knowledge, and supporting

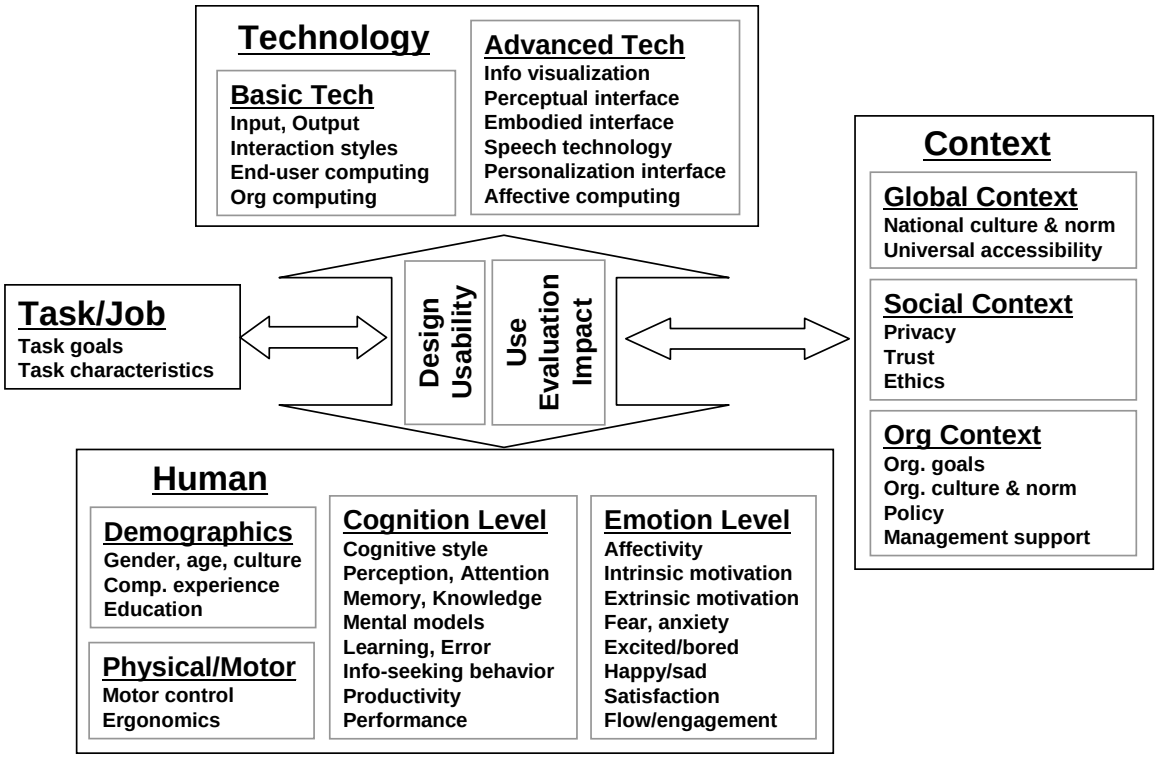

Figure 1. A Broad Overview of HCI [Zhang & Li, 2004]

personnel and procedures. Figure 1 indicates one way of examining technological issues when studying HCI. All the topics under Human and Technology in Figure 1 are meant to be illustrative, rather than exhaustive.

The thick vertical Interaction arrow (the "I" arrow) between Human and Technology represents the "I" in HCI. It is the core of all the actions and can be further divided into two stages: issues that occur during the development of a computer artifact, and issues that occur during the use and impact of the artifact in real contexts. Ideally, concerns about humans and technology should influence interaction. Thus the labeling is meant to be bi-directional. These two classes of emphases are represented by the box "Design / Usability" on the left side inside and the "Use/ Evaluation /Impact" box on the right side of the Interaction component respectively. Zhang and Li further list the specific research topics for each of these two emphases, which are incidentally dominated by CHI and MIS studies respectively.

The picture with Human, Technology, and Interaction alone is incomplete. The interaction experience is relevant and important only when humans use technologies to support their primary tasks within certain contexts, being organizational, social or societal. Normally, humans use technologies not for the sake of technologies but for supporting their primary tasks, whether job-related or entertainment-oriented. In addition, tasks are carried out in a certain setting or context that imposes constraints or significance for doing and completing the tasks. Three contexts are identified: organizational context, social context, and global context. The task and context boxes add the dynamic and essential meanings to the interaction experience the human has with technology. In this sense, studies on interaction are moderated by tasks and contexts. The two horizontal arrows connecting with Task and Contexts represent this fact. [Zhang and Li, 2004].

Although the framework is intended to illustrate research concerns of HCI in the MIS context, it can be helpful to structure and organize HCI concepts within the MIS curricula.

HCI AND SYSTEMS DEVELOPMENT LIFE CYCLE

As educators, we must assure that our students understand HCI tenets and apply them to the IS development and management processes. If HCI is addressed at all in the current IS curricula, it normally happens in the design phase of the systems development life cycle (SDLC). Usually one or two lectures and one chapter of an analysis and design text are devoted to a brief overview of HCI within the design phase. We believe that HCI should be included in the analysis phases of the SDLC as well as the design phases. Deferring HCI to the design stage limits the impact of HCI concerns on the final product. User analysis and task analysis should be at the center of HCI. Figure 2 illustrates the role of HCI within both the analysis and design phases of SDLC.

The left side of Figure 2 represents the analysis and design phases that are currently taught in typical analysis and design classes. They focus on the functionality of the system. These processes emphasize usefulness, with too little focus applied, and usually much too late to ensure that the resultant system is usable.

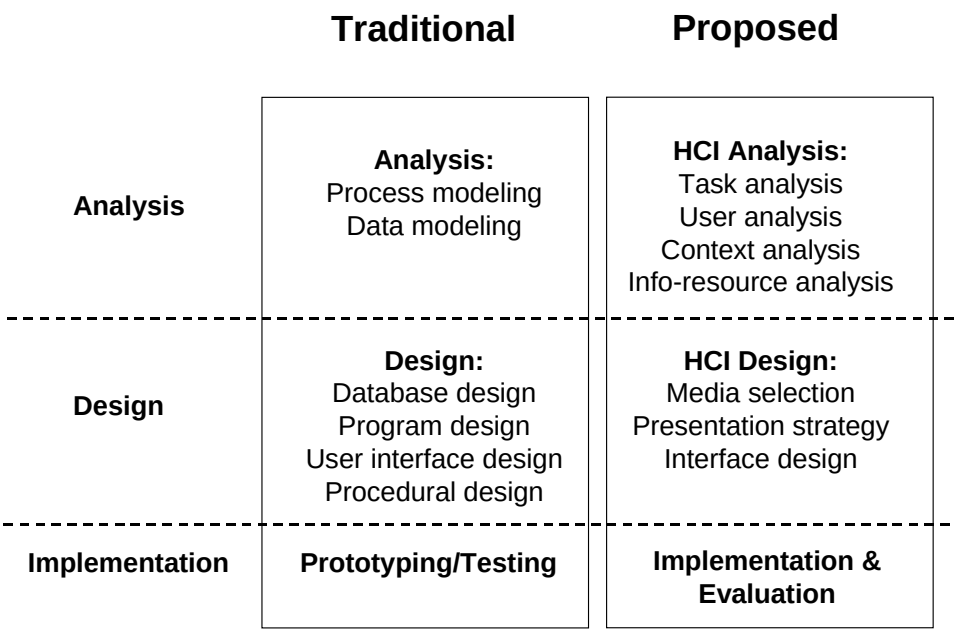

Figure 2. HCI Development Life Cycle: the Traditional Place of HCI in Systems Development Versus the Proposed Scope

The right side of Figure 2 represents the inclusion of an HCI-orientation in the analysis and design phases. In the analysis phase, the task is at the heart of the HCI focus. User analysis, context analysis, and information/data resource analysis all feed into the formation of evaluation goals and metrics. The HCI-informed design phase includes media selection, presentation strategy formulation, and interface design specification. Both the analysis and design phases should be informed by HCI principles and guidelines. Multiple iterations of formative evaluation take place during the design phase. During implementation, a summative evaluation may occur. At every phase, if the evaluation process uncovers weaknesses and lack of conformance to evaluation goals and metrics, the analysis and/or design phases are repeated until the goals are achieved and the metrics meet their target levels.

If MIS curricula included this HCI approach in the analysis, design, and development of information systems, graduates would have a deeper understanding of user needs and expectations and would be able to develop information systems that are not only technically functional and organizationally effective, but that are also usable, and promote positive user experiences.

IV. STRATEGIES FOR INCORPORATING HCI INTO MIS CURRICULA OR PROGRAMS

In this section, we first briefly visit the AIS model curricula. We then explore some strategies for incorporating HCI materials in the curricula. As noted by the curricula committee, the model curricula are recommendations, rather than requirements. MIS educators use the model curricula to establish their own IS programs. We hope the strategies suggested here are helpful for incorporating HCI into IS programs.

THE AIS MODEL CURRICULA

With the advent of The Association of Information Systems (AIS), a model curriculum for undergraduate MIS programs was created in 1997 (jointly with ACM and the Association for Information Technology Professionals) [Davis et al, 1997] and is updated periodically.

The most recent version of the MIS model curriculum for the undergraduate level [Gorgone et al., 2002, p. 17] includes the core courses listed in Table 1.

Table 1. Core Courses in the IS 2002 Model Curriculum

1. Personal Productivity with IS Technology*	7. Analysis and Logical Design
2. Fundamentals of Information Systems	8. Networks and Telecommunication
3. Information Systems Theory and Practice	9. Physical Design and Implementation with DBMS
4. E-Business Strategy, Architecture, and Design	10. Physical Design and Implementation in Emerging Environments
5. IT Hardware and System Software	11. Project Management and Practice
6. Programming, Data, File, and Object Structures	

*Required for all business majors

The model curriculum for the MS level [Gorgone et al., 2000, p. 10 -12] includes the core courses listed in Table 2.

Table 2. Core Courses in the MSIS 2000 Model Curriculum

1. Data Management
2. Analysis, Modeling and Design
3. Data Communications and Networking
4. Project and Change Management
5. IS Policy and Strategy
6. Integration (choose 1 of these 3) • Integrating the Enterprise • Integrating the IS Function • Integrating the Technology

In addition, the MSIS 2000 model curriculum requires that students take a sequence of 4 courses in a career track. Individual universities can choose which career tracks to offer, based on their student population, their faculty capabilities, and the needs of local industry. Examples are given of tracks in academia, consulting, data management and data warehousing, decision making, electronic commerce, enterprise resource planning, global IT management, human factors,

knowledge management, managing the IS function, new ways of working, project management, systems analysis and design, technology management, or telecommunications. It is expected that each school would offer a subset of these tracks or invent some of their own. A particular student would choose one career track to pursue.

Next we offer several suggestions for incorporating HCI into the current MIS curricula. We acknowledge the great difficulty that accompanies core curricular changes at both the graduate and undergraduate levels and the restriction on the total number of core credits each program can have. Curricula may be seen as zero-sum games to the extent that the total number of course credit hours at both the graduate and undergraduate levels is often fixed. Introduction of new requirements must necessarily be accompanied by eliminating existing requirements. Graduate curricula may be even more constrained by a cap on the number of credits in the program and fewer elective options available for substitution. That leaves us with the knotty problem of trying to identify courses in the current core that might be eliminated or targets for a reduction in credit hours. We might think of more creative ways to package one- or two-credit course components, but many universities have trouble scheduling courses that do not fit the standard 3-credit format. With these restrictions in mind, we present specific strategies and examples of how to do so.

FIVE STRATEGIES FOR INTEGRATION HCI INTO IS CURRICULA

How should an IS department proceed to integrate HCI into its graduate and undergraduate IS curricula? Change is difficult. It is unrealistic to attempt to move from no coverage of HCI directly to some ideal coverage of HCI. It is more realistic to follow a phased or evolutionary approach to the integration of HCI into the IS curricula. The following steps are recommended:

1. Ensure coverage of HCI considerations within each required and elective course. Some courses lend themselves more readily to integration than do others. Courses such as management information systems (MIS) already contain many human and managerial components. These introductory courses are likely candidates for beginning an HCI focus.
2. Initiate a separate course dedicated to HCI. Although such change might be difficult, a realistic first step would be to offer a graduate seminar, elective course in HCI. In Section V we offer a HCI course outline derived from the various courses that we teach in our institutions.
3. When the graduate course becomes a permanent part of the graduate curriculum, the next step is to initiate a separate course at the undergraduate level. One way to make the transition into this course is to offer a course that is cross-listed with a senior level prefix and a graduate level prefix. The course outline could follow the undergraduate outline presented in Section V with additional requirements for graduate students. Once this course is in place and is being offered on a continuing basis, it is advisable to teach separate courses at the graduate and undergraduate levels. Such separation also would depend on demand.
4. Implement the optional HCI track at both the graduate and undergraduate levels. Acceptance of such track will be determined by the previous success of the HCI courses at the university, the faculty orientation towards HCI, and what happens at the national level. Most universities are reluctant to introduce new requirements without outside support. Outside influences such as accrediting bodies and professional associations influence curricular decisions. University culture and climate may also dictate the relative likelihood for change.
5. Offer multiple elective courses in HCI. While most schools will not have the opportunity to offer an HCI program or even an emphasis in HCI, some schools may decide to emphasize HCI as the focus of their MIS curriculum. In such a case, multiple courses on HCI topics may be offered. We present two examples from our experience that may be adapted for use in business schools in the U.S. At Yonsei University in South

Korea, undergraduate students may take several classes in HCI. For example, the program offers three HCI courses, focusing on system usefulness, an industry orientation, and multi-disciplinary collaboration. The course focusing on usefulness emphasizes Internet-based electronic commerce, starting with business models that can inform systems design. The course with an industry orientation includes guest speakers from industry on the design of digital contents, which are then presented to and judged by industry representatives. The multi-disciplinary collaboration course focuses on design of screens and includes students from business, graphics design, and cognitive science, and includes a strong emphasis on HCI theory and principles of graphic design. An alternative example is offered by the School of Information and Library Science at the University of North Carolina in Chapel Hill. There, the graduate degree program in information science includes a strong foundation in user-centered systems analysis, followed by a course in user interface design and a seminar in human-computer interaction. Students may also develop individual projects related to HCI, and may focus their masters' thesis on an HCI topic.

ADJUSTING THE HUMAN FACTORS TRACK OF THE GRADUATE MSIS 2000 CURRICULUM

Integration of HCI into the core graduate curriculum is difficult due to the limited number of courses and credit hours. To accommodate such restriction, we recommend that the core courses and the integration course options remain the same for the time being. At this time, we wish to focus on the Career Track of "Human Factors" to reflect the development of the field. The existing set of courses that are currently included in this track are listed in Table 3.

Table 3. Courses in the Human Factors Track

1.	Ergonomics of Computing
2.	Interface Design
3.	Usability Analysis and Testing
4.	Multimedia Design and Production

"Human Factors" has special meanings and normally refers to a discipline that was originated from Ergonomics. To avoid confusion, we recommend changing the name of the track from "Human Factors" to "Human Computer Interaction", which is more appropriate for MIS. We also suggest that the Career Track on Human Computer Interaction should encompass the following four courses to reflect the current state of the development of the field. Each of these four courses are explained briefly next.

1. Introduction to Human Computer Interaction
2. User Interface Design and Project
3. Usability and Use/Impact Evaluation
4. HCI Development Lifecycle for System Design and Analysis

Introduction to HCI

The Ergonomics of Computing course is a bit narrow for MIS students. The name of the course is also less appropriate for MIS concerns. We recommend adding the study of basic human characteristics and behaviors that impact the development and use of information systems and contexts and name this course "Introduction to HCI".

Interface Design

Interface Design is a popular course in a number of IS programs. Normally it is a project-oriented course and can be expanded to include principles and guidelines of HCI.

Usability Analysis and Testing

Traditionally, Usability Analysis and Testing courses focuses on the system development stage prior to actual use (the left box of the Interaction component in Figure 1). The user or organizational evaluation of use and impact of released systems are fundamentally important and have MIS implications. Thus we suggest expanding usability concerns to broader evaluation concerns, including issues that occur during both system development and actual use stages.

HCI Development Lifecycle for System Design and Analysis

Finally, we recommend expanding systems analysis and design course to include the HCI concerns occurring during the entire system development life cycle. The resultant course would be the HCI Development Lifecycle for Systems Analysis and Design, or Advanced Systems Analysis and Design.

EVOLUTIONARY OPTIONS FOR INCORPORATING HCI IN THE IS CURRICULA

Rather than trying to designate which course or courses should be replaced by the introduction of an HCI required course, we suggest that the AIS curricula taskforce consider the introduction of the HCI materials into the model curricula in various ways. Here we present three options for incorporating HCI materials into IS curricula: (1) integrate with core business major IS courses, (2) integrate with required IS courses, and (3) offer a separate HCI course.

Option 1: Integrate with Core Business Major IS Courses

Most universities require business majors to take at least one IS course at both the undergraduate and graduate level. In the recent past, as computer usage in industry shifted from programming to fourth generation languages, the nature of this course changed from programming to usage of application packages. The typical text for this class changed from a total hardware/software orientation to include aspects of information systems. This change grew from AACSB emphasis on information systems coverage in the curriculum. Rather than offer an additional required MIS course at the junior level, many schools elected to squeeze systems concepts into the already ambitious "Intro" course. Textbook authors followed with texts that offer a variety of topics that range from hardware components to systems development. Attention to HCI issues went from nonexistent in the early courses to some attention to managerial issues in the later courses.

Textbooks chose to target the non-IS business majors with books that focus on the managerial issues in IS. The books are less technical and view the computer as a tool for accomplishing managerial tasks rather than an end in itself. The chapters in these texts often include:

1. Management Support Tools (such as Decision Support Systems and Expert Systems),
2. Privacy, Computer Crime, and Security,
3. Office Automation,
4. Personal Productivity Software,
5. Computer Impact on Work, and
6. Computer-related Change.

These topics are directly and indirectly related to HCI. They certainly are more human-oriented than the narrow topics of hardware and software. They do not, however, deal directly with such core HCI topics as usability, interaction styles, documentation, information presentation, ergonomics, or human cognitive/ affective/ behavioral issues.

The strategy in this type of course should be to integrate the HCI components into the body and text of the book. A single chapter on HCI or human considerations is likely to fall at the end of the book

and end up as window dressing rather than add real meaning and knowledge to the book and subsequently the student. Each chapter could contain an HCI segment wherein an appropriate HCI focus is addressed as an integral part of the chapter. It could well be at the beginning of the chapter to capture the attention of the student and draw them into the chapter. It might even be helpful to begin the book with a section on computer anxiety. If students are experiencing anxiety, perhaps dealing with it in the beginning may relieve it and set the tone for a relaxed yet informative semester. Sidebar 1 is a list of typical topics offered in the introductory course and suggested HCI components for each topic.

SIDEBAR 1. TYPICAL TOPICS AND SUGGESTED HCI COMPONENTS

Introduction to Computing (e.g. Courses 1 and 2 in IS 2002)
HCI Components within Each Topic Area

I. Overview
   - A. The role of computer users
   - B. The role of computer specialists
   - C. The computer as a human productivity tool

II. Hardware-Ergonomic Issues

III. Software
   - A. Usability
   - B. Designing the User Interface
   - C. End User Involvement

IV. Input and Output
   - A. End User Productivity
   - B. Direct Manipulation Devices such as touch screen and mouse
   - C. User-oriented media such as voice I/O

V. Central Processing Unit-How the CPU relates to human information processing

VI. Data Communication
   - A. Computer impact on human communication
   - B. Data Communications impact on organizational issues such as power, productivity, structure, strategy

VII. Software Development
   - A. HCI design guidelines
   - B. User Interface Specification Tools
   - C. User Acceptance Testing
   - D. Implementation issues such as resistance to change
   - E. Use of Prototyping to support user/analyst communications
   - F. Training the end user

VIII. Database
   - A. Query support
   - B. Object-oriented databases and their support of realistic mental models of objects

IX. Management Support Tools
   - A. Expert Systems and Explanation Facilities
   - B. Decision Support Systems and graphical user interfaces
   - C. Executive Information Systems and graphical user interfaces
   - D. Information Centers – end user support

X. Office Automation-The impact of computers on work design

XI. Production Automation
- A. Productivity and HCI
- B. Operator-less factories
- C. Locus of Control-the machine or the human?

XII. Ethical issues
- A. Privacy
- B. Accessibility
- C. Property
- D. Accuracy
- E. Accountability

XIII. Future Trends
- A. Global Issues
- B. HCI and Wireless Environments
- C. Computers in health care
- D. Quality of Work Life and Personal Life

Option 2: Integrate with Required IS courses

A number of required courses are candidates for integrating HCI materials into the existing course coverage. Each of these courses and their integration with HCI are explained below.

1. Programming courses
2. Technical IS courses
3. Systems analysis and design, and
4. Management Information Systems

Programming Courses (e.g. Course 6 in IS 2002)

The inclusion of HCI in programming courses is important, but seldom done. In these courses, the goal is to train future programmers and analysts. The focus of programming courses is on syntax, functionality, and efficiency. Factors such as usability and readability are seldom taught or used for evaluation. It is no wonder that end users are often frustrated with the products that programmers produce. Structured-programming techniques help ensure maintainability of code, but do little to ensure usability.

Recent language upgrades such as VB.NET tend to standardize the resultant generated interfaces (a positive feature), but limit the flexibility of those interfaces (a negative feature). It is up to software vendors to ensure that the interfaces generated by their products are usable and flexible.

Each programming course should include at least three HCI-related sections; one on HCI principles and guidelines, one on maintainability of code, and one on the usability of the coded program/system. HCI guidelines should be taught and software should be evaluated on how well the software conforms to these guidelines. Documentation should be required to support the maintainability of code.

Technical IS Courses (e.g. Courses 1 and 3 in MS 2000)

Most IS undergraduate programs and master's programs require database and interactive business systems courses in addition to MIS, Systems Analysis and Design, and Programming courses. Elective courses may include Simulation, Decision Support Systems, Expert Systems, senior or thesis projects, and many seminar and advanced topics courses. Rather than list all the

possible HCI areas for each course, a general HCI integration approach for all of these courses follows.

When developing a course outline, each topic should be examined to find a match between the various HCI components and that topic. For example, all systems require a user interface. Therefore all the HCI guidelines and aspects of user interfaces such as information presentation, decision making support, locus of control, interface specification tools, usability and direct manipulation devices should be presented. All systems require documentation, development, and implementation. The various HCI aspects that are appropriate to the system-specific topics such as resistance to change, end user involvement, IS professional/end user communication, documentation guidelines, and productivity issues should be discussed.

If a concerted effort is made to address the HCI issues within the context of each course, the course would be strengthened and the positive outcomes described previously should result.

Systems Analysis and Design (e.g. Courses 7, 9 & 10 in IS 2002, Course 2 in MS 2000)

HCI should be a strong component of every Systems Analysis and Design course. Prospective analysts and programmers should have a thorough knowledge of HCI theory and application because the Systems Development Life Cycle (SDLC) involves various HCI factors at every stage in the cycle.

Such aspects as user/analyst communication, development team composition, graphic techniques for documentation, prototyping, user interface design guidelines, user acceptance testing, usability, resistance to change, training, and documentation all relate to HCI. The importance of these topics should be stressed and taught in an integrated manner.

Newer development technologies should be explored and evaluated for compatibility with HCI guidelines. The underlying philosophy of systems analysis and design is that the system is built because of and for the end user not for the IS staff; therefore, usability and effectiveness should be primary concerns as well as efficiency and accuracy. The system that is successful is the one that is used effectively by the end users. "State of the art" technology and extravagant features are meaningless if the system does not support the needs of the end user.

Sidebar 2 shows a list of topics that can be offered in the Systems Analysis and Design course and how related HCI issues may be incorporated into this course (adapted from Carey, 1991).

SIDEBAR 2. TOPICS FOR SYSTEMS ANALYSIS AND DESIGN COURSE

Topics and related HCI Issues

I. Introduction
   - A. The role of the IS staff in IS development
   - B. The role of the end user in IS development
   - C. Goals and metrics for effective HCI

II. HCI Considerations in Systems Development
   - A. Human Information Processing and its role in decision making
   - B. Graphical User Interfaces (GUI)
   - C. Adaptive User Audience Models

III. System Development Life Cycle
   - A. The life and death of a system
   - B. The relationship of HCI factors to the phases of the SDLC

IV. The Feasibility Study
   - A. Problem determination techniques
   - B. Analyst/User communication
   - C. Development team composition

V. The Analysis and Requirements Determination Phases

A. Interviewing the end user
B. Tools that support Analyst/User communication
C. The HCI considerations of Joint Application Design (JAD)
D. Prototyping as a means for requirements determination

VI. The Design Phase
A. User interface design
B. Usability testing
C. Standards
D. Use of prototyping to fine tune design specifications
E. Media and techniques to support computer-human interaction
F. Locus of control, ownership, and empowerment issues

VII. The Implementation Phase
A. Coding practices
B. Structured Walkthroughs
C. Documentation techniques
D. Training
E. Combating user resistance to change
F. Summative evaluation
G. Post Implementation Review

Management Information Systems (MIS) (e.g. Courses 3 & 4 in IS 2002)

The purpose of an MIS course is to provide IS students with managerial skills that relate to the IS function. The focus is not technical, although an understanding of the technology is important. The focus is on management of the information technology. Issues, strategies, and tactics for management of the IS function are presented. These issues are often organized around individual aspects of technology such as e-commerce. A course would approach the topic of e-commerce by first laying groundwork for technical understanding and then exploring the issues, strategies, and tactics for managing the technology.

Often the textbooks that support an MIS course draw their knowledge from practitioner journals and use cases to illustrate each of the proposed strategies and tactics. Managerial topics such as leadership, management of the system development process, management of the technologies, end user computing, and the impact of information technology on humans are included in this course. The managerial focus rather than a technical focus ensures that some human considerations will be addressed. A separate section on the human impact of information technology strengthens the HCI focus. An HCI focus would emphasize the IS professional and end-user link. End-user involvement, system-user communication, and over-arching organizational issues are the focus within this course.

Option 3: A Separate Course on HCI

A separate HCI course at both the undergraduate and graduate levels should cover the same basic topics; therefore, the outline below is for both the graduate and undergraduate courses. To distinguish between the two levels, the format of the course and the requirements of the courses will differ and the emphasis on theory should be greater at the graduate level. The graduate course may follow a discussion/student presentation/lecture format with required readings. The requirements at the graduate level might include both an applied working project and/or a theoretical paper. One example is the use of Visual Basic.Net as a tool for teaching the design and execution of user interfaces (Galletta, 2003). The format for the undergraduate level course should be primarily lecture with some "hands on" training in the use of interface specification tools. The requirements at the undergraduate level might include a working project, a research experiment, and evaluation of software usability.

Based on our experiences, we conclude that an HCI course in a curriculum including only one such course should cover the topics and details listed in Table 4.

Table 4. Details of HCI Course Topics

1. The Participants and their Roles a. The end user b. The IS professional c. The computer d. Information 2. Human-based Issues a. Perception b. Cognition c. Memory Constraints d. Problem Solving e. Affect (Emotion) f. Behavior 3. Evaluation Issues a. Evaluation methods b. Usability evaluation c. User experience evaluation	4. Interactive Technologies a. Visual Displays b. Information presentation c. Control devices d. Input/output media 5. HCI Design a. Design Principles & Guidelines b. Design Process c. Practical Applications 6. Impacts of HCI a. Humans b. Work c. Organization d. Society e. International

V. EXPERIENCES IN TEACHING HCI IN MIS AND OTHER NON-COMPUTER SCIENCE PROGRAMS

The authors can share with readers number of aspects on teaching hci to is and other non-computer science students at different study levels (undergraduate, graduate, and doctoral). In this section, we focus on two aspects: teaching hci to audiences with different interests, and some pedagogical techniques for delivering HCI materials at different study levels.

TEACHING HCI TO AUDIENCES WITH DIFFERENT INTERESTS

The set of topics listed in the earlier section on the individual HCI course represents a consensus of the authors. However, various programs and instructors may take those basic topics and give them a specific thrust or focus. We present four such HCI foci with different emphasis:

1. Focus on usefulness
2. Focus on industry-orientation
3. Focus on multi-disciplinary collaboration
4. Focus on content and information retrieval such as for programs in Library and Information Science

HCI with a Usefulness Focus

This undergraduate course is offered at Yonsei University [Kim, 2003]. The usefulness focus is essentially an Internet e-business focus. The course, first given in 1996, is now a flagship course. This focus starts with the business model that, in turn, informs the systems design process. Once students are introduced to the Internet and HCI (2 weeks), the business model is presented by exploring Internet strategies and marketing, market research, and ends up with a business proposal (7 weeks). The focus then shifts to a strong emphasis on HCI design including the design of information, interaction, navigation, and representation (4 weeks). The last phase focuses on testing and implementation and includes usability testing. The output from this course is a functional e-commerce system with payment and security modules.

HCI with An Industry Orientation

The industry-focus HCI course is also an undergraduate course offered at Yonsei University [Kim, 2003]. Students hear guest speakers from industry. They receive free Personal Digital Assistants (PDA) and explore the challenges of designing interfaces for these small devices. Student groups design a system that focuses on the delivery of new digital content for the wireless PDA system. They make a final presentation of the newly designed and implemented system. Attending this final presentation are venture capitalists, content specialists, intellectual property lawyers, mobile Internet Service Providers (ISP), and members of the electronic industry. The student projects that are judged to have excellent market potential are identified by the venture capitalists and corporate sponsors and are actually brought to market. Yonsei University benefits from the revenue stream and the students job opportunities are excellent even before they graduate.

HCI with An Multi-Disciplinary Collaboration Focus

The multi-disciplinary collaborative course includes students from business, graphics design, and cognitive science and is delivered through the HCI labortory at Yonsei University. The cognitive science students bring with them a background in philosophy, linguistics, psychology, computer science, neuroscience, emotional science, cognitive engineering, and system engineering. This strong understanding of human cognition enhances the design and execution of systems that adhere to human computer interaction principles. The course includes a strong emphasis on HCI theory and principles of graphic design including color, visual style, metaphors, icons, and web-based topology [Kim, 2003].

HCI Courses for Library and Information Science Master Students

Some experiences offered by faculty teaching HCI to non-computer science or non-MIS students can provide insight to HCI course offerings. One example is the course offered in the Information and Library Sciences (ILS) program at the University of North Carolina at Chapel Hill [Wildemuth 2003]. The key difference in HCI in ILS is the emphasis on content and information retrieval. The three focal areas of study are humans, technology, and content. The ILS MS program includes a course in user interface design and a seminar course in HCI. The User Interface Design course covers the following topics:

- humans as system users,
- task analysis and description,
- developing a design,
- specifying the design in a prototype, and
- evaluating the design with usability inspection and usability testing.

VI. PEDAGOGICAL TECHNIQUES FOR DELIVERYING HCI COURSES

Pedagogy and the particular pedagogical demands of teaching HCI courses are important considerations when teaching students at different study levels. Here we list some techniques we use for teaching HCI to undergraduate, graduate, and doctoral students.

Teaching Undergraduate Students

The emphasis is on class time, basic concepts and principles, and hands-on experiences. Techniques used include the following [Zhang, 2003]:

- Lectures
- In class exercises & discussions
- Readings
- Case studies
- A design or usability evaluation project (group based)
- Short essays to justify a (good) design decision or criticize a (bad) design example
- Peer evaluation of other groups' projects
- Individual student class presentations

- Participating in HCI research methods such as lab experiments and surveys
- Hall of shame and Hall of fame for students' own projects, or their collections of designs by others
- Quizzes
- Midterm and final examinations

Teaching Graduate Students

The emphasis can be on class time, basic concepts and principles, independent thinking, and hands-on experiences. Some similar techniques for undergraduate can be used for graduate students [Zhang, 2003]. Table 5 is a list of sample assignments used for graduate students [Galletta, 2003].

Table 5. Assignments at the University of Pittsburgh

1. Use of VB.net as an interface design and implementation tool (first half of course) 2. Executive memos that summarize assigned readings 3. Interface critiques (in and outside of class) 4. Use of Tullis software to design a text-based interface	5. Design of an icon 6. Major design project and presentation to class 7. In class exercise on mental models 8. In class exercise on retroactive inhibition (color-based)

Teaching Doctoral Students

Some universities can offer doctoral seminars on HCI [Galletta, 2003; Zhang, 2003]. The emphasis is normally on research. For example, students could develop research proposals for further investigation [Zhang, 2003]. They could also design, code, and run experiments, and write up research reports [Galletta, 2003]. Table 6 is a list of sample readings used at the University of Pittzburgh [Galletta, 2003].

Table 6. Readings at the Doctoral Level at the University of Pittsburgh

1. Previous experiments from the same course (12 articles) 2. Overview of hard and soft science(7) 3. GUIs and Direct Manipulation (8) 4. Design Principles (6) 5. "Damaged merchandize" and HCI evaluation (7) 6. Social factors (5)	7. Devices (11) 8. Menus and command languages (2) 9. Hypermedia (10) 10.Task Analysis/GOMS (6) 11.Cognitive and other fit (7) 12.Mental models and learning (13) 13.Future technologies (12)

VI. CONCLUSION

This article makes a case for the inclusion of HCI content in IS model curricula and suggests ways in which such curricular change can be implemented. We believe that the lack of HCI coverage in the AIS model curricula resulted in IS graduates who lack sufficient understanding of information systems users and their work tasks. This deficiency, in turn, could result in systems that are less usable than they could be given better management of development and more careful design for supporting organizational effectiveness and efficiency.

Including HCI in the IS curricula is important in today's knowledge-driven environment. Including HCI courses should provide the means for attracting students to an IS program and placing those graduates in industry. Advanced technology far surpasses our human ability to use it effectively. Focusing attention on HCI issues should result in IS professionals who would pay attention and understand human needs and thereby enhance communication between themselves and the users. Emphasis on HCI will inevitably result in future systems developed and managed by our students that are useful, usable, and enhance users' positive experiences with the technology.

We urge all HCI scholars to join forces to influence the model curricula and to convince departmental and college-level curricular committees to include HCI in the IS curricula. Strategies for accomplishing these difficult tasks are presented in the article.

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EDITOR'S NOTE: The following reference list contains the address of World Wide Web pages. Readers who have the ability to access the Web directly from their computer or are reading the paper on the Web, can gain direct access to these references. Readers are warned, however, that

1. these links existed as of the date of publication but are not guaranteed to be working thereafter.

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LIST OF ABBREVIATIONS

AIS	Association for Information Systems
ACM	Association for Comp0uting Machinery
CHI	Computer-Human Interaction
HCI	Human-Computer Interaction
MIS	Management Information Systems
SIG	Special Interest Group
SIGCHI	Special Interest Group on Computer-Human Interaction

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