6 : Data Analysis and Interpretation

IT4106 − User Experience Design (UXD)

Level II - Semester 4

Overview

- The goal of this topic is to introduce a variety of methods, and it describes in more detail how to approach data analysis and presentation using some of the common approaches taken in interaction design.

Intended Learning Outcomes

- At the end of this lesson, you will be able to;
  - Discuss the difference between qualitative and quantitative data and analysis.
  - Analyze data gathered from questionnaires.
  - Analyze data gathered from interviews.
  - Analyze data gathered from observation studies.
  - Make you aware of software packages that are available to help your analysis.
  - Identify some of the common pitfalls in data analysis, interpretation, and presentation.
  - Interpret and present your findings in a meaningful and appropriate manner.

List of sub topics

1.1 Quantitative vs Qualitative

1.2 How to do a Quantitative Analysis

1.3 How to do a Qualitative Analysis

1.4 Analytic Frameworks

    1.4.1 Conversation Analysis

    1.4.2 Discourse analysis

    1.4.3 Content analysis

    1.4.4 Interaction analysis

    1.4.5 Grounded theory

    1.4.6 Systems based frameworks

1.5 Analyzing Requirements with Personas and Scenarios

    1.5.1 Personas

    1.5.2 Scenarios

1.6 Interpreting and Presenting Findings

Data Analysis- Introduction

- Influenced by the goals identified and the data gathered
- Different Types
    - qualitative analysis approach,
    - quantitative analysis approach
    - Mixed
- Begins with the initial reactions
    - This may involve identifying patterns or calculating values such as ratios, averages, or percentages
    - Look for anomalies
        - E.g: people who are 999 years old
        - Known as data clensing

Data Analysis- Introduction

- Interpretation of the findings can be done in parallel with analysis
- Common mistakes:
    - investigator's existing beliefs or biases to influence the interpretation of results.

> An initial analysis of the data has revealed a pattern of
> responses to customer care questionnaires that indicates that inquiries from customers
> routed through the Colombo office of an organization take longer to process than those
> routed through the Jaffna office.

    - Different interpretations
        - customer care operatives in Colombo are less efficient
        - they provide more detailed responses,
        - the technology supporting the inquiry process in Colombo needs to be updated
        - Customers reaching the Colombo office demand a higher level of service
        - ...
    - Make claims that go beyond what the data can support.
- Finding the ideal presentation method depends on the goals as well as the target users.

1.1 Quantitative vs Qualitative

- **Quantitative data** is in the form of numbers, or data that can easily be translated into numbers

- **Qualitative data** is in the form of words and images, and it includes descriptions, quotes from interviewees, vignettes of activity, and photos

1.2 Quantitative Analysis

- **Quantitative analysis** uses numerical methods to ascertain the magnitude, amount, or size of something;.
  - Use different types of graphs/ charts for representations
    - Bar graphs
    - Pie charts
    - Scatter plots
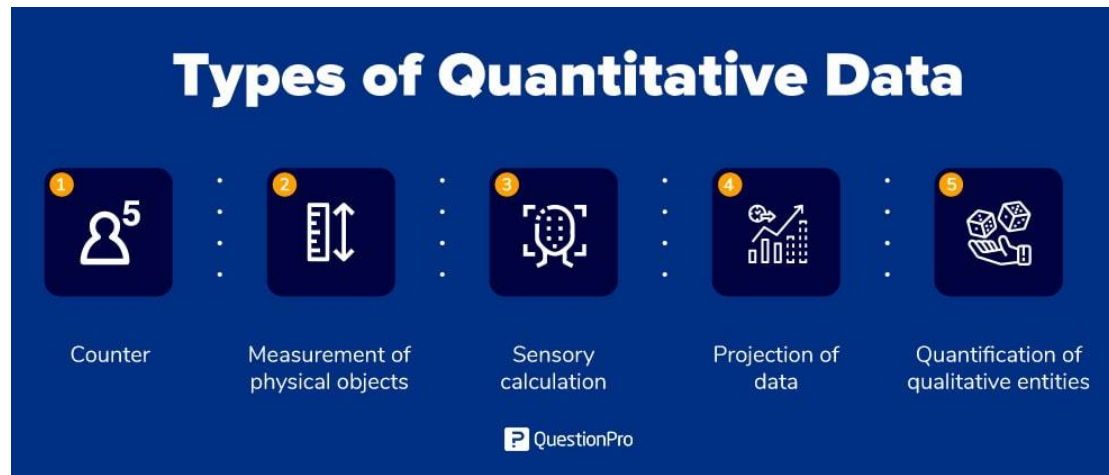
Quantitative vs Qualitative

- While **Quantitative analysis** use **numbers**, **Qualitative analysis** focuses on the **nature of something** and can be represented by themes, patterns, and stories.

Describing a population	
A quantitative analysis	A qualitative analysis
The average person is 5 feet 11 inches tall, weighs 180 pounds, and is 45 years old.	the average person is tall, thin, and middle-aged

Quantitative vs Qualitative

- There is a false assumption that certain form of data gathering can only result in quantitative data and that others can only result in qualitative data.
  - Some assume that an observation type data gathering only qualitative data is collected and in a questionnaire type data gathering, only quantitative data is collected [Wrong assumption]

Type of data/ Data gathering techniqu	Observation	Questionnaire
Quantitative	• number of people involved in a project • how many hours someone spends sorting out a problem	• participant's age, • number of software apps they use in a day • years of work experience
Qualitative	notes about feelings of frustration	The comments written

Qualitative data as NUMBERS!!!

- Qualitative data can also be converted into a set of numbers.

Assume you have collected a set of interviews from sales representatives about their use of a new mobile app for reporting sales queries.

- Let's convert into numbers
  - count the number of words uttered by each interviewee
  - Can attempt to conclude "how strongly the sales representatives feel about the app" --- Is this meaningful??

Initial Steps in Data Analysis

- Some initial processing is normally required before data analysis can begin.
    - For example
        - audio data may be transcribed by hand or by using an automated tool
        - quantitative data, such as time taken or errors made, is usually entered into a spreadsheet

	Usual raw data	Example qualitative data	Example quantitative data	Initial processing steps
Interviews	Audio recordings. Interviewer notes. Video recordings.	Responses to open-ended questions. Video pictures. Respondent's opinions.	Age, job role, years of experience. Responses to close-ended questions.	Transcription of recordings. Expansion of notes. Entry of answers to close-ended questions into a spreadsheet
Questionnaires	Written responses. Online database.	Responses to open-ended questions. Responses in "further comments" fields. Respondent's opinions.	Age, job role, years of experience. Responses to close-ended questions.	Clean up data. Filter into different data sets. Synchronization between data recordings.
Observation	Observer's notes. Photographs. Audio and video recordings. Data logs. Think-aloud Diaries.	Records of behavior. Description of a task as it is undertaken. Copies of informal procedures.	Demographics of participants. Time spent on a task. The number of people involved in an activity. How many different types of activity are undertaken.	Expansion of notes. Transcription of recordings.

Qualitative Analysis

Three basic approaches to qualitative analysis

- Identifying themes – Inductive Analysis
- categorizing data – Deductive Analysis
- Analyzing critical incidents

Analysis is often performed iteratively, and it is common for themes identified inductively then to be applied deductively to new data, and for an initial, pre-existing categorization scheme, to be enhanced inductively when applied to a new situation or new data.

Qualitative Analysis

- The first step in qualitative analysis is to gain an overall impression of the data and to start looking for interesting features, topics, repeated observations, or things that stands out
  - How to decide which is an interesting event will depend on what is being observed
    - E.g If it is a study of how pairs of students use a collaborative learning tool, then activities such as turn taking, sharing of input devices, speaking over one another, and fighting over shared objects would be appropriate to record
- The second step is to look more systematically for themes
  - focuses on checking for consistency

Identifying Themes- Thematic analysis

- considered as an umbrella term to cover a variety of different approaches to examining qualitative data.
  - Used to identify, analyze, and report patterns in the data
- A theme represents a pattern of some kind with respect <u>to the goals driving the study</u>.

  Imagine a survey to evaluate if the information displayed on the university website is appropriate and sufficient.
  - Respondents suggest that the course commencement date and duration should be displayed – a main theme.
  - Respondents say the university's logo is distracting – minor theme

Identifying Themes- Thematic analysis

- Once the themes are identified, then look for an overall narrative

- Often applied in a group using brainstorming techniques with sticky notes

- A common technique for exploring data, identifying themes, and looking for an overall narrative is to create an affinity diagram.

  - Affinity Diagram is a method which can help you gather large amounts of data and organise them into groups or themes based on their relationships.

  - also called "Space Saturate and Group"

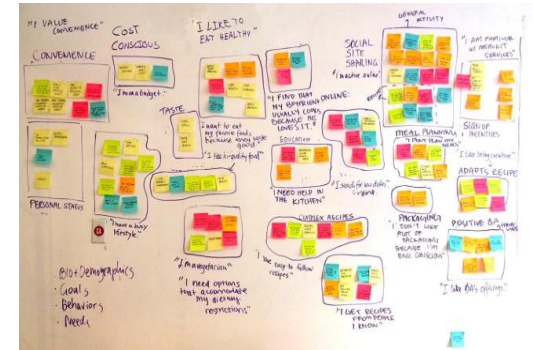   - The group saturate the space with images and notes. Then start grouping to see connections

Creating affinity diagrams

1. Find a wall where post-its can be applied

2. Put pieces of data gathered, ideas, and observations onto post-it notes

3. Take one post-it and make it the first post-it in the first group

4. Take the next post-it and ask, "Is this similar to the first one or is it different?". Then, you will place it in the first group or into its own group.

   You continue post-it by post-it as you place similar ideas together and create new groups when ideas do not fit into an existing cluster

5. Ones you have several groups, cluster them

6. Rank the most important clusters over less important clusters.

7. Sometimes it makes sense to create connections with other clusters using lines or other devices between individual bits of data or clusters of data

8. Describe what you have synthesized, for example, insights, user needs, pain points, or look for gaps you haven't addressed yet.

9. Focus on translating what you've organized and understood into practice, rather than just identifying similar ideas.

https://www.interaction-design.org/literature/article/affinity-diagrams-learn-how-to-cluster-and-bundle-ideas-and-facts

Categorizing Data

- Recorded data can be transcribed before being analyzed from various perspectives.

- Having categorized the data, the results can be used to answer the study goals.

Categorizing Data- Example

I'm thinking that it's just a lot of information to absorb from the screen. I just I don't concentrate very well when I'm looking at the screen. I have a very clear idea of what I've read so far . . . but it's because of the headings I know OK this is another kind of evaluation now and before it was about evaluation which wasn't anyone can test and here it's about experts so it's like it's nice that I'm clicking every now and then coz it just sort of organizes the thoughts. But it would still be nice to see it on a piece of paper because it's a lot of text to read.

Am I supposed to, just one question, am supposed to say something about what I'm reading and what I think about it the conditions as well or how I feel reading it from the screen, what is the best thing really?

Observer: What you think about the information that you are reading on the screen . . . you don't need to give me comments . . . if you think this bit fits together.

There's so much reference to all those previously said like I'm like I've already forgotten the name of the other evaluation so it said unlike the other evaluation this one like, there really is not much contrast with the other it just says what it is may be . . . so I think I think of . . .

Maybe it would be nice to have other evaluations listed to see other evaluations you know here, to have the names of other evaluations other evaluations just to, because now when I click previous I have to click it several times so it would be nice to have this navigation, extra links.

Excerpt from a transcript of a think-aloud protocol when using an online educational environment. Note the prompt from the observer about halfway through. Source: Armitage (2004).

Categorizing Data- Example

1. **Interface Problems**
   1.1. Verbalizations show evidence of dissatisfaction about an aspect of the interface.
   1.2. Verbalizations show evidence of confusion/uncertainty about an aspect of the interface.
   1.3. Verbalizations show evidence of confusion/surprise at the outcome of an action.
   1.4. Verbalizations show evidence of physical discomfort.
   1.5. Verbalizations show evidence of fatigue.
   1.6. Verbalizations show evidence of difficulty in seeing particular aspects of the interface.
   1.7. Verbalizations show evidence that they are having problems achieving a goal that they have set themselves, or the overall task goal.
   1.8. Verbalizations show evidence that the user has made an error.
   1.9. The participant is unable to recover from error without external help from the experimenter.
   1.10. The participant suggests a redesign of the interface of the electronic texts.

2. **Content Problems**
   2.1. Verbalizations show evidence of dissatisfaction about aspects of the content of the electronic text.
   2.2. Verbalizations show evidence of confusion/uncertainty about aspects of the content of the electronic text.
   2.3. Verbalizations show evidence of a misunderstanding of the electronic text content (the user may not have noticed this immediately).
   2.4. The participant suggests re-writing the electronic text content.

Identified problems should be coded as [UP, << problem no. >>].

Criteria for identifying usability problems from verbal protocol transcriptions

Categorizing Data- Example

- The final step is to code the transcription according to the criteria
  - The excerpt is coded using the categorization scheme

[I'm thinking that it's just a lot of information to absorb from the screen. **UP 1.1**][I just I don't concentrate very well when I'm looking at the screen **UP 1.1**]. I have a very clear idea of what I've read so far . . . [but it's because of the headings **UP 1.1**] I know OK this is another kind of evaluation now and before it was about evaluation which wasn't anyone can test and here it's about experts so it's like it's nice that I'm clicking every now and then coz it just sort of organises the thoughts. [But it would still be nice to see it on a piece of paper **UP 1.10**] [because it's a lot of text to read UP 1.1].

Am I supposed to, just one question, am supposed to say something about what I'm reading and what I think about it the conditions as well or how I feel reading it from the screen, what is the best thing really?

Observer: What you think about the information that you are reading on the screen . . . you don't need to give me comments . . . if you think this bit fits together.

[There's so much reference to all those previously said **UP2.1**] [like I'm like I've already forgotten the name of the other evaluation so it said unlike the other evaluation this one like, there really is not much contrast with the other it just says what it is may be . . . so I think I think of . . . UP 2.2]

[Maybe it would be nice to have other evaluations listed to see other evaluations you know here, to have the names of other evaluations other evaluations **UP 1.10**] just to, [because now when I click previous I have to click it several times **UP 1.1, 1.7**] [so it would be nice to have this navigation, extra links **UP 1.10**].

1. **Interface Problems**
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Critical Incident Analysis

- *Critical incident analysis* is one approach that helps to identify significant subsets of the data for more detailed analysis.

- The main focus is to identify specific incidents that are significant and then to focus on these and analyze them in detail, using the rest of the data collected as context to inform interpretation.

  - E.g. in a usability test, a critical incident could be an occasion where the users were obviously stuck

Analytic Frameworks

1.4 Analytic Frameworks

- Analytical frameworks help analyze and interpret data from a qualitative study
- Six different approaches
  - Conversation Analysis
  - Discourse analysis
  - Content analysis
  - Interaction analysis
  - Grounded theory
  - System based frameworks

Conversation Analysis

- **Conversation analysis (CA)** examines the semantics of a conversation in fine detail

- This technique is used in sociological studies

- The focus is on how conversations start and how turn-taking is structured, together with other rules of conversation.

- It has been used to analyze interactions in a range of settings, and it has influenced designers' understanding of users' needs in these environments.

- It can also be used to compare conversations that take place through different media.

Discourse Analysis

- **Discourse analysis** focuses on dialogue
- The meaning of what is said and how words are used to convey meaning.
- Discourse analysis is strongly interpretive
- It pays great attention to context
- Language is a form of social reality that is open to interpretation from different perspectives

Content Analysis

- **Content analysis** typically involves classifying the data into themes or categories and then studying the frequency of category occurrences (Krippendorff, 2013).

- The technique can be used for any text, where "text" refers to a range of media including video, newspapers, advertisements, survey responses, images, sounds, and so on

Interaction Analysis

- Way of investigating and understanding the interactions of human beings with each other and objects in their environment

- Interaction analysis is an inductive process

- The technique focuses on both talk and nonverbal interactions with artifacts and technologies, and it is based on video recordings.

- The goal is to derive generalizations from videos of naturally occurring activities, focusing on how the people being observed make sense of each other's actions and their collective achievements.

Grounded Theory

- The goal of *grounded theory* is to develop theory from a systematic analysis and interpretation of empirical data

- The derived theory is grounded in the data

- It is an inductive approach to developing theory

- Development of a "grounded" theory progresses through alternating data collection and data analysis

- Data categorization called as 'coding'. It has three aspects;
    - Open coding
    - Axial coding
    - Selective coding

Systems based Frameworks

- Conducting analyses of small fragments of conversation or identifying themes from interviews may be useful for highlighting specific working practices

- Understanding how a whole socio-technical system works at scale requires a different kind of analytical framework

- Two such frameworks are:
  - socio-technical systems theory
  - Distributed Cognition of Teamwork

Framework	Data	Focus	Expected outcomes	Level of granularity
Conversation analysis	Recordings of spoken conversations	How conversations are conducted	Insights into how conversations are managed and how they progress	Word-level, or finer, for instance, pauses and inflection
Discourse analysis	Recordings of speech or writing from individuals or several participants	How words are used to convey meaning	Implicit or hidden meanings in texts	Word, phrase, or sentence-level
Content analysis	Any form of "text" including written pieces, video and audio recordings, or photographs	How often something is featured or is spoken about	Frequency of items appearing in a text	A wide range of levels from words, to feelings or attitudes, to artifacts or people
Interaction analysis	Video recordings of a naturally-occurring activity	Verbal and non-verbal interactions between people and artifacts	Insights about how knowledge and action are used within an activity	At the level of artifact, dialogue, and gesture
Grounded theory	Empirical data of any kind	Constructing a theory around the phenomenon of interest	A theory grounded in empirical data	Varying levels, depending on the phenomenon of interest
Systems-based frameworks	Large-scale and heterogeneous data	Large-scale involving people and technology, such as a hospital or airport	Insights about organizational effectiveness and efficiency	Macro-level, organizational level

Table 9.5 Overview of analytical frameworks used in interaction Design

Interpreting and Presenting Findings

Interpreting and Presenting Findings

- There are three kinds of presentation styles that can be used to interpret and present the data in a meaningful way:
    - using structured notations
    - using stories
    - summarizing

Structured Notations

- A number of *structured notations* have been developed to analyze, capture, and present information for interaction design
    - Unified Modeling Language (UML)
    - work models used in contextual design
- Advantage
    - the meaning of different symbols is well-defined, and so it provides clear guidance on what to look for in the data and what to highlight and that it enforces precision in expression
- Disadvantage
    - by highlighting specific elements, it inevitably de-emphasizes or ignores other aspects, and the precision expressed by the notation may be lost on an audience if they don't know the notation well
    - To overcome these disadvantages, structured notations are usually used in combination with stories or other easily accessible formats.

Using Stories – AKA narratives or scenarios

- *Storytelling* is an easy and intuitive approach for people to communicate ideas and experiences.

- Storytelling may be employed in three different ways
    - First: participants may have told stories of their own during data gathering.
    - Second: stories (or narratives) based on observation, such as ethnographic field studies, may be employed for further data gathering
    - Third: stories may be constructed from smaller snippets or repeated episodes that are found in the data.

Summarizing the Finding

- Presentation styles will usually be used in combination to produce a summary of the findings
  - E.g: a story may be expanded with graphical representations of activity or demographics, and data excerpts from transcripts or videos may be used to illustrate particular points.
  - Tables of numerical data may be represented as graphs, diagrams, or rigorous notations, together with workflows or quotations