

QUALITATIVE RESEARCH

Priyam Rajkhowa

WHAT IS QUALITATIVE RESEARCH?

- Study of highly complex and contingent phenomena
- Numbers of variables is too high to be handled by quantitative methods.
- Collecting, analysing, and interpreting data by observing what people do and say.
- Qualitative research refers to the meanings, concepts, definitions, characteristics, metaphors, symbols, and descriptions of things.
- Usually emphasizes words rather than quantification in the collection and analysis of data

- Predominantly emphasizes an inductive approach to the relationship between theory and research, in which the emphasis is placed on the generation of theories
- Has rejected the practices and norms of the natural scientific model in preference for an emphasis on the ways in which individuals interpret their social world
- Embodies a view of social reality as a constantly shifting emergent property of individuals creation (processes) in qualitative you generate “*deep cultural understanding*” about the phenomenon in question ==> *theoretical generalizations*

QUALITATIVE RESEARCH

Strengths

- Good for examining feelings and motivations
- Allows for complexity and depth of issues
- Provides insights into the real life situations

Weakness

Can't extrapolate to the whole population

Volume of data

Complexity of analysis

Time-consuming nature of the clerical efforts
required in this method of research

"ETHOS" OF QUALITATIVE RESEARCH: "INTERPRETIVISM"

1. Seeing through the eyes of the people being studied
2. Emphasis on content ("thick description")
3. Emphasis on process
4. Flexibility and limited structure
5. Concepts and theory grounded in data

QUALITATIVE RESEARCH STRATEGY

1. Focus on words

2. Inductive
relationship between
theory and research

3. Interpretivism
(epistemology)

4. Constructionism
(ontology)

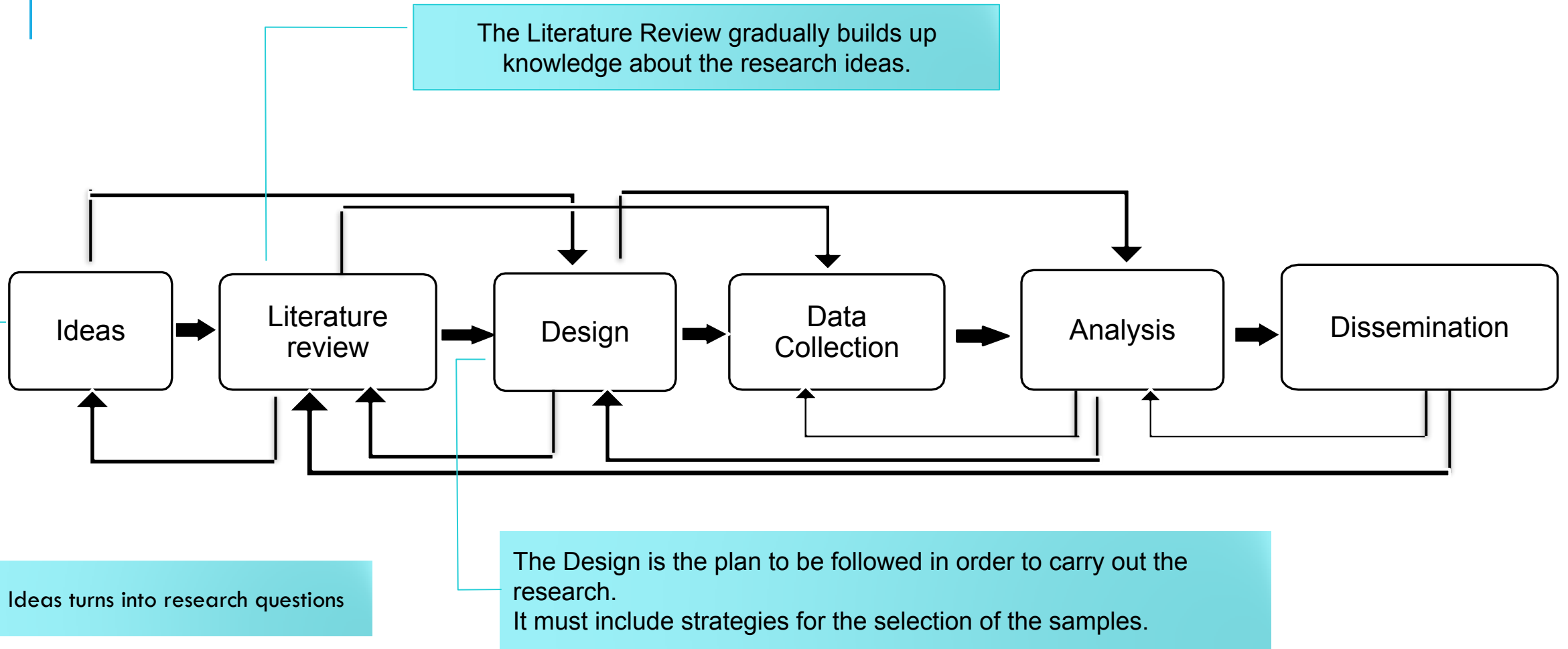
QUALITATIVE RESEARCH PROCESS

1. General research questions
2. Selecting relevant site(s) and subjects
3. Collection of relevant data
4. Interpretation of data
5. Conceptual and theoretical work
 - 5.a. Tighter specification of the research question(s)
 - 5.b. Collection of further data
6. Write up findings and conclusions

Major difference: relationship between theory and data.

-Theory extracted from data

RESEARCH PROCESS



RESEARCH PROCESS

Data Collection

The Data Collection and Organization phase is devoted to gathering the data for the research and organizing it, so that it can be properly analyzed. These are difficult tasks, since the volume of data collected in qualitative research can be enormous.

Analysis

- The Analysis includes three concurrent flows of action:
- Data Reduction, which focuses, simplifies, and transforms raw data into more manageable forms;
- Data Display, which presents the data as organized and compressed assemblies of information that permit conclusions to be analytically drawn; and
- Conclusions & Verification, where the researchers review and finalize all their conclusions and make sure that they satisfy the requirements of validity.

Dissemination

Dissemination takes the form of very well written and detailed documents, so that other researchers can evaluate the analysis and conclusions obtained and decide if they trust the results and want to use them to feed their own research.



OBSERVATION



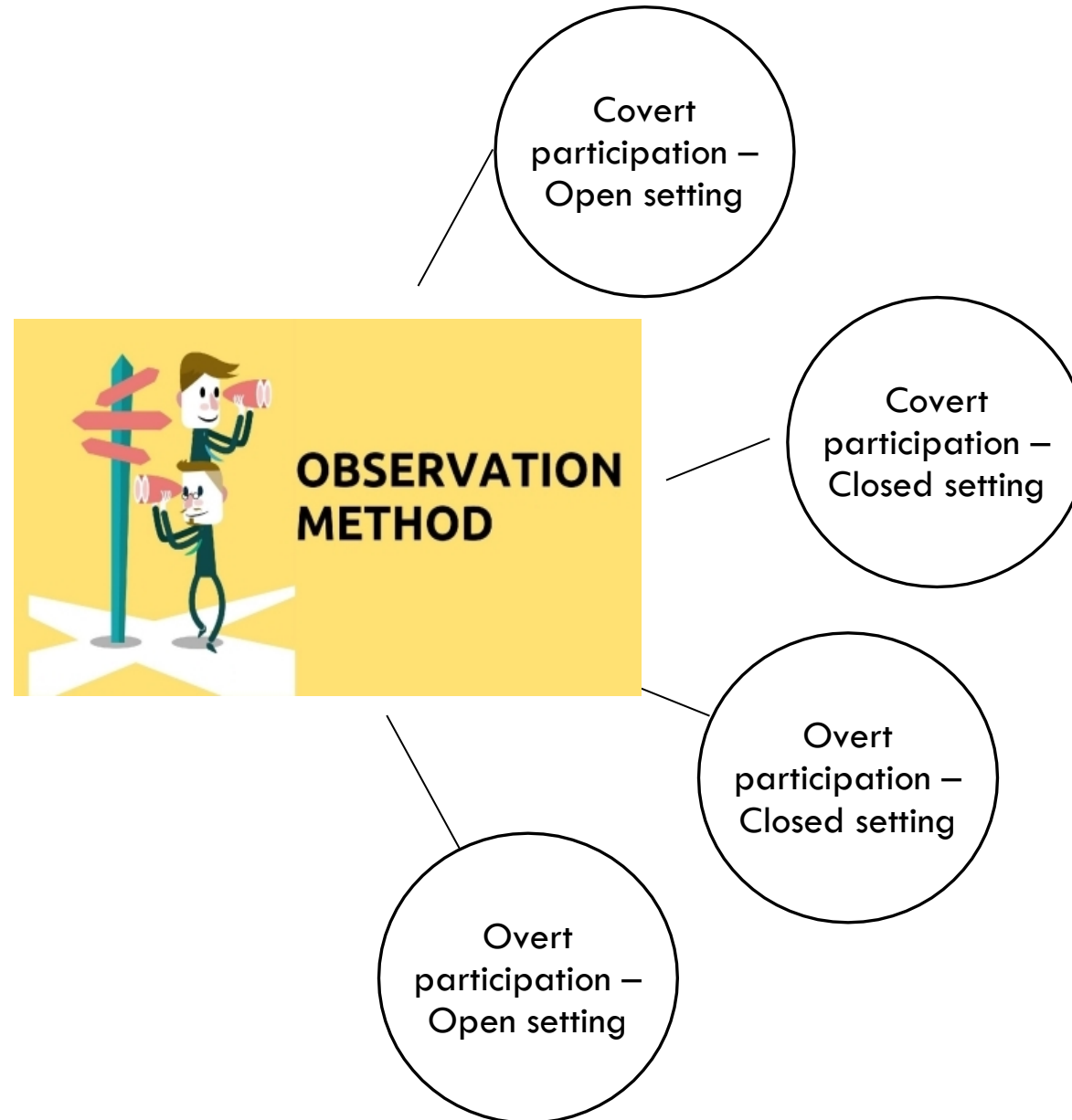
The diagram consists of three horizontal rows. Each row has a rounded rectangular box on the left containing text, and a larger rectangular box on the right. A vertical blue line is positioned to the left of the first row. The text in the rounded boxes describes the process of observation, its purpose, and a limitation.

Observing people working or performing activities and interacting with technologies

Gaining an understanding of what people really do in practice

Without complementary interviews it can be difficult to make sense of what is observed

PRACTICE OF OBSERVATION



Covert role:

- No need for permissions
- People do not react to the researcher
- Problem of doing notes
- Problem of not being able of using other methods than observation
- Creates anxiety
- May raise ethical questions
- Necessitates trustful relationships to the people studied

Overt role:

- Necessitates trustful relationships to the people studied

THINK-ALLOUD

Users talking through thoughts while interacting with the system or solving a problem

Requires access to system. Data focuses on the system rather than the broader work context

Understanding how people perceive and experience the system and how they use it to support their work

UNSTRUCTURED INTERVIEW

- The researcher uses at most the short list of key words or central
- Issues that should be discussed about. Interviewee is allowed to answer freely and the researcher only responds to the points that seem to be worthy of being followed.
- Almost like a conversation.

TYPES OF INTERVIEW

STRUCTURED

- FOCUSED INTERVIEWS
- PRE DETERMINED/CLOSE ENDED QUESTIONS
- QUICK AND EASY TO ADMINISTER
- LIMITED RESPONSES/LACK DETAIL
- CHEAPER TO OBTAIN INFO

SEMI-STRUCTURED

- FOCUSED INTERVIEWS
- OPEN ENDED QUESTIONS
- TIME CONSUMING
- ENCOURAGES PROBING
- EXPENSIVE TO EMPLOY AND TRAIN INTERVIEWERS

UNSTRUCTURED

- RESPONSE DEPENDENT QUESTIONS
- TIME CONSUMING
- DETAILED DISCUSSIONS
- EXPENSIVE TO EMPLOY AND TRAIN INTERVIEWERS

SEMI- STRUCTURED INTERVIEWS

Integrating people about their work,
their experiences of technology their
hopes for future technology

People have difficulty reporting
accurately on what they do

Gathering people's perceptions and
experiences

Key characteristics of semistructured interviews

- ✓ Loose, flexible structure
- ✓ Iterative
- ✓ Groups or individual participants
- ✓ Scheduled in advance
- ✓ Gathers information from key informants who can inform the topic
- ✓ Insight into participant perspectives
- ✓ Deep exploration of participant thoughts and experiences
- ✓ Often the sole data source for a qualitative study

FOCUS GROUPS



Facilitating a group discussion, most commonly between people with similar backgrounds about the theme or technology of interest

Gathering perceptions and experiences, often with greater breadth but less depth than interviews

Focuses on perceptions rather than actions risk of groupthink unless carefully managed

Background in marketing studies: testing new products

Specific theme that is explored in depth

Is not just a money or time saving technique but conscious strategy

The aim of the discussion is told to the group

FOCUS GROUPS

In critical studies used to raise consciousness among a group

Some have also claimed that group interview is less artificial situation than “normal” interview and that group situation reduces the leading role of interviewer

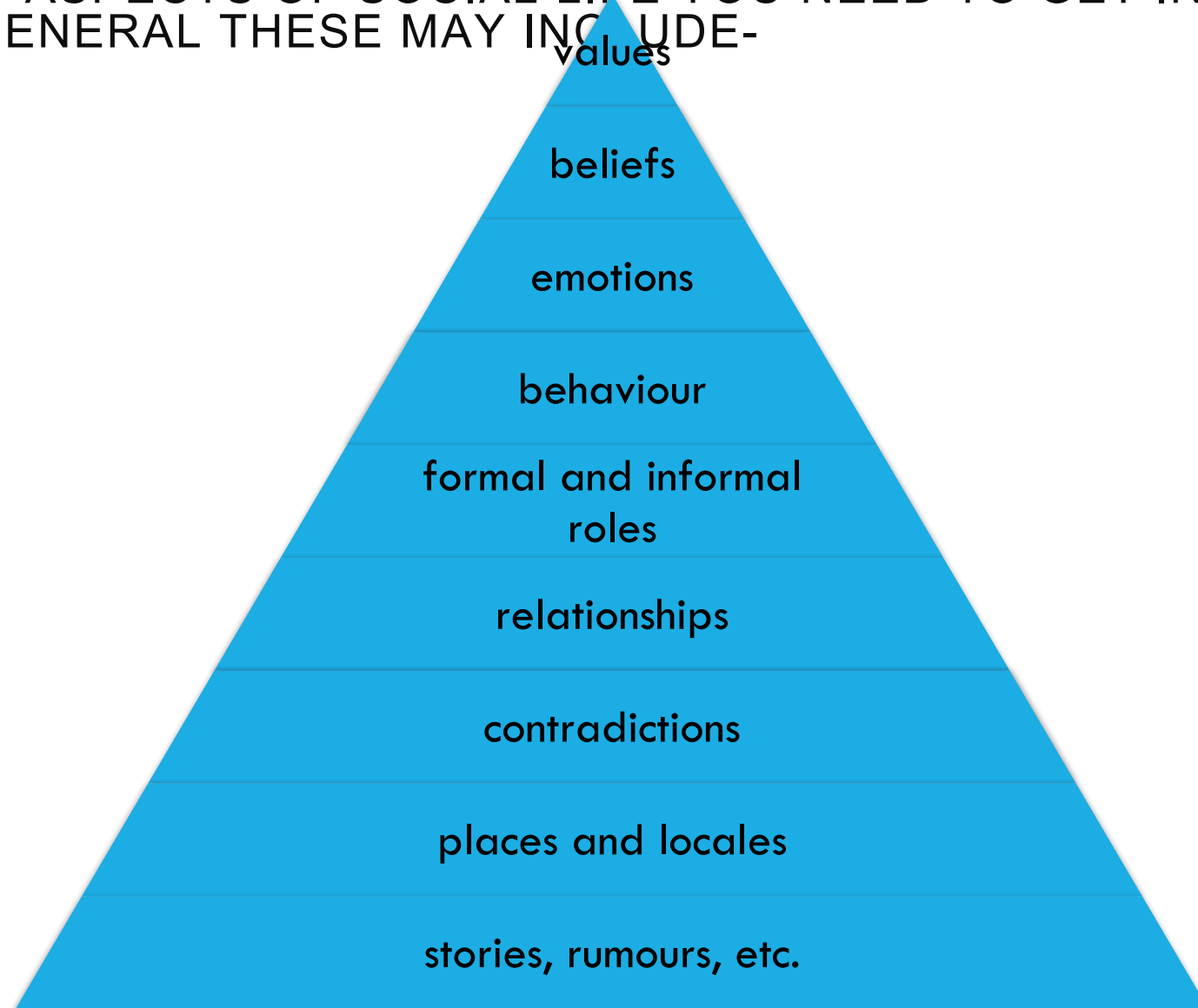
Introduce yourself to the setting in which interviewees engage in order to understand their point of view

Create a certain amount of order on the topic areas so that your questions will cover the whole area and they follow each other in reasonable order

All the time remember focus on your research question and formulate such interview questions that are concretely oriented to answer to it (but avoid too specific questions)

Use language that is relevant and understandable to the people interviewed

THINK WHAT ASPECTS OF SOCIAL LIFE YOU NEED TO GET INFORMATION ABOUT, IN GENERAL THESE MAY INCLUDE-



DIARY STUDIES

- Participants maintain a diary of relevant actions, experiences or thoughts
- Longitudinal data gathering that is situated in the context of use
- Maybe fairly superficial unless participants have a high level of commitment



AUTOETHNOGRAPHY

Researcher participates in the intervention and maintains a diary of actions, experiences and reflections

researcher gaining empathy but participants and with others who experience the intervention

highly subjective, and probably not representative of the user population

WORKING WITH EXISTING SOURCES

building understanding
based on background
material

using existing sources like
video social media audio
text etc as data for
addressing the research
problem

data was generated for a
different purpose and
audience, so may not be
directly suited to the current
research question

THEORY SHAPED RESEARCH

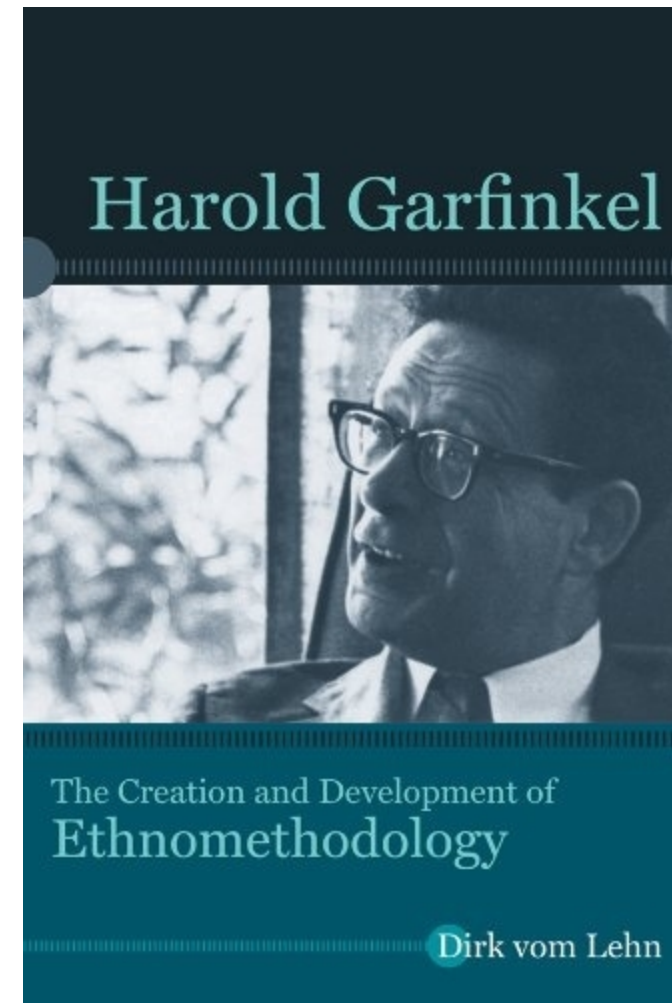
The design of data gathering and analysis is informed and constrained by the selected theory

Testing extending theory or gaining insights into design or evaluation of system from the selective theoretical perspective

May overlook important considerations that are not covered by the theory

ETHNOMETHODOLOGY

- Ethnographic research is inspired by the practices of cultural and social anthropology, where the researcher integrates for a period of time the community where the study is taking place.
- Data gathering and analysis shaped by the ethnomethodological focus on how workers perform and makes sense of their work
- Gaining insights for design based on how people were can make sense of their work
- It may overlook important considerations that are not covered by the approach
- The approach is very common when developing and assessing information systems.
- E.g. to understand how the 4200 workers of a company react to the setting up of an CRM solution so as to improve that solution and make sure that future solutions do not suffer from similar problems.



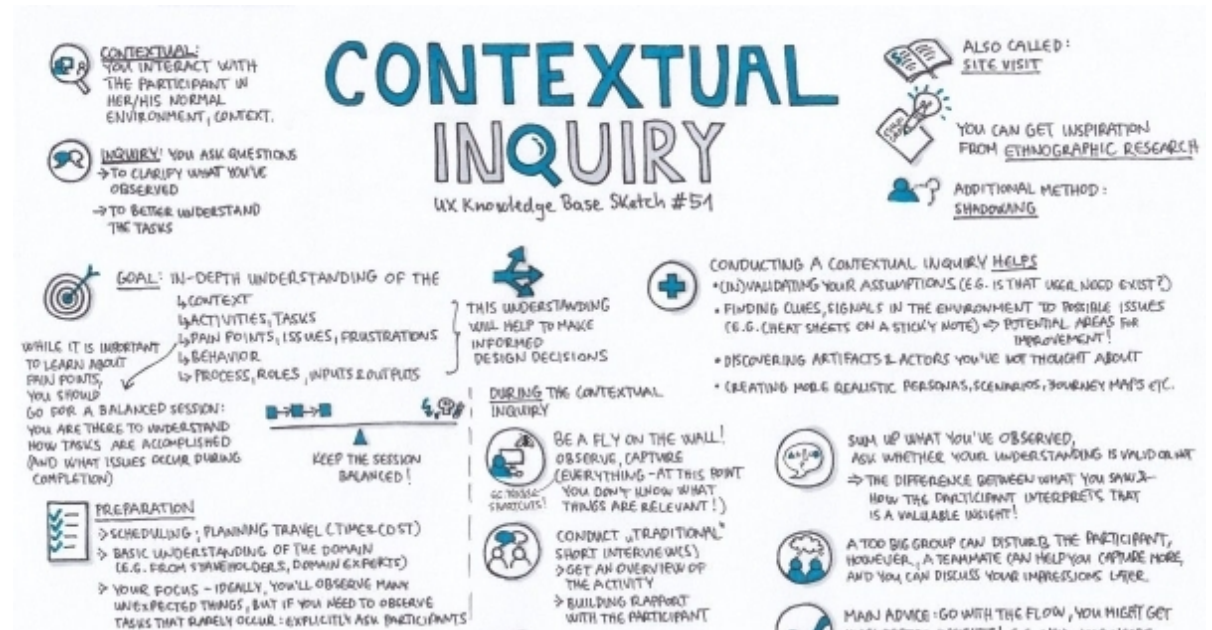
CONTEXTUAL INQUIRY

data gathering and preliminary analysis shaped by the constructs & questions of contextual inquiry example information flow artifact use etc

gaining insights for design based on information flow, how current artifacts are used etc within work

we overlook important considerations that are not covered by the contextual inquiry models

it is also not suited to mobile settings

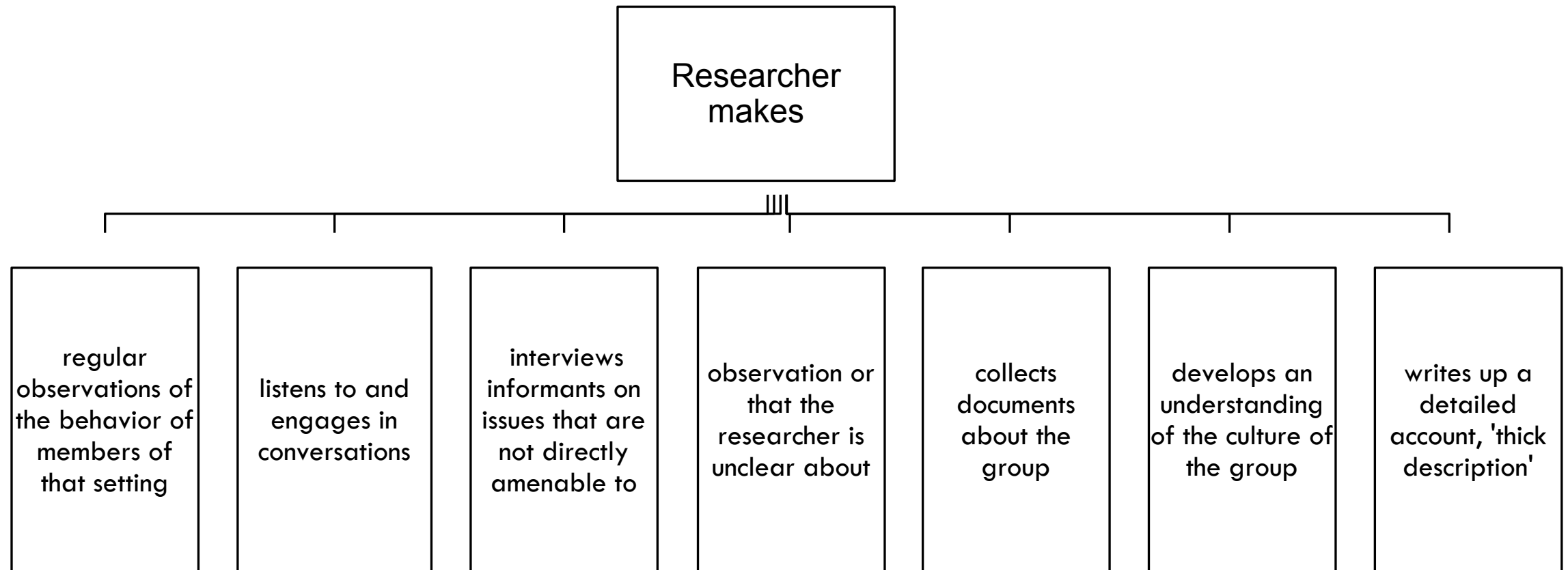


PARTICIPANT OBSERVATION

- The researcher participates to a very great or lesser extent in the setting being studied
- Getting immersed in the activity and experiencing something similar to what others experience in that situation
- It is not always possible to participate meaningfully in the activity requires reflexivity to understand one's own role in the situation



“PARTICIPANT OBSERVER IMMERSES HIM-/HERSELF IN A GROUP FOR AN EXTENDED PERIOD OF TIME, OBSERVING BEHAVIOUR, LISTENING TO WHAT IS SAID IN CONVERSATIONS BOTH BETWEEN OTHERS AND WITH THE FIELDWORKER, AND ASKING QUESTIONS.” (ALAN BRYMAN: SOCIAL RESEACH METHODS, 2004)



ACTION RESEARCH

- Involves an intervention example introducing a new technology or process and studying the effect of that intervention on work in user experience
- Introducing innovations into the situation and understanding their effect on practice
- Can be difficult to discern the effects that are attributable to the intervention
- It requires reflexivity



Action-Research is today one of the more promising qualitative research approaches in Information Sciences and Technologies research.

In essence, it consists of repeatedly going through the cycle:

Planning => Action => Reflection

Action-research corresponds to what John Dewey called the *Principle of Intelligent Action*.

ACTION RESEARCH

- We start by making a plan of our action in a crude first approximation, we act following that plan, and we then reflect on the results obtained.
- From this reflection, we correct our previous plan, act in agreement with the new plan, and reflect on the results we have now obtained.
- The cycles go on, repeatedly, until we are happy with the results.



GROUNDNED THEORY

Grounded Theory is a research approach proposed the sociologists *Barney Glaser* and *Anselm Strauss*, who claim that research should depart “*from the ground*”.

The researcher categorizes empirically collected data in order to build a general theory that fits the data.

In essence, it is based on the generation of theory from data.

This approach radically defies the traditional positivist approaches, which claim that the researcher must depart from a theory, establish hypotheses that conform to the theory, and than get to the field to confirm the hypotheses in light of the theory.

- Involves interleaving data gathering usually interviews with analysis focusing on systematically developing theory in strongest form
- Developing new theory from data
- Depth of analysis may be disproportionate for small studies

GROUNDING THEORY

Emphasizes systematic analysis of data:

- Theoretical sampling
- Coding
- Theoretical saturation
- Constant comparison

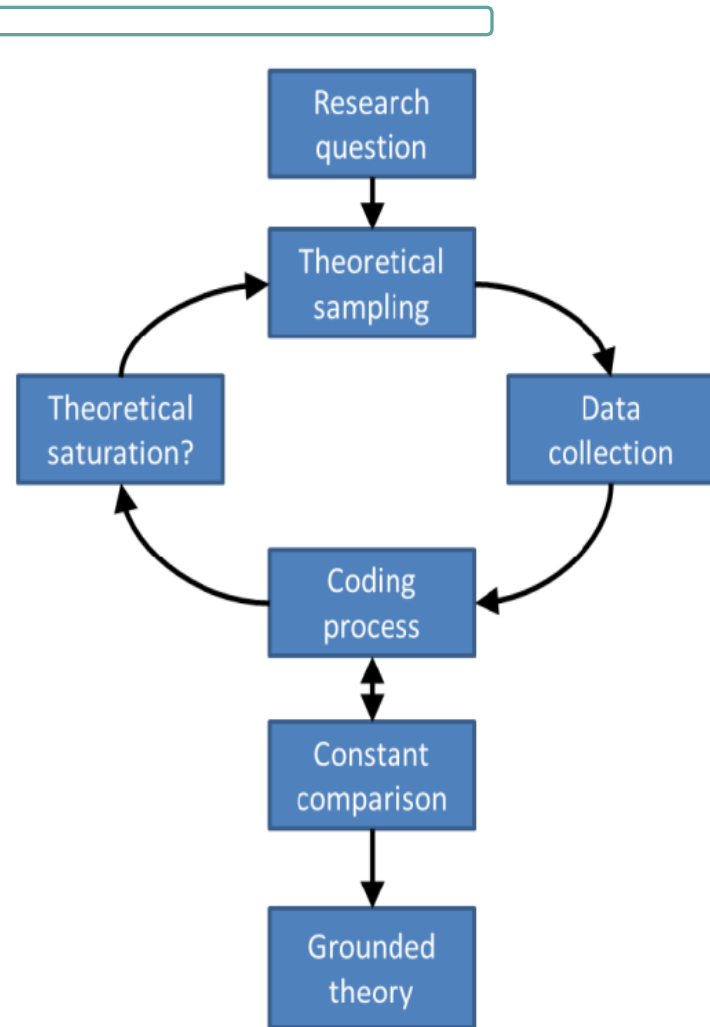
Coding = naming fragments of the data, producing an index

Coding as a process:

1. Read the data
2. Read the data again and start the coding (marginal notes)
3. Read the data again and finish the coding
4. Read the coding again and try to formulate general categories out of codes
5. Do experimental coding
6. Test everything with the data

The basic idea is to proceed from the mess of minor codes to the

major categories that give systematic structure to the data in general



Coding as such is only a means to organize the data, to reduce a vast amount of material into organized categories

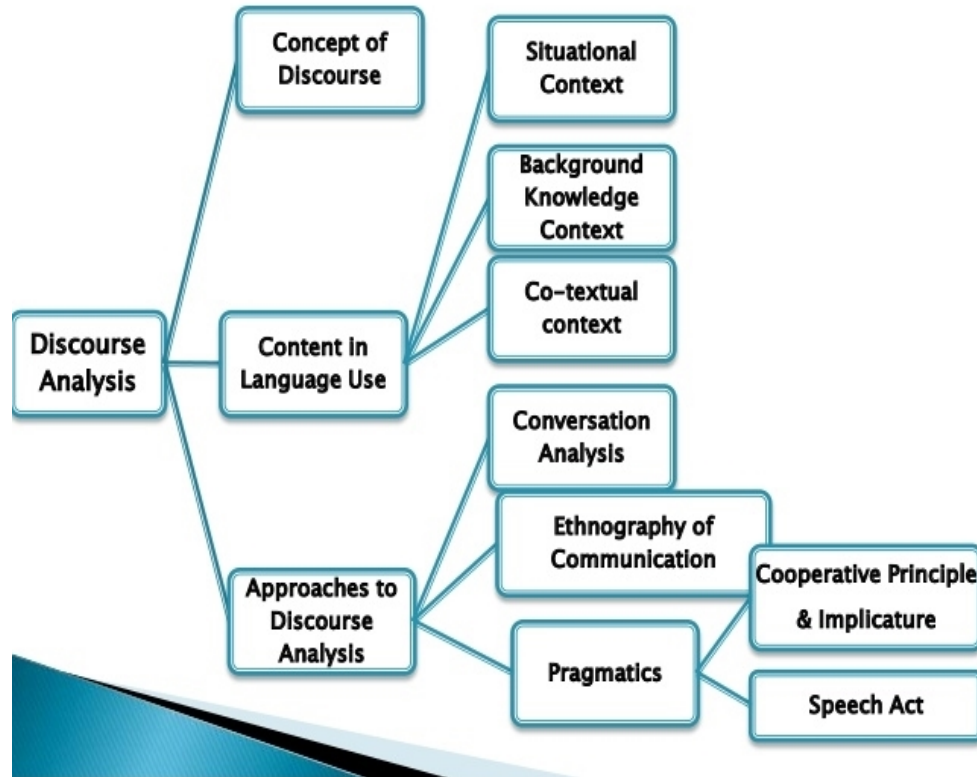
- Interpreting the categorized material still needs to be made
- On the other hand interpretations develop during the coding process
- 'Theory' means that you are capable of organizing the data systematically and *meaningfully*

DISCOURSE ANALYSIS

Philosophically based on social constructivism

- John Austin: descriptive and performative speech acts (*How to do things with words*, 1962)
- Michel Foucault: discourses, power-knowledge relationships (*Archaeology of Knowledge*, 1969)
- *Studies social reality as constructed in language (or in 'text')*
- Language as a constitutive part of social reality, not only as its mirror (factory vs. theatre)
- How meaning is constructed in language? ('truth')
- What is done with the words? (effects)
- Social reality as competition over meanings/'truths'
- Contextualized analysis (materialism)

DISCOURSE ANALYSIS



-The researcher does *not* study if the text represents something correct or incorrect but is honestly interested *how* something is presented and is open to the fact that it may be presented in multiple ways – even by the one and the same person

- The text is seen not as a personal product but as a discursive field in which the subject takes different articulative positions there is no subject behind the text (even if it can be legitimately asked what kind discourse f. ex. police produces about criminals)

- Interest lies in the differences

- Utilizes often pretty small scale and ready made materials like news paper articles and official documents which are produced in “natural” settings

SURVEYS



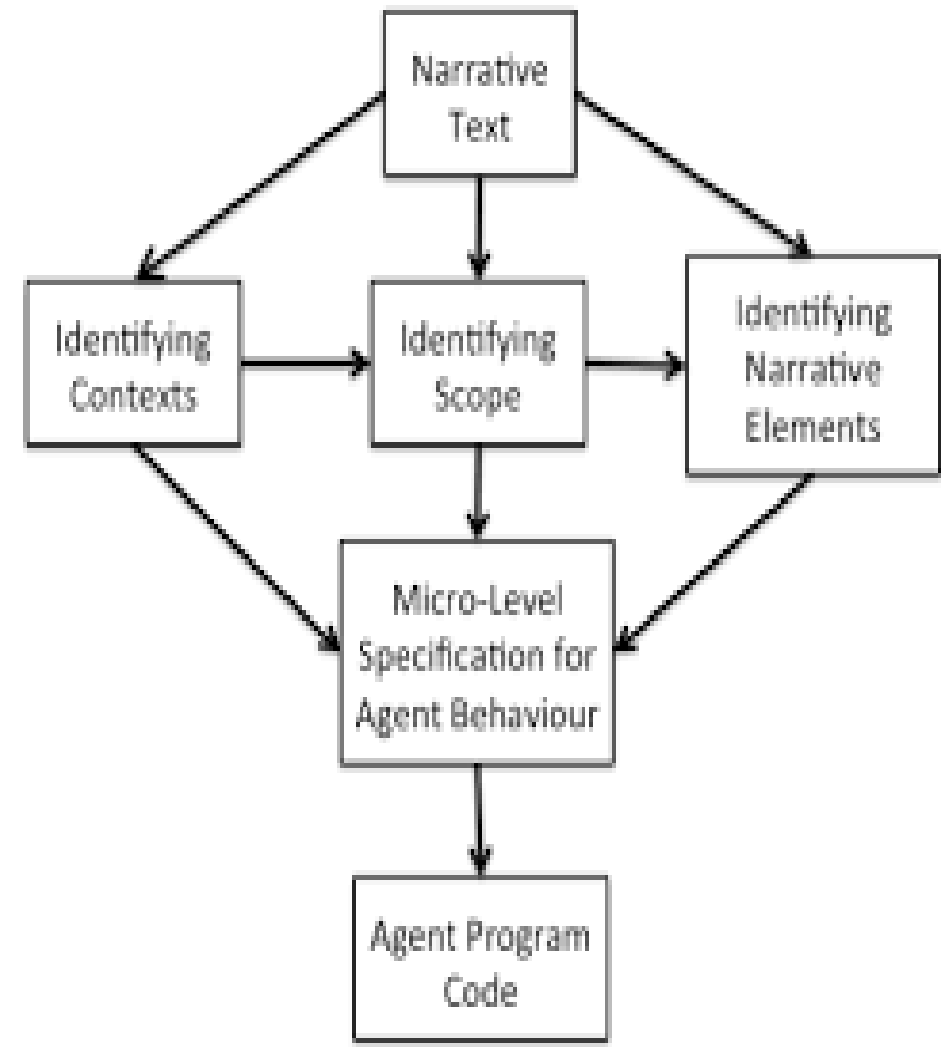
- In surveys the subjects complete a survey form without the intervention of the researcher.
- Surveys are particularly useful when the subject population is large (or distributed geographically), majority opinions are sought, and the subjects are motivated to respond.
- Special care must be taken to minimize the length of the survey, manage the choice of words and terminology, look after the balance of its structure, fully plan the strategies for its subsequent analysis, and test-pilot it thoroughly.
- Surveys can include closed and open questions, but the number of open questions should be reduced to a minimum.

CONVERSATION ANALYSIS

- Based on ethnomethodology
- Focus on the practical common sense reasoning in everyday life situations in which people make sense of reality in face to face interaction
- Intersubjectivity produced in micro-level interaction
- Interprets formal characters of conversation
- Detailed transcriptions, sophisticated coding system

NARRATIVE ANALYSIS

- Philosophical backgrounds in hermeneutics and structuralism
- Analyses stories and storied nature of human recounting of lives and events
- Focus on plot line
- May be analysed as a chronological-logical construction, or is cut into structural elements using f.ex. Greimas' actant model



ANALYSIS

- Codes are tags that categorize the data collected during a study to assign meanings to them.
- Coding makes it easier to search the data, make comparisons and identify patterns that require further investigation.
- It can also be used to extract quantitative data from qualitative data.
- Codes can be based on: themes, topics, ideas, concepts, terms, phrases, or keywords found in the data, but they can also correspond to passages of audio or video recordings and to parts of images.
- A large variety of coding schemes exist, as well as many software tools – like NVivo and Atlas TI – used to assist in coding and in helping to organize the resulting patterns.

RELIABILITY AND VALIDITY

Two major trends in the debate about rigor and validity in qualitative research:

- The exclusive trend, for which the qualitative paradigm is so radically different from the quantitative paradigm that a new language must be used to express its rigor and validity. (Guba & Lincoln, 1981; Guba & Lincoln, 1982; Guba & Lincoln, 1989)
- The inclusive trend, which argues that the credibility of qualitative research can only be widely accepted if the language of mainstream (quantitative) research is maintained, although operationalized to meet the new conditions and circumstances.

RELIABILITY AND VALIDITY

THE EXCLUSIVE TREND

- The proponents of the exclusive trend claim that the terms 'validity' and 'reliability' from qualitative research do not make sense in qualitative research, so they should be replaced:

Quantitative	Qualitative
<ul style="list-style-type: none">• internal validity• external validity<ul style="list-style-type: none">• reliability• objectivity	<ul style="list-style-type: none">• credibility• transferability• dependability• confirmability

Credibility

Credibility is achieved when the results are seen as believable by the participants in the research.

The participants decide about credibility.

Techniques for establishing credibility include: prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, referential adequacy, and member checking.

Transferability

Transferability exists when the results can be applied to other contexts.

The researcher should describe in detail the context and underlying assumptions of the research (thick description), so that transferability is possible, but the person who transfers the results to a different context is responsible for the transferred to other contexts.

Dependability

Dependability emphasizes the stability of the data over time.

The researcher must be able to account for the permanently changing context in which the research takes place, describing any changes that occur and how these changes affect the research. This requires what is sometimes called progressive subjectivity.

Confirmability

Confirmability demonstrates that the inquiry is free of bias, values and prejudice, i.e. that the data interpretations and outcomes are rooted in contexts and persons apart from the researcher and are not mere products of the researcher's imagination.

The researcher must document the procedures, so that others can check and recheck the data throughout the study. Techniques that may be used to strengthen confirmability include: prolonged engagement, persistent observation, peer debriefing, negative case analysis; and triangulation.

CRESWELL (2009) PROPOSES THE USE OF EIGHT PRIMARY STRATEGIES TO ENSURE QUALITATIVE VALIDITY:

Triangulation

Member checking

Rich, thick description

Avoidance of researcher bias

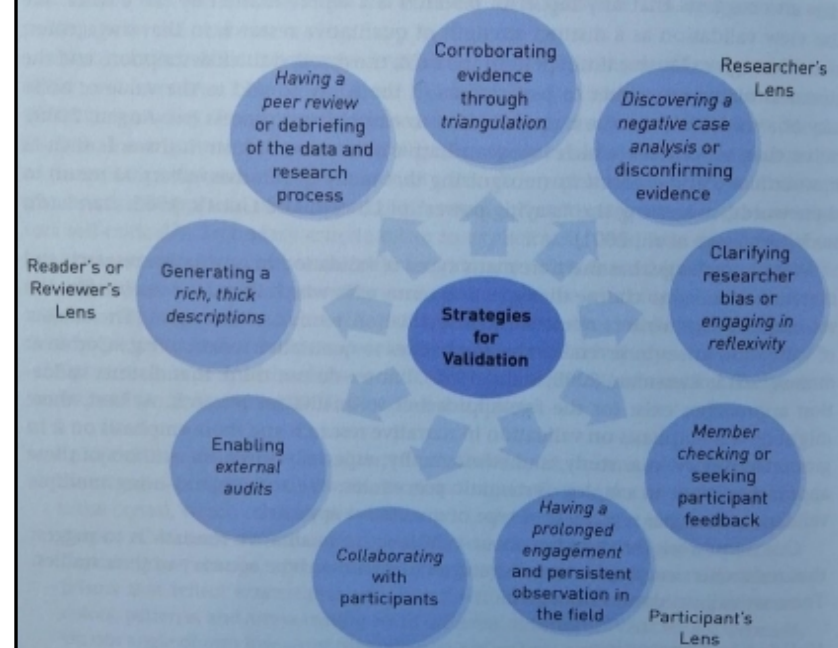
Negative case analysis

Prolonged engagement

Peer debriefing

External auditing

FIGURE 10.1 • Strategies for Validation in Qualitative Research



QUALITATIVE RELIABILITY

Yin (2003) suggests that qualitative researchers should:

Document the procedures of their case studies

- document as many steps of the procedures as possible
- set up a detailed case study protocol and database

Gibbs (2007) suggests several reliability procedures:

- Checking transcripts for mistakes
- Check the persistence of the meaning of the codes
- Coordinate communication among coders
- Cross-check codes developed by different researchers

The background of the slide features a series of overlapping, translucent, wavy lines in shades of blue and pink. These lines flow horizontally across the frame, creating a sense of movement and depth. The colors transition from a deep blue on the left to a vibrant pink on the right, with various shades of purple in between. The overall effect is a modern, artistic, and fluid design.

Case Studies

Automotive Case Studies

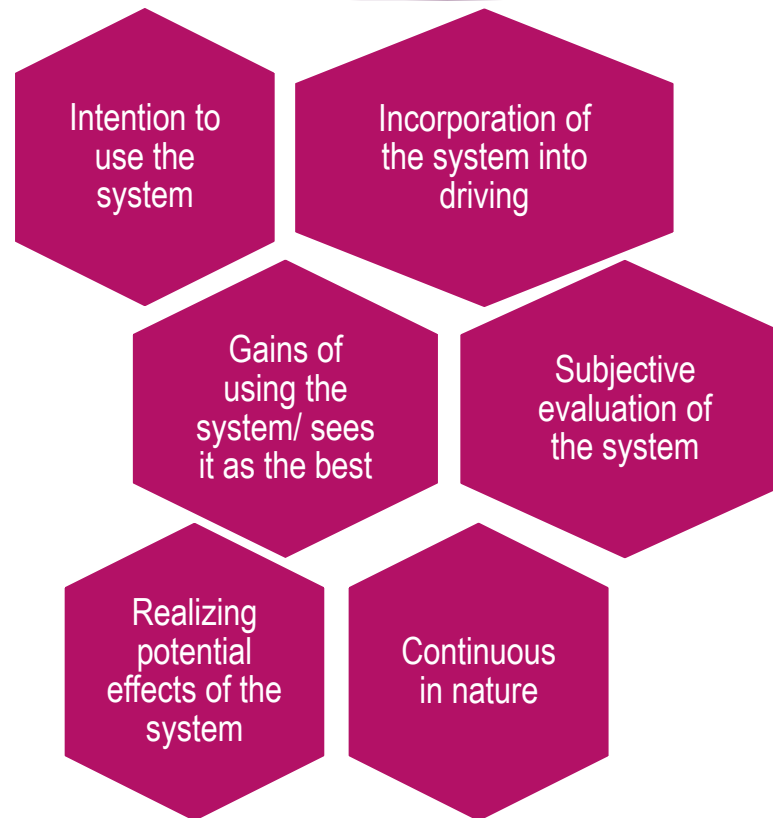
Wearable Laser Pointer for
Head Down Display

Eye Gaze and Finger Movement
Controlled Head Up Display



DRIVER ACCEPTANCE

What is it about?

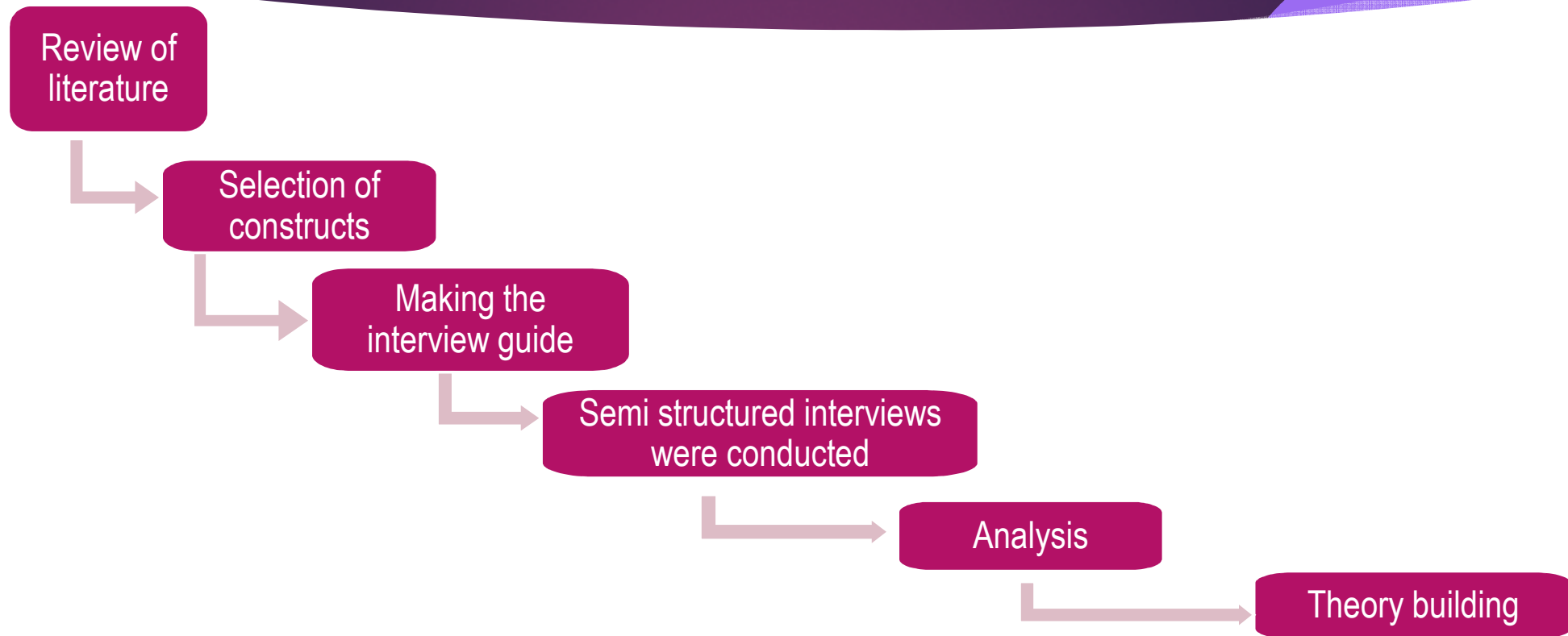


Objective

- ▶ The aim of this study being undertaken is to explore and understand the process of technology acceptance in the prototype stage of product lifecycle.
- ▶ The feedback and feelings of the end users can be understood when the product is in the prototype stage so that necessary desired changes can be incorporated into the design to make a better



How was it proceeded?





REVIEW OF LITERATURE

- ▶ There are multiple standardized models in the area of driver assistance systems and information technology.
- ▶ These models have been developed from the year 1974. The most recent standardized model of acceptance in the area of information technology is the UTAUT model.
- ▶ UTAUT stands for Unified Theory of Acceptance and Use of Technology.
- ▶ It was developed in the year 2003 and further modified in 2007
- ▶ It is from the literature study that various standardized models and theories of acceptance were found

A few theories of acceptance

The Pleasure, Arousal
and Dominance paradigm
(Mehrabian and Russell
1974)

Expectation
Disconfirmation Theory
(Oliver 1980)

Technology Acceptance
Model (TAM) (Davis
1989)

Theory of Reasoned
Action (Ajzen and
Fishbein 1980)

Theory of Planned
Behaviour (TPB) (Ajzen
1991)

Social Cognitive Theory
(Compeau and Higgins
1995) • Innovation
Diffusion Theory (Rogers
1995)

UTAUT model (2007)

A few constructs selected for the interview guide from literature study

Intent to use

Eagerness to use the system

Perceived usefulness

Value the system as useful

Perceived ease of use

Tell that the system is easy to use

Perceived safety

Recognize that the system is safe to use, prevents accidents

Technology anxiety

Feeling fearful when interacting with system

Enjoyment

Feeling of satisfaction and pleasure

A few existing questionnaires used as reference

WEAR questionnaire

Pupils' Attitude Towards Technology (PATT)
questionnaire

QUEST Questionnaire

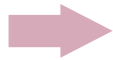
Questionnaire for the Evaluation of Physical Assistive
Devices (QUEAD)

PANAS questionnaire

System Usability Scale (SUS)

How was the interview guide prepared?

Table of all the constructs from literature study was made



Most occurred and recent constructs were selected



Multiple iterations and feedback from supervisor and colleagues were taken



Pilot study was done

Type of questions in the interview guide

Open ended
(allows free form
answer)

Close ended
(Yes/no)

Critical questions
(important topics)

Bonus questions

Questionnaires

LASER POINTER QUESTIONNAIRE

Perceived usefulness

1. After using the laser pointer do you feel that you established the task efficiently? Do you feel that this is a better way than the old school way? Why so? How do you think that this has enhanced your performance to complete the task and how do you think and feel it is effective? How do you think by using this technology would enable you to react to various situations more quickly and easily?

Perceived ease of use

2. I hope it was easy to learn... was it easy to learn? Do you think you can use this easily after showing you a few times as to how to use? Why so? Was the process of using it easy, clear and simple? What is your perspective on it?
3. Do you belief and feel it is easy to use? Was it a fun way of establishing your task or was it lifesome and boring? How is it better?

Attitude and Perceived enjoyment and Privacy

4. How do you feel after using this tech? Was it fun and enjoyable? I hope you liked it! It would be really grateful if you could share some benefits of using it.
5. Was it a pleasant experience using it? What about comfor level? (there would be modifications done this is just a prototype.)
6. Can you briefly tell if you feel that this device is breaching your privacy?

Anxiety

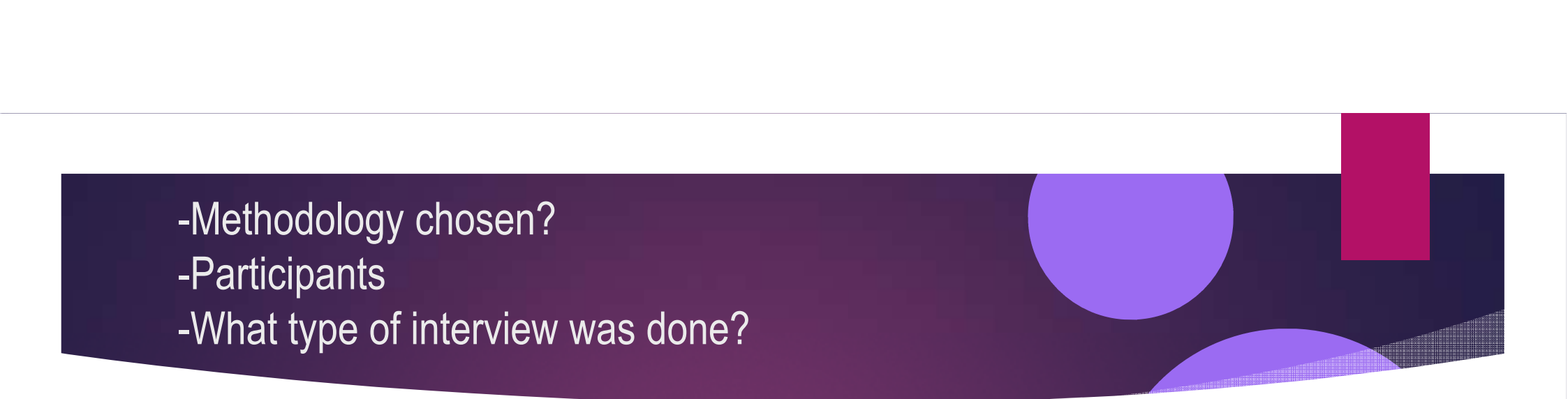
7. Were you nervous, confused, tense and anxious while using the laser pointer? You think you would be comfortable after a couple of times using it? Did you feel that you would end up doing any damage to the laser pointer damage?
8. Was it creating any kind of hindrance while performing the task?

Behavioural Intentions

9. Say, if the device was available to you for free and at a very reasonable price, would you purchase it and use it or other way round? Would you recommend it to your family and peers?
10. Do you take advice from your peers and colleagues regarding investment in technology? You feel that they would approve of the use of a technology like this? Why so? How do you feel after using this technology? Did you like using the laser tracker that you would recommend it to your friends and peers? Why would you like to use this laser pointer? (overall)

EYE TRACKING QUESTIONNAIRE

1. Do you think using the device would improve, enhance and increase your driving proficiency? You feel there will be a reduction in the time taken to complete the task? How and why?
2. How do you find this eye gaze technology useful for you? Is it easy and convenient to use as compared with the existing technology? (ask them regarding what are the existing technology they are using) Say after using this technology, do you feel that your driving would be better? How so in what ways? What are your expectations and feelings regarding it?
3. Any difficulties while using the eye tracking device? How easy is it to use? Can you please rate it on a scale of 1 to 10, 1 being low in difficulty and 10 being high in difficulty? Is it cumbersome or clumsy? You are getting appropriate feedback that your task has been established right? Did you understand that your task has been established? Was it Difficult to learn? Was it Easy and Simple? Were you able to focus and concentrate well on the task? What would be the frequency of the average usage of the eye tracking on a daily basis?
4. Who do you take advice from or inspiration when it comes to investment in technology? Would people around you or people from whom you take advice for investment in technology feel that this technology innovation will be of use? Would they think that this piece is going to be useful and would they use it? Why do you think so? What do you think about it? You approve of using this tech? This is a good idea?
5. Do you think that your colleagues should use this technology? Your friends?
6. Is using this tech invoking anxiety in you? Like are you feeling nervous and confused looking at it? Does the look of it makes you feel anxious and uncomfortable? Do you feel that you may end up doing something more damaging than good? Does the usage look very difficult?
7. You enjoyed using the tech? Why was it enjoyable? Was it fun or was it annoying?
8. Do you think using this tech would make you look like a person who is interested in tech or cool or boost your status among your circle of people?
9. If it was affordable then would you definitely purchase it? If it was freely available to you then would you use it? Do you think you have the knowledge to purchase and use this tech? Why and how?
10. Do you think this tech fits well with the way you drive? How so? You intend to use this tech in the future? Why? Would you use it in the future?



-Methodology chosen?
-Participants
-What type of interview was done?

- ▶ Grounded theory methodology (Strauss and Corbin)
- ▶ Total 11 participants for each study b/w the age group of 28 to 58 years
- ▶ Face to face interviews
- ▶ Semi structured interviews in the participant's mother tongue
- ▶ Time was allotted at the end of each interview for participants to add further topics beyond the questionnaire that seemed important to them.
- ▶ Transcripts were prepared by translating the interviews to English

How was the analysis done?

Thorough reading of transcripts multiple times

Sections & paragraphs were re-read

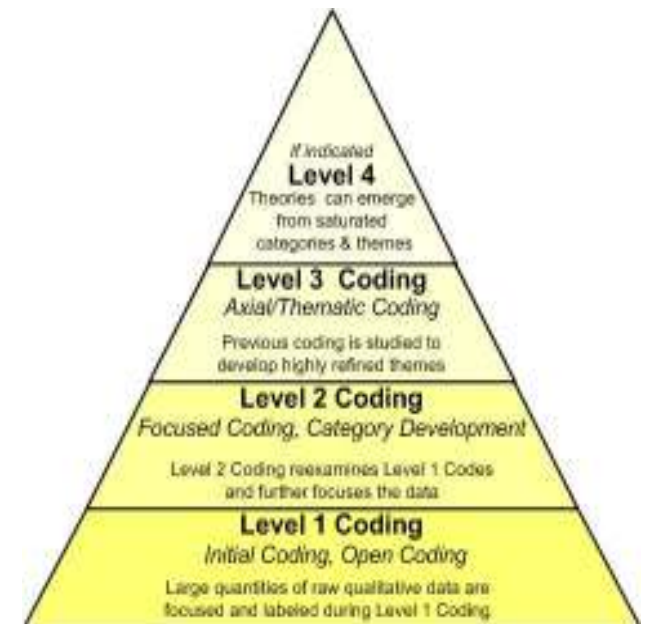
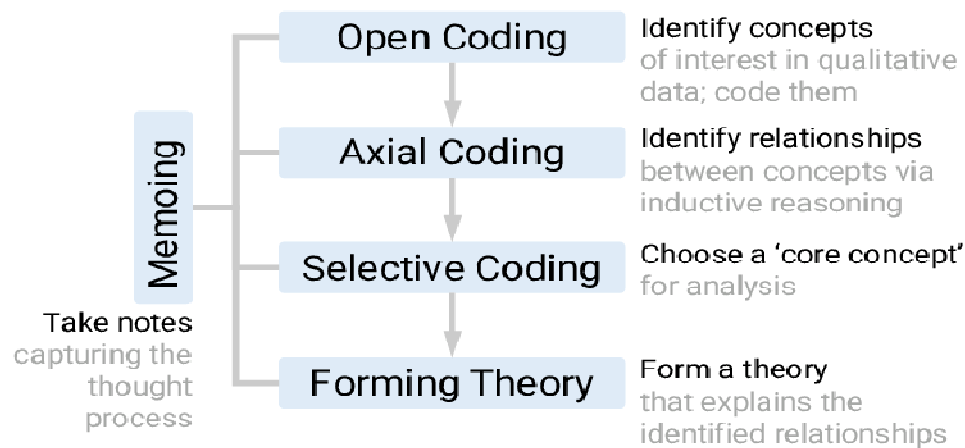


Diagram showing the different levels of coding in grounded theory

Findings from HDD study

HDD was **liked, is easy to use, recognized as useful** & it was **easily learnt** by the drivers

Having the pointer in the hand of the driver will **prevent damages, access to unsubscribed services, expenditure on maintenance cost**

Felt safe, **familiarity** with laser, less mistakes, **no fear**

HDD being considered important, **10k** (approx.) was the expected budget

Acceptance
of HDD

Accessories shops, local garages, service centres & family members who owns vehicles impact their decision of buying new gadgets and updated technology.



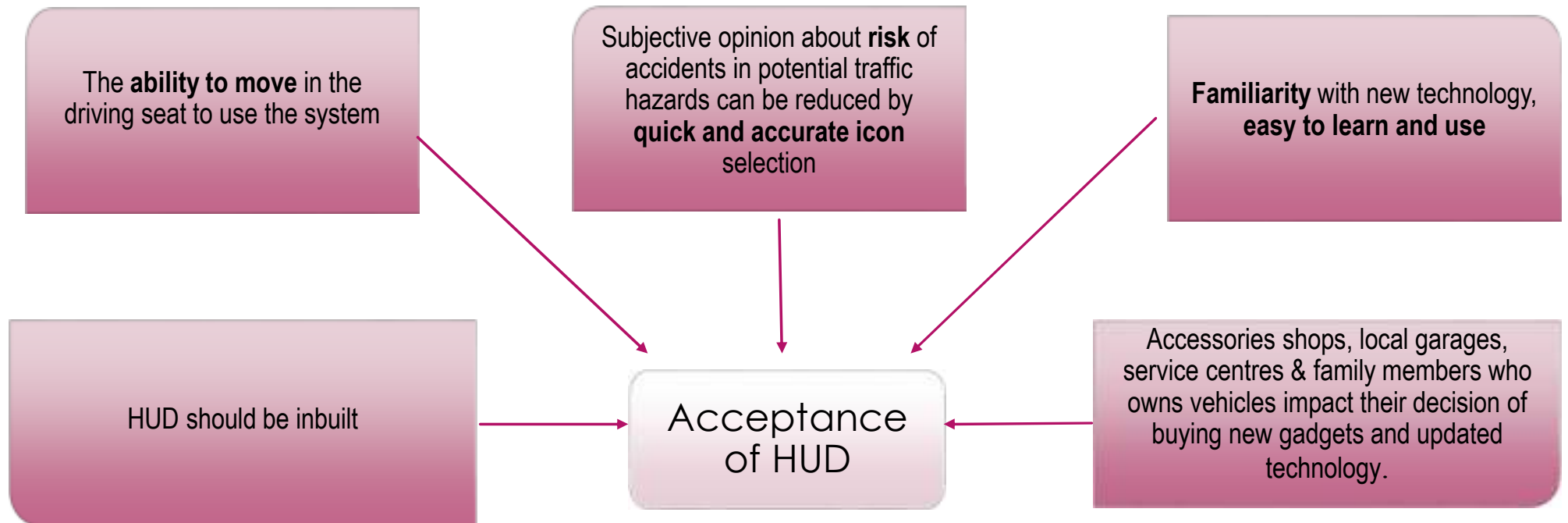
Insights from HDD study

- ▶ HDD ace at easy to use, smoothness, dexterity as compared to touch.
- ▶ It was found to be useful in traffic as well as for outstation drives as it requires less focus.
- ▶ It contributes to the perception of prevention of accidents as the drivers think that more the hands on the steering wheel, lesser the chances of accidents.
- ▶ The experience of driving is enhanced as the drivers feel that the shifts of hand is lesser.
- ▶ HDD is perceived as a durable product as there is no touch involved so the chances of getting spoilt and damage is much lesser.

Insights from HDD study

- ▶ It thus would contribute to less expenditure on maintenance of the vehicle. The battery life is expected to be as that of a watch.
- ▶ The drivers think that with the implementation of such technologies, any inconveniences during the pick up and drop off a customer would be barged.
- ▶ It will reduce the screen time gaze like in touch and prevent accidents and enhance driving experience.
- ▶ The fear of pressing the wrong icon is lesser than touch.
- ▶ The system should be placed on the right hand side as majority of the drivers are right handed, it will be convenient and help to maintain lane.
- ▶ Error chances in touch is more as more finger space is required. HDD reduces the chances of error and the fear of committing such errors as well

Findings from HUD study





Insights from HUD study

- ▶ It was perceived it might lead to difficulties as it was slow
- ▶ Competing driver's concentration on the road and the windshield was also perceived as a risk.
- ▶ It was thought that it would be useful in the highways as there are few distractions in the road
- ▶ It is easy, comfortable and can be learnt in a short duration of time.
- ▶ Taking into account the traffic and customer safety, swiftness of the device was expected.



Insights from HUD study

- ▶ Not being able to meet the expectations of the customers in heavy traffic, along side performing secondary tasks contributed to the perception that the risk of accidents and customer dissatisfaction would be high.
- ▶ The scanning of the eyes took time which was found to be uncomfortable.
- ▶ It was suggested that it should not be displayed on the windshield all the time as it distracts. ON/OFF button, quick restart was suggested.
- ▶ There was easy to learn and less concentration was required
- ▶ Should come inbuilt.