Ergonomics Research Techniques

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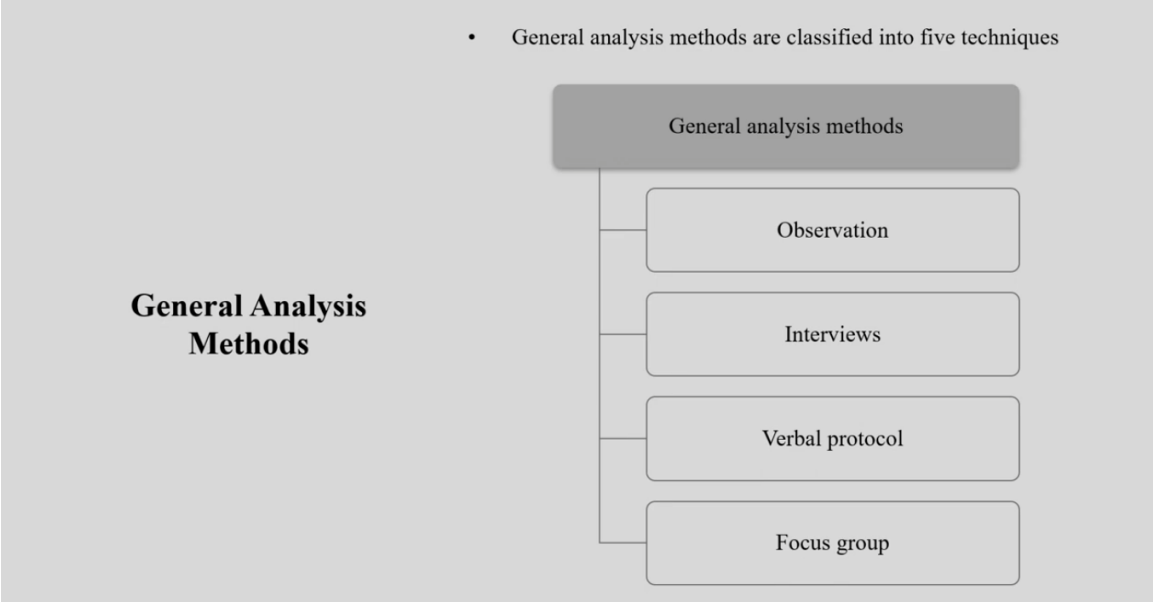
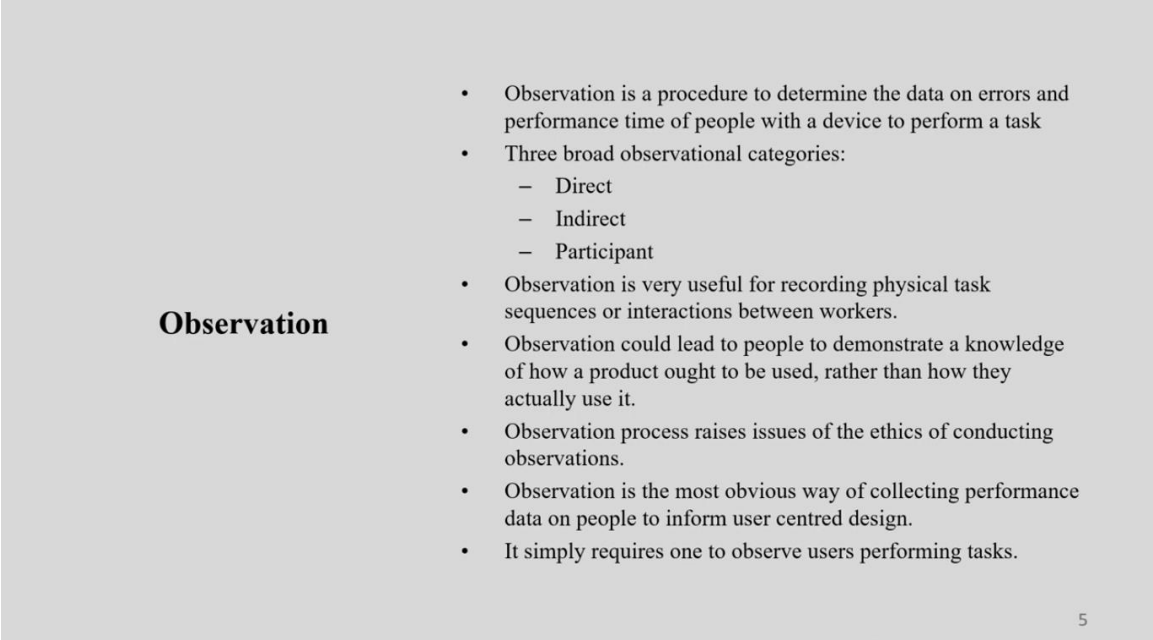
Week 7: Lec 24- General Analysis Methods

Observation, interviews and verbal protocol

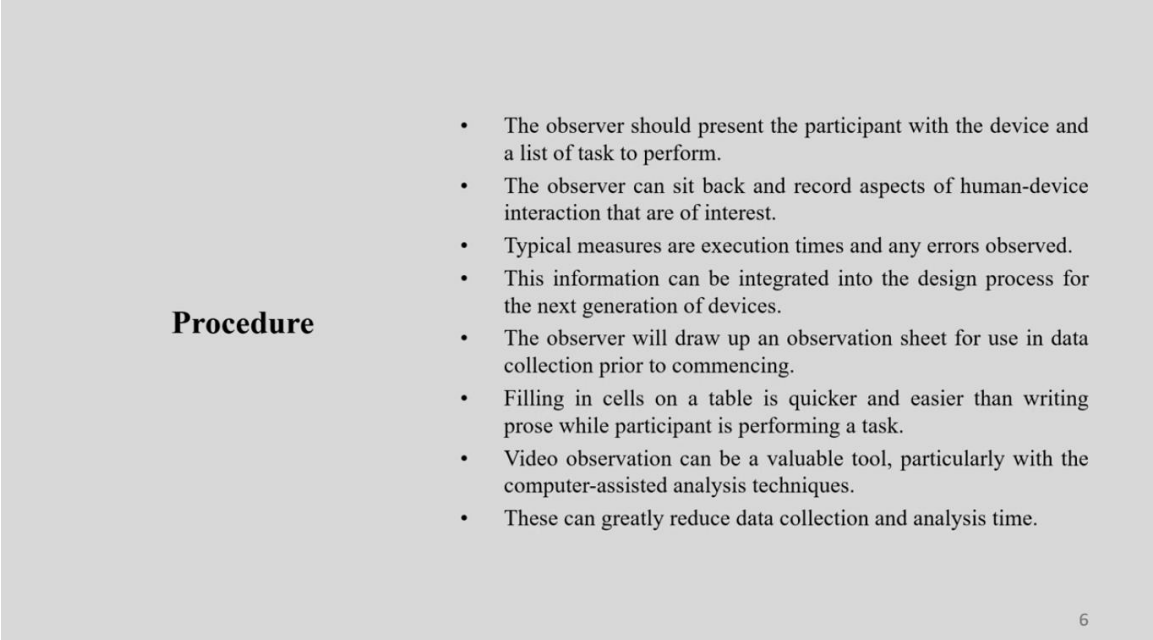
Welcome back to this particular class which we will talk about behavioral and cognitive method. So, in last class what we did we get an broad idea that what are the types of tools and techniques available when we talk about cognitive ergonomics. So, today what we will do we will go for the detailing of each technique as far as possible as much as possible and we will in some cases we will have some examples and then you can practice it at your home and then you can get back to us if if something is required to discuss further ok.



So, as we mentioned in earlier class that specifically when we talk about general analysis method of cognitive ergonomics then there are four major techniques or tool rather we say we can use for our data collection or to fulfill our objective we can use these methods to get our data or to understand the situation. So, observation, interviews, verbal protocol and focus group.

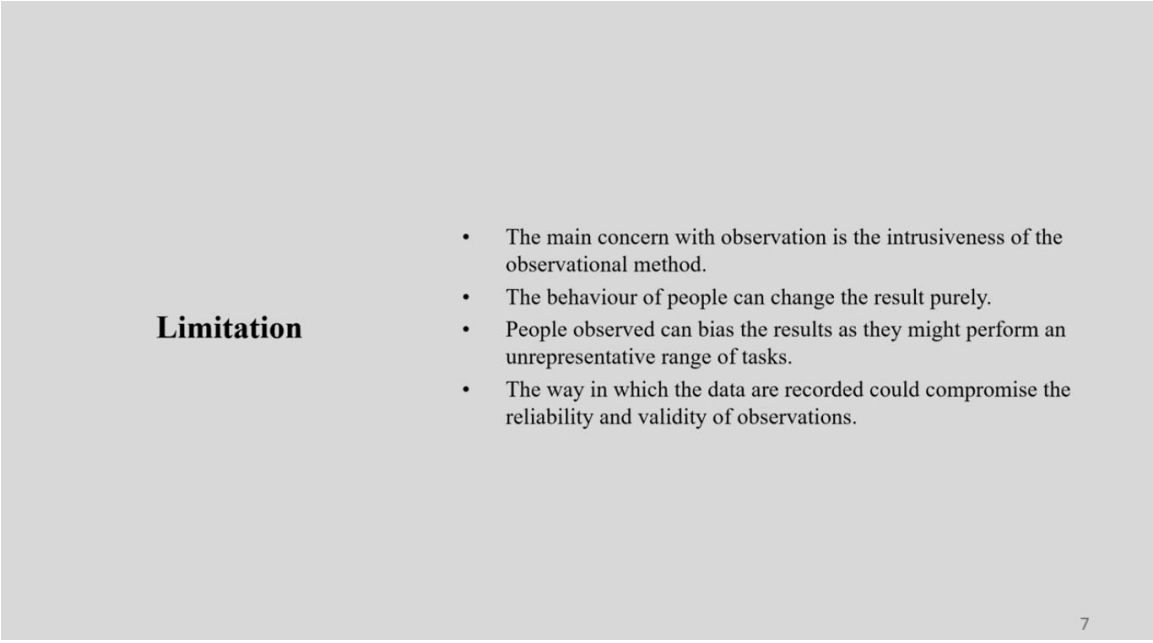


So, let us start in detail about the observation. So, as I mentioned in earlier presentation that it is mainly three types direct, indirect and participant. So, what is observation? Let us recall some points. So, observation is the procedure to determine the data on errors and performance time of people with evidence to perform a task. So, it is very important over here is the task. So, when somebody is performing a particular task we really need to understand what are the varieties of error or difficulties they are facing. And this is really possible when we go for this observational method. So, observation is very very useful for any physical work recording and then you know sequencing that particular task also the interaction between the workers and machine. So, observation could lead to people to demonstrate a knowledge of how a product ought to be used. So, it it actually tells you that how the product need to be used rather how do the person is going to use it ok. So, it tells you that how the product you are going to use it. So, the product that I am going to test with you how you are going to use it. So, observation process raises issues of the ethics of conducting definitely the observation. Observation is the most obvious way of collecting performance data on people to inform user certain design ok, user centered design. So, how people are using it. So, we get information about this. So, it is very much useful method in the field of design of course, apart from that industrial designers like you know industrial engineers, occupational healthwork like the people who are working in the field of occupational health and all they also can use it. It simply requires one to one to observe the users performance and how they are performing that particular task. So, the sequence, steps, methods,behavior, the posture, that you know the way they are taking the task ahead. So, all these are minute observation that they can do and using this observation technique they can record it and can use it for next course of action.



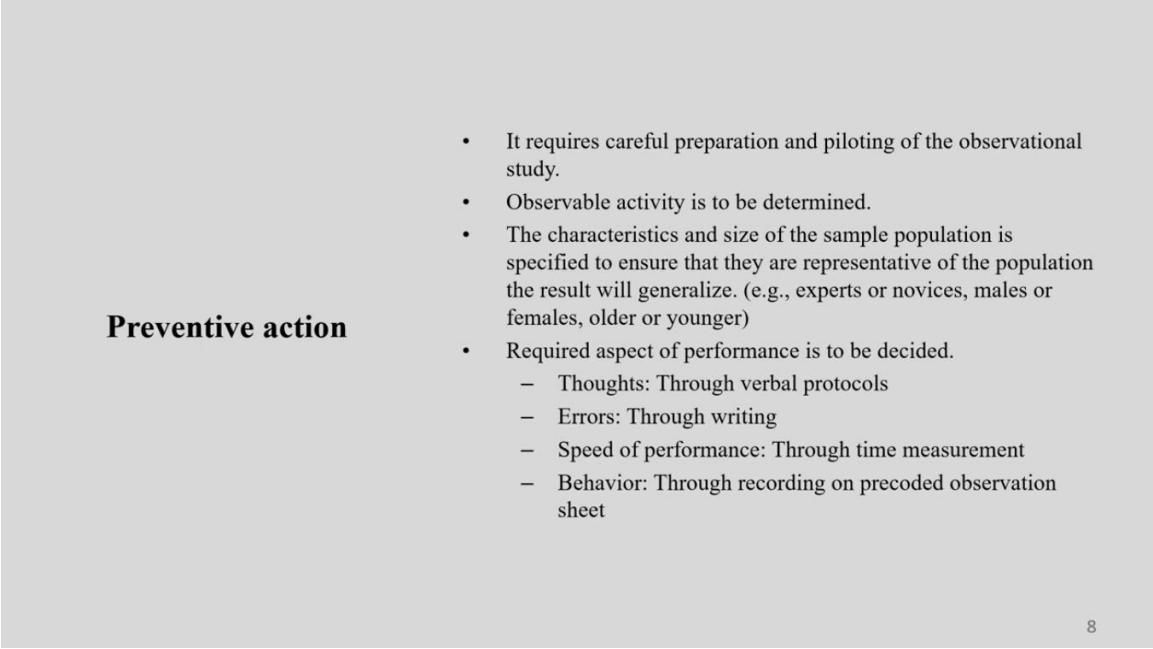
So, the observer should present the participant with the device and the list of tasks to perform. So, if it is like you know there is a there is a product and I want to understand how the person is going to use that particular product. So, what we will do? We will give the product to that particular subject and we will ask the subject to use it in a sequential manner and we will observe it ok. The observer can sit back and record that you know various aspects of human device interaction that those interaction which are of their interest. So, it is it is happened that when there is a product and there is an user they do interact. However, every interactions are not important for the observer. So, for observer there are some objectives, there are some motiv to do this particular study based on that the observer will decide which points to be noted. So, the technique how do we collect data it is very very important. So, typical measures are execution time and any error observed. So, so how long it is taking to execute a particular task or particular work. So, that may be a concern from from the researchers perspective. Also the kind of error they are doing subjects are doing while doing this particular job. So, these are the major area or major variable that normally people look for. So, the the observer will draw up an observation sheet for use in data collection prior starting to this particular task. So, they keep a data sheet ready. So, they keep on observing and pointing out that. Feeling normally how do we do what what happened when we go for a data collection it becomes very difficult for us to you know give some you know vocabulary comments ok that becomes very tedious that becomes very difficult and also it becomes very difficult for someone to retribe that data and you know understand data. So, what is important over here is make a table. Point number 1, 2, 3, whatever the observation you are actually interested you make a point of it and then keep onno addressing them. So, tick observation point 1 give a tick, observation point 2 give a tick, observation point 3 if it is there then tick if it is not there do not mention it.

So, that way the data collection becomes much easier and the person get a very nice data and which can be translated very easily. Also it helps your core researcher to understand your data because sometimes if we go for our own handwriting some some type of data then it becomes very difficult for our core researcher to understand that and you know interpret that data. However, if we go for this tabular form it becomes very easy for everyone in the same group to understand that data. So, it is very easy to do that. So, video observation can be a valuable tool. So, normally what experts suggest that when we are going for an observation study we put up a camera and we do the observation, you know we do the recording. Once the data is being recorded let us come back to the laboratory and analyze it. So, there is always a chance for us to replay the same sequence and if if anything to be noticed we can notice it. So, there is less chance of losing any data. This can greatly reduce the data analysis and data collection time specifically collection time because you know what happens we we need not to go to the field repeatedly. So, we have because you know human data collection is very very tough. So, you know getting consent from the person who is going to be your subject and then you know taking their time collecting data it is it is very difficult job always right. Everybody of us definitely accept that. So, if we go for the video recording it helps you to reduce the timing for the data collection. However, as I as we were saying that observational tool this observation tool is very very useful and it is it is it is a preliminary tool that we always use in the field of design, in the field of ergonomics, in in the in in this situation.



However, there are some limitation because this particular tool gives you a very basic idea about this particular job or particular task that you are looking for. So, the main concern with observation is the intrusiveness of the observational. It is very intrusive in

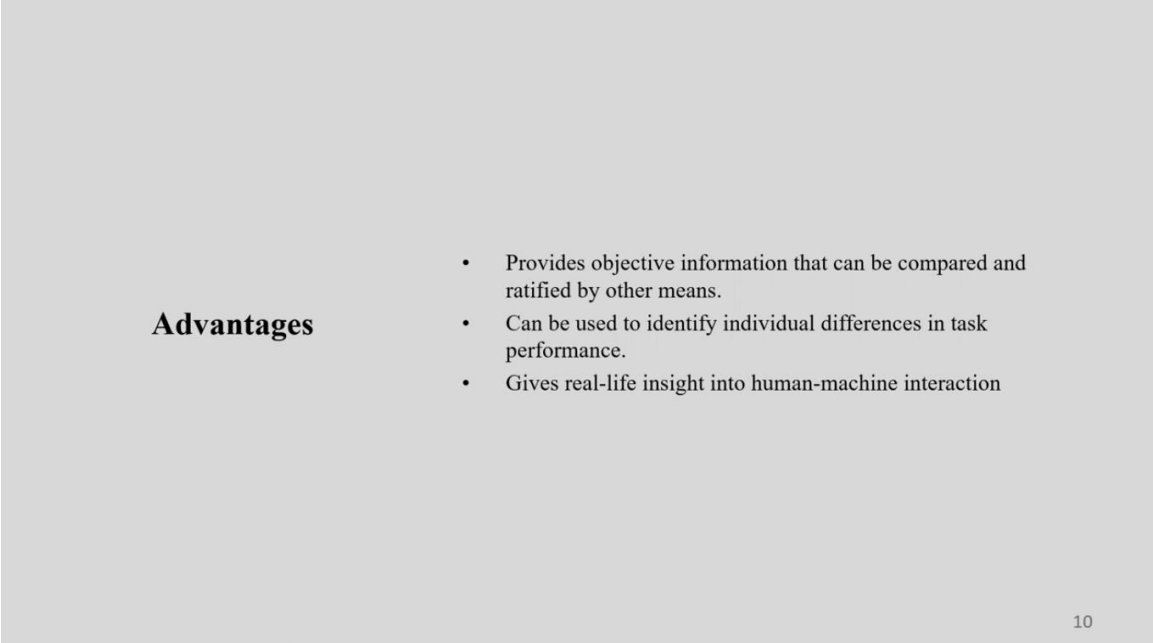
nature. So, that that that is the major limitation of it. So, the behavior of people can change the result purely. So, suppose I am a person who is going to observe the second person. If the second person knows what I am going to do, how I am going to do and he or she himself change the behavior purposefully then it becomes very difficult for me as an observer to get the real data. So, any influence from the from the subject from the participant may change the result. So, depending on the objective or aim of the study, we choose which type of observation need to be done. One can be done with after discussing with the with the subject. So, it is the subjects knows that you are going to observe them, you are going to get data from them, then something some type of data comes. If you do not allow them to know what exactly you are going to do and you know you know in a in a in a different manner you are going to collect the data, then it is called the covered observation like you know you are not allowing the person to get the inform you know know the information that you the person is going to get observed ok. So, those cases the data can be different. However, there are always a chance that the subject influence the data ok. So, people who are being observed can bias the result. So that is again it is it is a very you know troublesome point for for this particular tool. And this way the way in which the data are recorded could know compromise the reliability and validity of the data. So, the researcher if they are very novice, they do not know how to collect data. If that is the case, then it may happen the quality of data may be you know compromised. So, we should be very careful when we are using this type of method to to collect some information. As I was saying that when when the person who is very new to this particular subject and not very much experience, then what happen they collect data in different way ok. So, those cases the the reliability and validity of this particular tool becomes less. So, it is very important for us when being a researcher we we use this particular tool, we know the situation very well and we know our aim and objectives of this study very well. Once we know these two situation very correctly, then we can definitely avoid these types of limitation partially ok. So, so as I was mentioning that you know there are limitations. So, there are some method or there are some steps that we can follow to you know to to to prevent that. So, it requires careful preparation. So, as I mentioned that if I am a novice researcher, then what will happen I may not have experience of doing the observational study. So, before I go for actual present or actual observation, I should do some kind of pilot study. Anyway pilot study is very very important for any any kind of data collection. Here in observation also pilot study is very important.



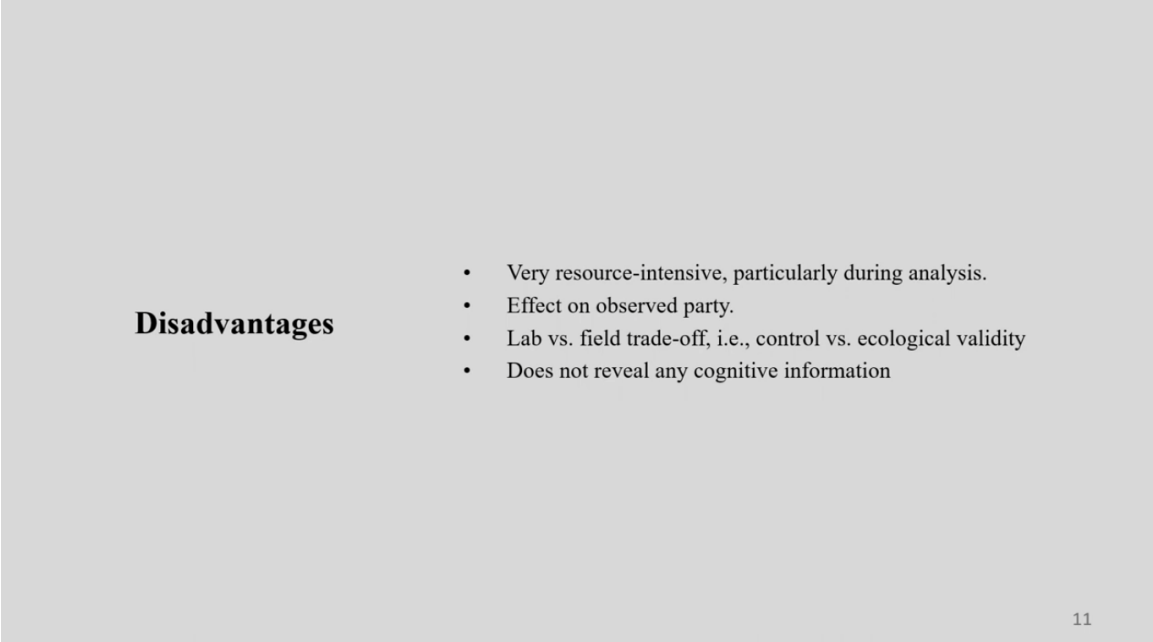
So, observable activity is to be determined. So, here it it is very important that activities ok. The activities when I am talking about I am going to observe. So, what exactly what activities I am going to observe that is very important. So, let us first find out before I go for observational study, let us find out what are the activities I am going to observe. So, list them out ok activity number 1, activity number 2, activity number 3 like that you let us list them out. Once I have the list, then it becomes very easy for us to get those information from the observation. So, the characteristic and size of the sample population is specified to ensure that they are representative of the population, the result will generalize. Because if the sample is not really representation of the population ok, this sample selection sample selection is very very important.

If sample is not really a representative representative of the population, then later when we are going to generalize this particular result of the observatory, it becomes very difficult. So, what we should do? We should fall we should do we should give a thought before we start this particular process. We measure the errors so through writing and speed of performance, how frequently, how what is the speed of my recording, how I am doing it. So, we should do that. Also the you know we should look for the behavior of the person, behavior of the subject. So, if we can do that, then it it actually help us to get quality data. We should also decide how the reliability of the data is to be checked. So, beforehand we can have some kind of testing methodology ready so that once we have the data, we can check the reliability. So, two way normally we can do recording of two observation are compared. So, same situation two recordings from the recording two observation can be compared. So, researcher 1 and researcher 2, they can compare their data that way we can check the reliability. So, these activities are videotaped and

conducted a reliability analysis on a sample of the videotape by comparing it with the direct observation that is also possible. So, one directly on the field, one at the laboratory and then compare them. So, then it becomes very easy for us to understand that my data is correct or not ok. These are the way how do we get quality data. Also when conducting the observation study, it is worth spending some time beforehand. So, as was mentioning that it is not only pilot study, the field we should visit frequently so that we really know the situation in detail before we start any kind of observational study. So that also the person who are going to be observed, we should get acclimatized with them, then it becomes easy for us to get the data. So, this way we can have some quality data.



Definitely, this is very easy tool. So, it has a few advantages. So, it provides objective information that can be compared and ratified by other means because you know the result of this particular study like result of the observation can be an input of other method ok. So, it is very very useful method and can be used to identify individual differences in task performance. So, there are operator 1, operator 2 and operator 3 ok. So, same task is being performed by every operator separately. What are the differences are happening and what are the causes of those differences? How the system or how the design is going to influence those differences? So, we can have definite result from this particular study and it definitely help us to improve the system once we have the data. This particular method gives us the real life insight into human machine interaction that is very important because we actually see them working ok. We see the operator working. So, it gives a real time information that is the advantage of this particular study.



However, there are some disadvantages. We will go very quickly. So, it is a very resource intensive because you need lot of time, you need manpower to you know you need sources to go to the field, get into the field, get an you know clearance that you should collect you will be able to collect data. So, it is very resource intensive. Effect on observed party. So, the subject who is going to be observed maybe there are some impact. So, we should avoid such cases. Here there are sometimes difficulties, lab data and field data, control data and ecological validity. So, these cases we get some disadvantages, does not reveal any cognitive information directly. Here it is very important. However, I am teaching this particular method in the cognitive section. Still I want to mention here, it never gives you direct information about the cognitive load, cognitive theory or anything. This the data the result, the information received from this particular method, we may use it for other study and then we can get the information related to cognitive,cognitive workload or cognitive load or many other thing ok. It never gives you direct information about the any cognitive information, any any not a single direct information ok. So, it gives you data in terms of time, in terms of error. It looks it is these all are physical data. So, these are some disadvantage.

Process of observation

- The simplest form of recording
  - A frequency count of specific event.
  - Requires an experimenter to perform physical actions, in response to user commands.
  - The commands are issued via verbal or controls (e.g., buttons).
  - The aim of the study is to assess frequency of functions by users or by machine.

12

Now let me explain you the process. It is very simple ok. So, a frequency count of specific event as I mentioned, we should have you know sequence of events that we should tabulate beforehand. So, a frequency count of each event requires an experimenter to perform physical action in response to user command. The commands are used via verbal or control ok. So, you can you can give some verbal instruction or you can have some control. The aim of this study is to assess frequency of functions by users or by machine. So, both it is possible.

Process of observation

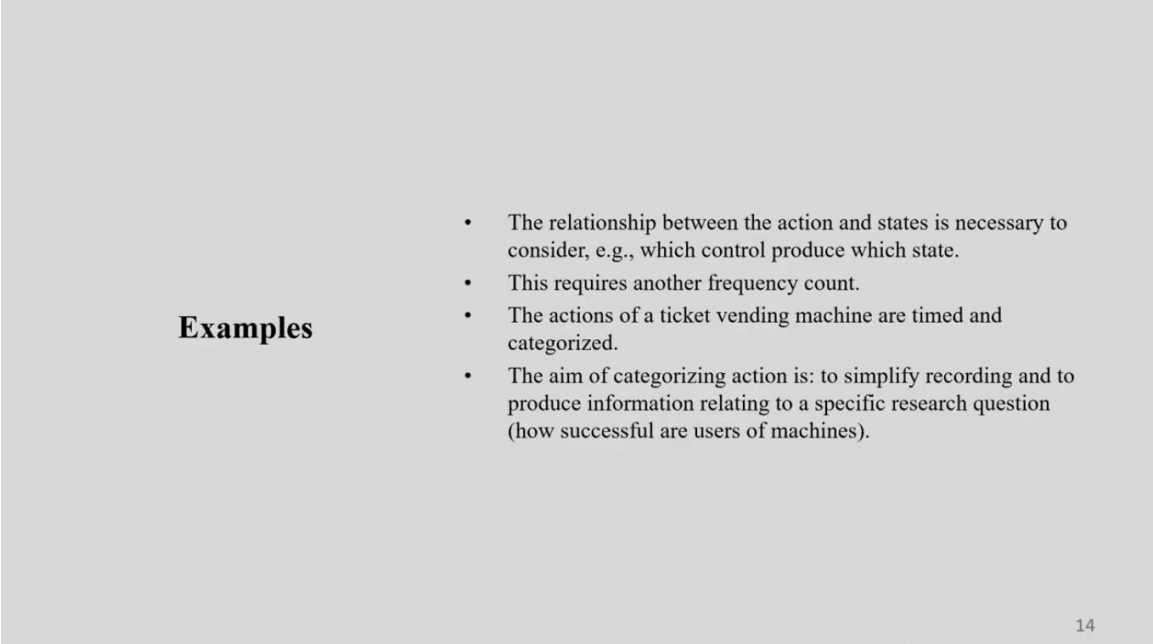
- Specific Event
  - Electronic book (eBook) study
- Physical action performance
  - Turn to content page
  - Turn to index
  - Turn to next page
  - Turn to previous page
- Command to perform the action
- Note down the frequency count of action

Action	Frequency
Turn to content page	3
Turn to index	1
Turn to next page	11
Turn to previous page	2

Frequency count for Electronic book study

13

So, here it is a small example. You know e-book study suppose we want to do an observation for the this. So, let us first find out what are the points we are going to observe. So, here in this particular example what I did? I pointed out four major task. One is turn the content page 1, second is into the index, third is to the next page and then previous page. What I did? I made a tab table over here right. So, all the actions I noted here and the frequency I noted here from observation. Now these numbers ok these numbers are very important. If you want to check the reliability of this particular tool or reliability of the method that you used, you can have two three co-researchers with you and with the same videotape or same specifically from the same videotape what you can do? All the researcher can count these number separately ok and then can check that how these are different. If these are different in in large then definitely somehow it has gone wrong you should perform it once again or you should have a better understanding about all these activities separately and again redo it. If it is not the numbers like the counting are not very different then your result is correct you are doing it perfectly ok. So, that way you can use this ok.



Now let me give one more example. So, the relationship between the action and the state is necessary to consider. So, which control produces which state? So, there may be some control, there may be some causal you know impact of it right. So, how they are connected? So, this requires another frequency count. So, maybe you can have some more detailing of it. So, I will give you example with the ticket vending machine ok ticket vending machine and so, how they are connected with the time and category ok. So, I will take you to the example first. So, you will be it will be very easy for you to understand.

Examples

- Specific Event
  - Buying ticket from ticket vending machine
- Physical action performance
  - Put the coins/ money
  - Buying ticket
  - Collect the change (if required)
- Command to perform the action
- Note down the frequency count of action

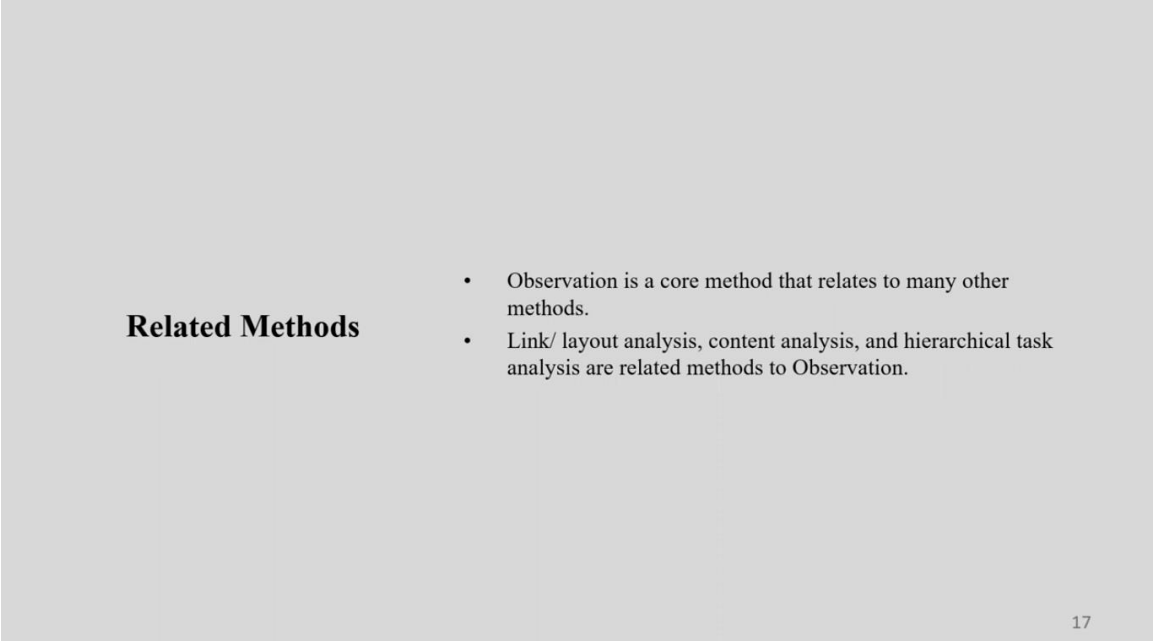
Change Given			Exact Money		
Subject	Time	Outcome	Subject	Time	Outcome
1	16	S	8	36	A
2	23	S	9	56	S
3	48	A	10	21	R

15

Sample of field observation of a ticket vending machine *(S= Success, R= Success with repetition, A= Abort)*

So, what I have done over here in a it is a automatic ticket vending machine. In one case there are three subjects who gave extra money to the vending machine and got the change back and collected the ticket or somewhere it is failed or the the process of buying ticket being aborted. Whereas, in other case some subjects again I took the same numbers subject 1, 2, 3 like three subjects they gave the exact money which is required to buy the ticket. Some cases it was successful, some cases it is unsuccessful, some cases they they they aborted that particular buying process ok. So, this is the data. So, in first case you have given the extra money and changes has been given back to you. So, you know it is it is like subject number 1, 2 and 3 did the same thing. So, these are the required time 16 and all are in second ok 23, 48 ok. Here it is successful, successful and last case it is aborted. Whereas, in the when somebody has given you the exact and not you to the ticket vending machine the exact money. Whereas, subject number 8, 9 and 10 first case it is like you know they could not complete the process. So, they had to abort that particular process. In the second case successfully they collected whereas, in the last case like you know subject number subject number 10 they they they they could complete the process. However, it took lot of time, repetition ok. Maybe the understanding was not correct about the information received from the display and again acting upon it. So, repetition. So, maybe here we can we can say the person who were using this particular vending machine either were not experienced or not able to understand the command given by the machine. So, from all these data, from all these observation we can have very clear information that how the machine and the the operators are interacting with each other. So, before I started this particular experiment. So, we checked this physical activity what we are going to record. So, put the coins and money buying the ticket collect the change. So, these are only three component that we

are going to record and from that only we could derive this particular table. So, before we start our experiment we should always able to know that what exactly I am going to do. So, 1, 2, 3 these three components we are going to observe. There may be many other extra things are involved. However, we are not going to observe them or record them ok. Maybe we can keep the recording as a videotape. However, for our data analysis we are not going to look for them we are going to neglect them right. So, this way we can have our data ready and later this data can be treated can be you know experimented or used for for for the different other purposes clear.



So, observational method we have some related method also. So, observation is a core method that relates to the to many other method like you know content analysis, hierarchical task analysis that we are going to discuss definitely it is a very important tool hierarchical task analysis. Last class also I was discussing this right. So, these all tools are connected to the observational method fine.

Tools Required

- Pen and paper: The simplest, cheapest and easiest to operate of all observations.
- The Observer and Drum: This is the basis of packages which have the potential to allow the analyst to control the rate at which video plays, so the tape can be fast-forwarded to allow quick capture of rare events observed over long periods.
- These products also will perform basic statistical analysis of the frequency and duration of specified events.
- This allows analysis of videotapes to be performed almost in real life.

18

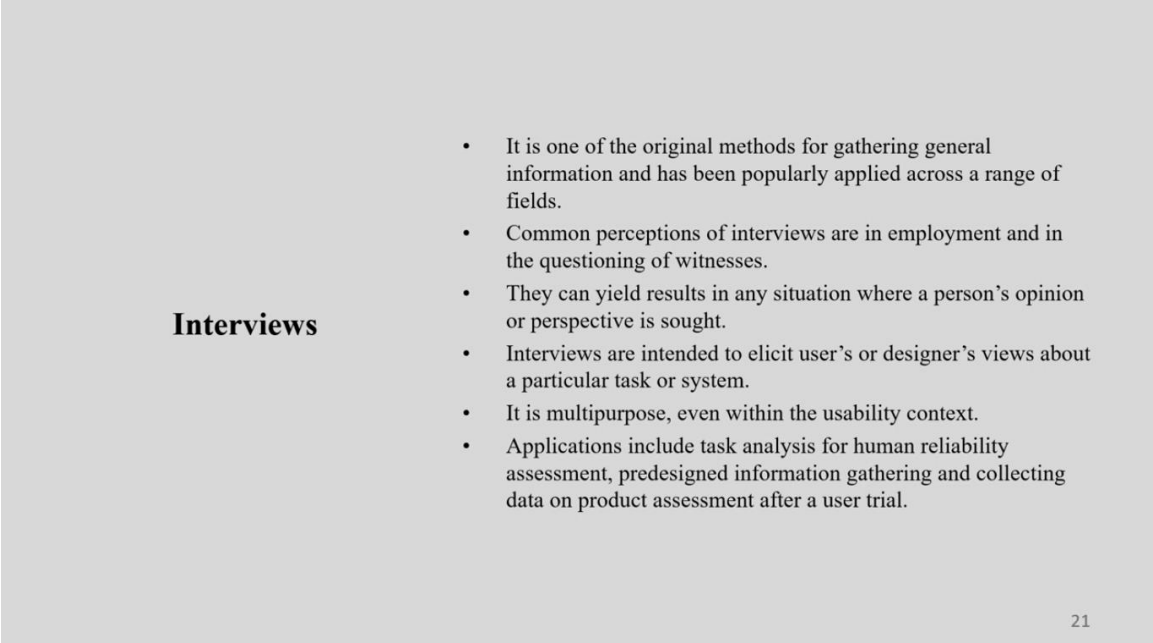
So, what are the instruments or what are the things we required when we do observational technique or observation recording. So, if we go for the direct like you know we are collecting data at the field itself in that case we need pen and paper. Whereas, if we want to collect the information and come back to the lab and do the analysis later in that case we need a video recorder and of course, always before we start any kind of observational study we should follow the human ethics ok. So,ethical permissions are always required before we go for observational study ok.

Summary

- Observation is direct method used in cases to avoid an error that can be a result of bias during evaluation and interpretation process.
- It is a way to obtain objective data by watching a participant and recording it for analysis.

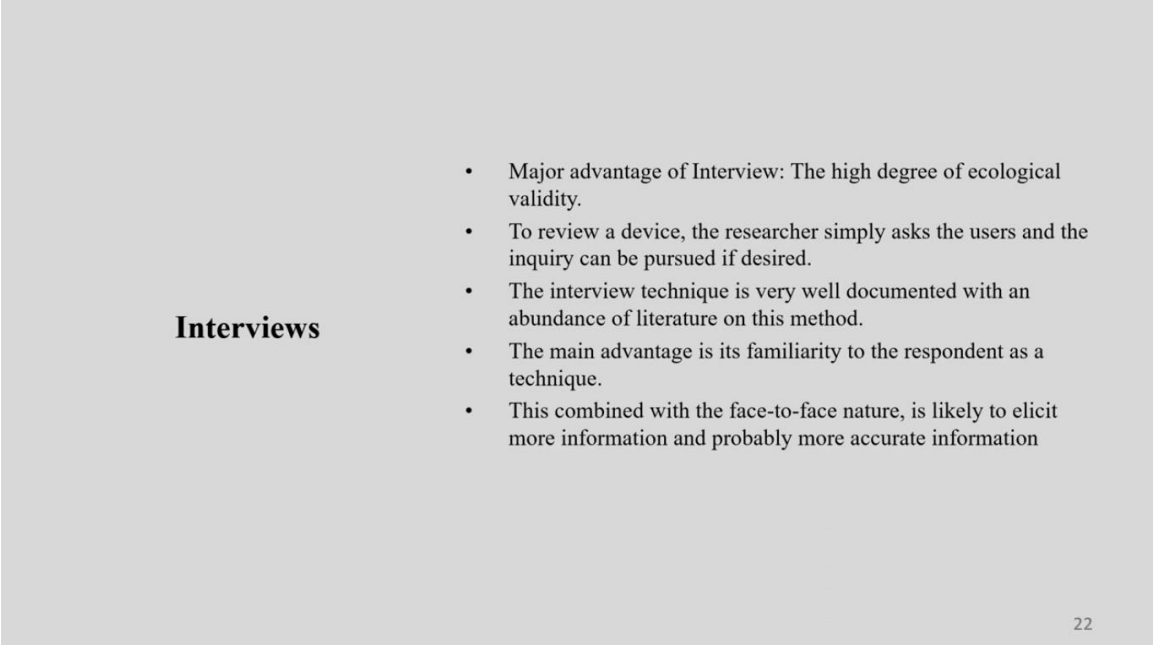
19

So, if we conclude this observational study it appears that it is very easy tool, it is very initial tool initial method to collect information about that particular situation about that particular workspace ok. So, work activity, performance, task right. So, I am using so many terminology because these are the commonly used terminology ok. So, we can you we can start with and this way this particular method actually will give you some objective that will take you further for more detailed analysis ok. So, it is a very initial tool and it will help you for more exploration. So, let us go for the next tool which is interviews. If you have any question for questionnaire, observation study you can definitely put it put up in the discussion section.

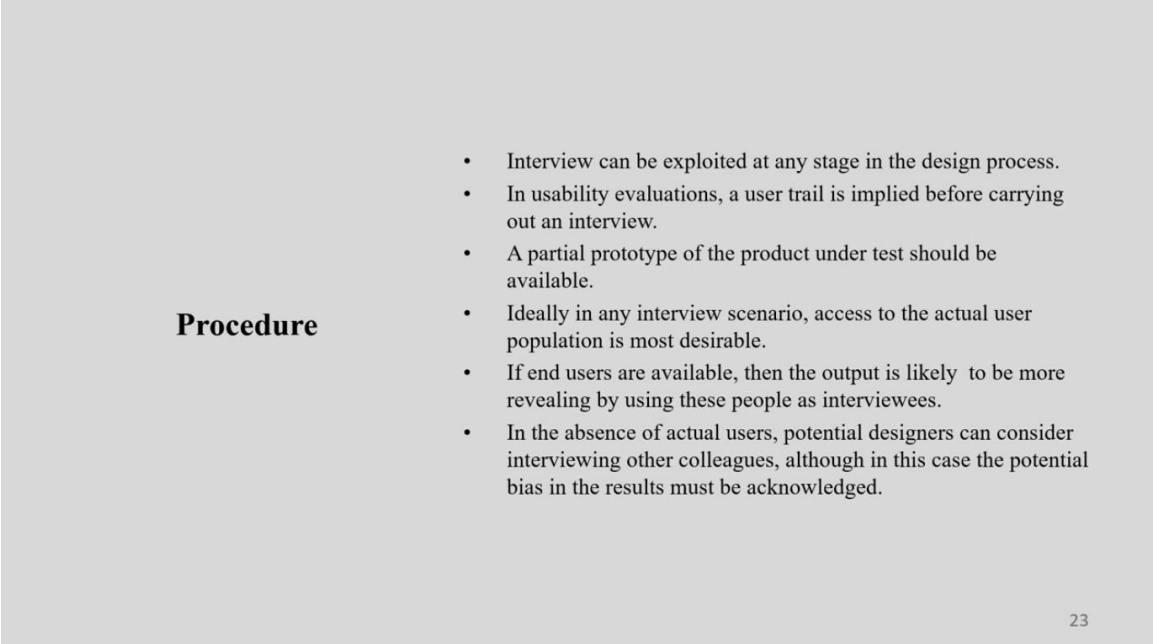


So, as I mentioned in the last lecture that what is interview, how do we do let us recall it once again. It is one of the very original method for gathering general information ok. It it is very gives you a very general information and has been very popular across a range of field. So, not only in the field of design, not only in the field of ergonomics, it is like you know in social science, in definitely design, ergonomics, occupational health, the industrial engineering, industrial management these interviews are very very useful tool. So, common perception about this interview are you know in employment and in the questioning of the weakness. So, you are employing some questionnaire questions and you are getting the information from the person. So, they can yield the result in any situation where a person's opinion or perspective is very important for the researcher ok. So, suppose I am a researcher I want to know about a particular incident happened in any industry. So, what will happen? We may go for an interview session with those people who are the stakeholder of that particular incident or or particular workstation right. So, once we get information then only we can go ahead, otherwise it becomes very difficult to take any decision or any kind of measure. So so sounderstanding the stakeholder

views stakeholders view are very important. So, interview becomes become a very you know initial and crucial tool for such cases. So, interviews are intended to elicit users or designers view about a particular task or system. It is multipurpose as I mentioned it is being used by many of them. So, it has multipurpose use ok and even within the usability context. So, from a single point also there are no several several views can come. So, applications include task analysis for human reliability assessment, pre-designed information gathering, collecting data on product assessment, maybe before and after trial. So, there can be varieties of use. So, in turn is a tool which really help you in all these processes.

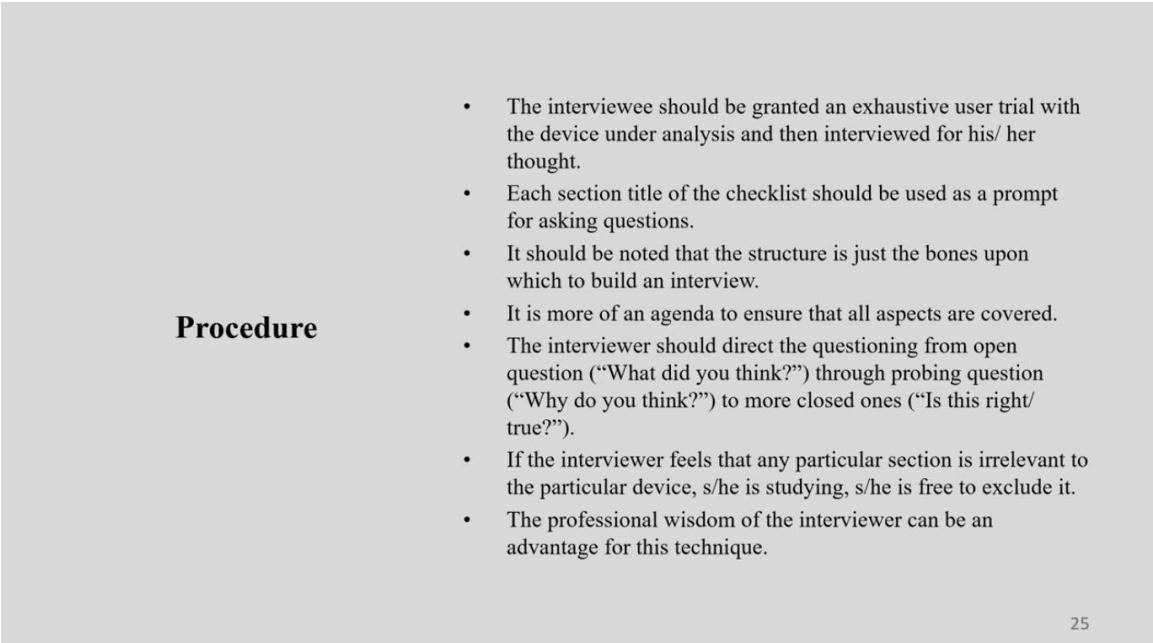


So, major advantages is a high degree of ecological validity ok. It is very very high ok. So, to review a device suppose you want to review you you you have a device which is newly designed. So, so if you want to review it, the researcher simply ask the user and they they inquiry can be you know perceived if if it is required. So, suppose I have a new product, I am going to know or I am going to understand what is the perspective from the user. I just simply go for the interview ok. So, the interview technique is very well documented with an abundance of literature for this particular method. So, if you go for any kind of literature where interview is being used as a tool you can understand that you know it is a very primitive tool. However, it is very very useful tool. This combined with the face to face nature which is possible, but in current days we can have different way of conducting interview. So, it is very very easy nowadays.

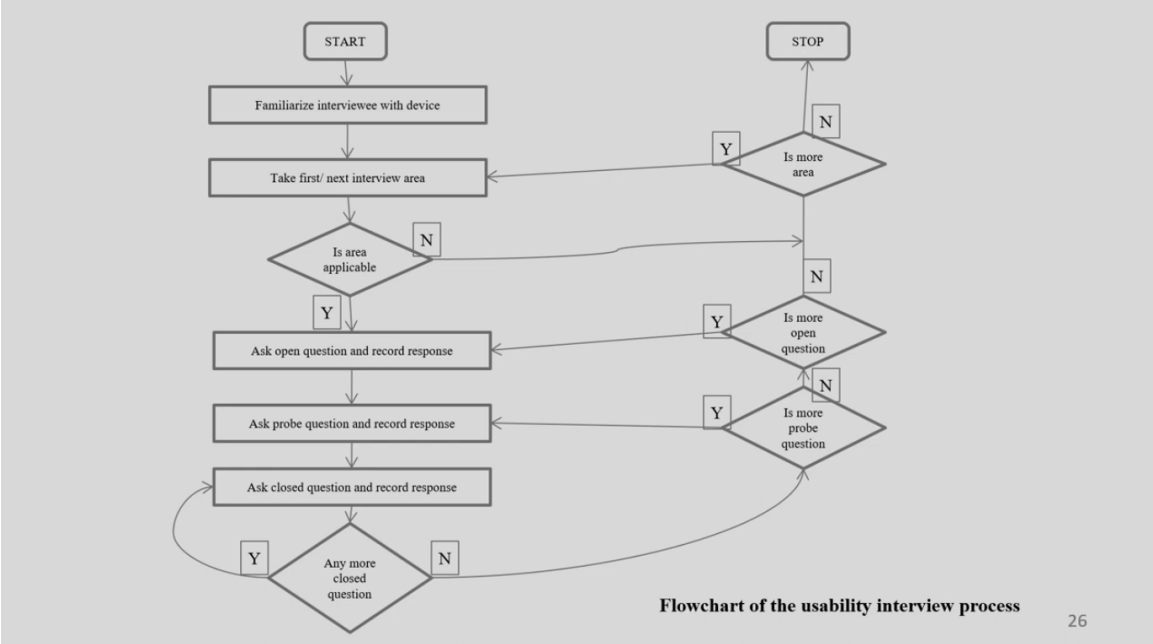


So, interview can be exploited at any stage. It is very funny that or very interesting rather it is very interesting that you know at any stage of my design process, at any stage of my research process, I can introduce an interview ok. Wherever I need to understand the stakeholders view, I need to understand the view from the users, I can definitely introduce this particular tool and get information. So, in case of usability evaluation, a user trial is implied before carrying out any kind of interview. A partial prototype of the product under test should also be available because you know if you do not have the product, you may not get a correct result from the interview. If end users are available for any case, for any interview session, then the output for that particular product should be available in that interview case. Otherwise, it becomes very difficult for the subject to reply to the questions asked by the interview ok. So, these are the requirement, basic requirement that we should follow when we are conducting any kind of interview.

Also we should understand also this this particular point I mentioned in my last lecture as well that it can be majorly three types, three variety ok. One is completely unstructured, some are semi-structured, some are completely structured. Now this completely structured interview are very similar. I would not say same, however it is very similar to a to with the questionnaire. There are some difference, however it it appears very similar. So, from a completely structured interview, definitely we can derive some questionnaire ok. So, based on the the nomenclature, we can understand completely unstructured, what is completely unstructured, semi-structured and completely structured. I described it in my earlier lecture.

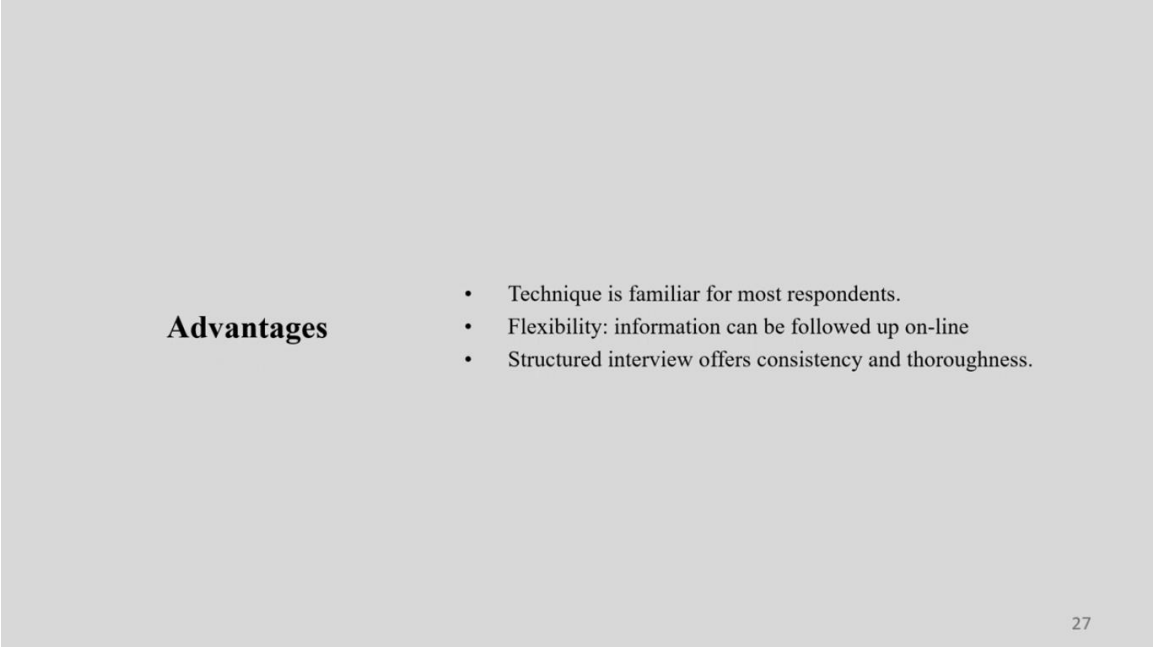


So, if we go further with the procedure of interviews, it says that interview the person who is taking the interview should be granted an exhaustive user trial with the device under analysis and then interviewed for his or her thought. Otherwise it will be difficult for someone to get the information. Each section ok when we are doing the interview, each section of the checklist should be used as a prompt for asking question. So, as I mentioned in the earlier lecture that you know you should have specific that you know some thought process should be there for any case ok. So, that that component should be very very clear. If that component is not clear, then it becomes very difficult to interact or get the information from the subject. The interviewer should direct the question questioning from open question. Normally that is the procedure that we follow and slowly it goes for the close end questions. So, so when if it is structured interview, we should write those questions in this fashion. If it is unstructured, we should be more experienced how do we derive the questions on the spot in this fashion ok. The fashion should be similar, the pattern should be similar. It can be structured, it can be semi structured or unstructured. However, the pattern should be starting with the open and slowly it will take you to the close end questions. If the interviewer feels that any particular section is irrelevant ok to a particular device he or she is studying, then they can easily exclude it ok. It may happen that you know it is a completely unstructured interview and the dialogue has gone some other direction. After collecting the data, the interviewee like the researcher has a full right to eliminate them from the data ok. It is possible. So, the professional wisdom of the interviewer can be an advantage for this particular technique because if they are very much experience, if they are very much professional, then it becomes very easy or becomes the data becomes very reliable.

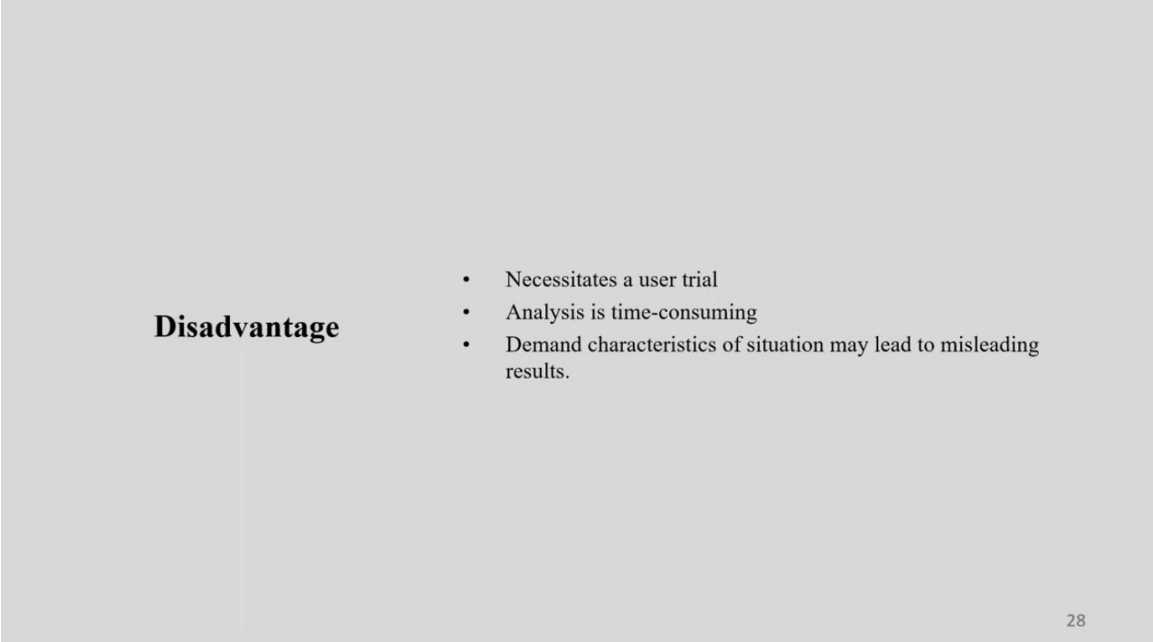


Flowchart of the usability interview process

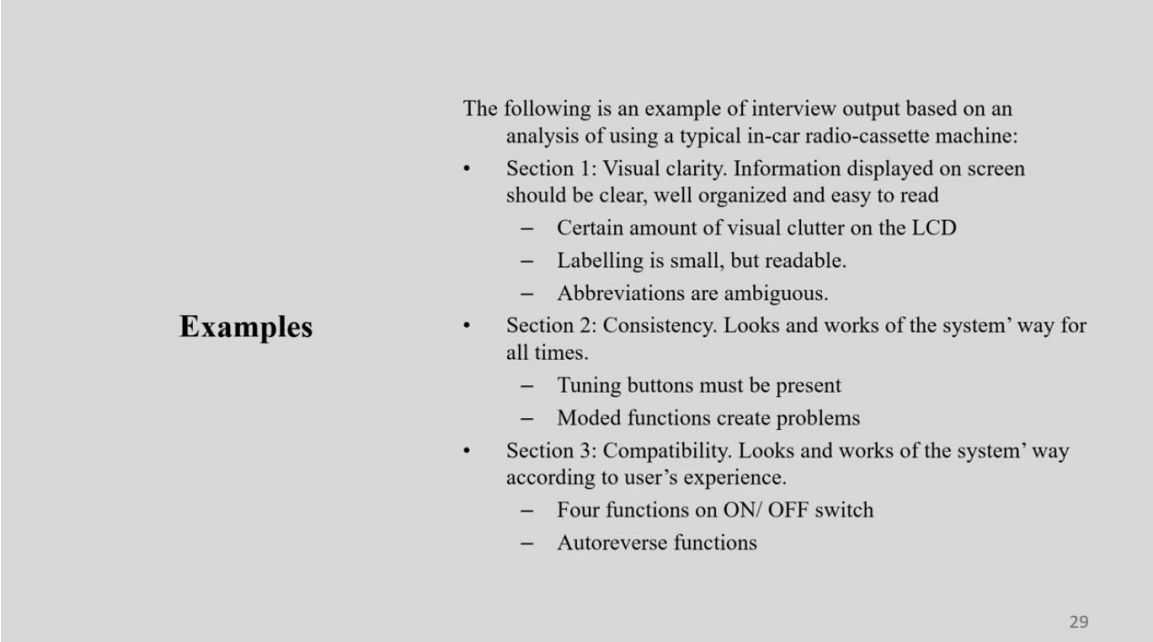
So, this is a kind of flowchart that you can keep in mind while you know doing this particular interview. However, this is not really the exact one to be followed. However, this is the general you we can definitely follow it ok. So, I am taking 2-3 seconds pause. You can look at this particular flowchart and understand how the flows goes when we talk about interview, how do we start and how do we stop the interview ok.



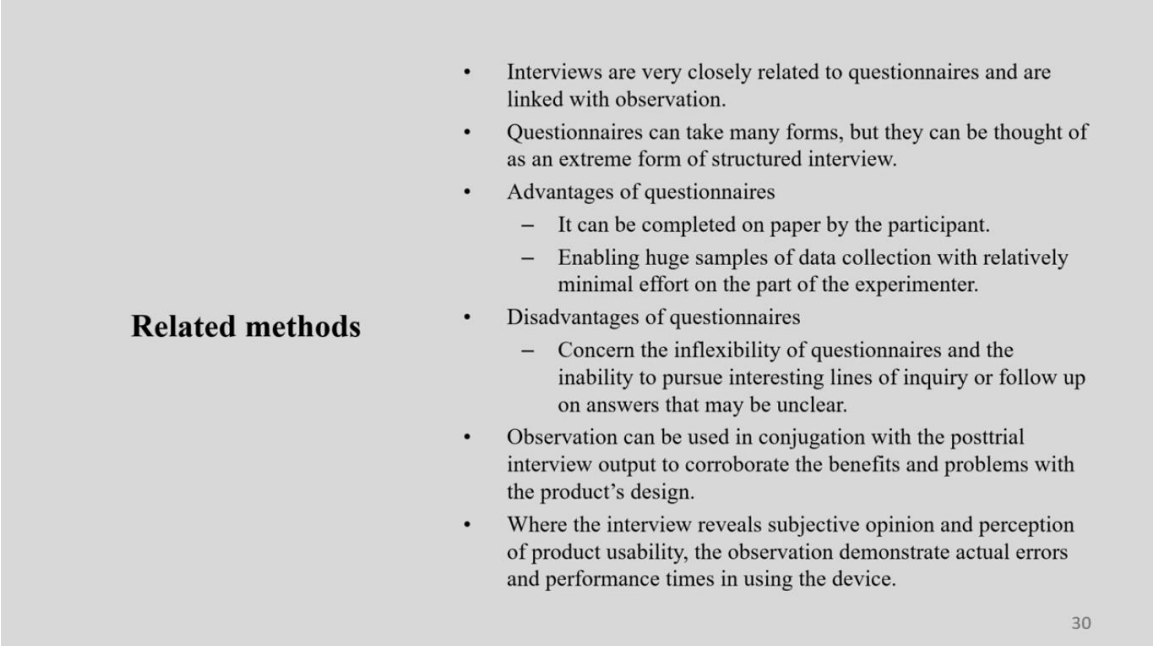
So, let us move towards the advantages. So, techniques this particular technique is very familiar for most of the respondents. So, it becomes very easy for researchers to introduce this. It is very flexible in nature and when we talk about the structured interview, it gives you an consistency. So, you know also the the detailings are there. So, it becomes very very easy for our for the researcher to extract data from this type of structured interview.



However, there are some disadvantages. So, you need user trial initially as I mentioned for the observationalmethod also that you really need some trials before you go for the actual data collection. Here the analysis is really time consuming because interviews we get several varieties of information if specially it is semi-structured or unstructured. So, how to extract data from that interview is very very difficult. So, it takes lot of time, it needs experience ok. From a single interview I being a novice person in this field may get only one or two information. However, an experienced person may get lot of information. So, it is very you know skilled based job, skilled based task. So, if you are not experienced enough to conduct interview and analyze them, then data may not be very reliable. So, it demands the characteristics of the situation may lead to misleading that result. Definitely, if the process is not or this the participants and the researchers are not on the same page, then it may have happen that result may mislead the researchers ok. So, we should be very very carefulwhile conducting this type of interviews and collect you know analyzing the result from the interviews.

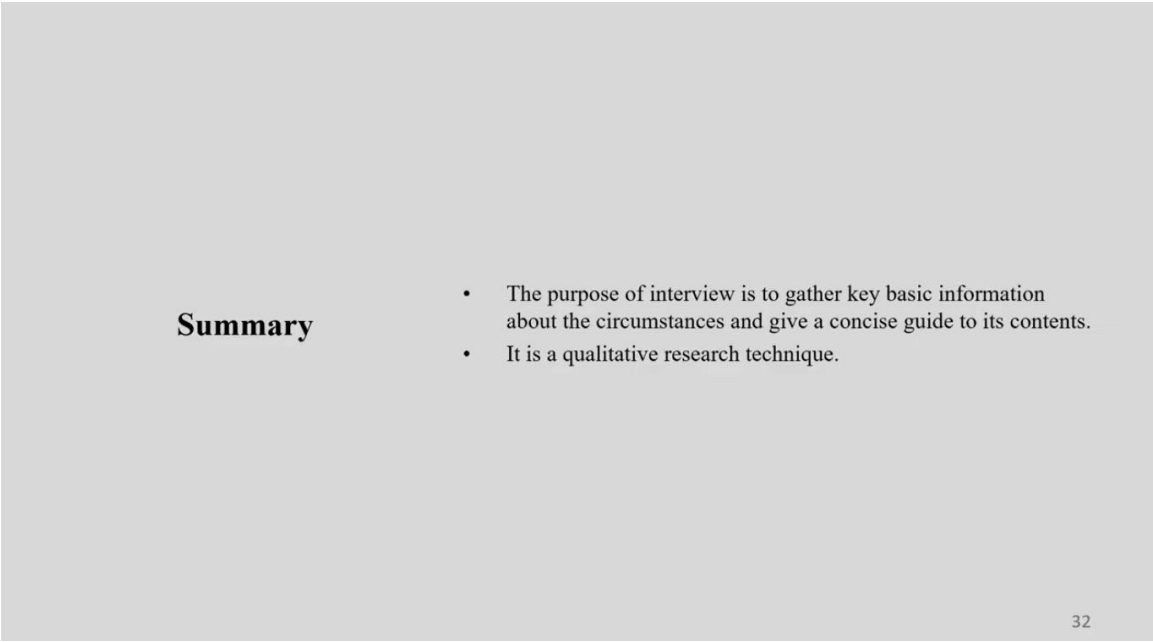


So, I will take some example. So, in a particular case, so what it says that interview output based on an analysis of using a typical in-car radio castle machine ok. So, here we are talking about in-car radio castle machine. So, in this particular case we had three major section that we talked about in the interview. There may be many things ok. However, based on our aim and objectives of the study we selected only three. First one was related to the visual clarity, second was the consistency and third one was the compatibility ok. Based on that we had some sections and we derived our questions only here ok. So, if it is structured, semi-structured or unstructured does not matter, but our all questions for this particular interview you know float around only these areas. So, first one was visual clarity, then second is the consistency and then compatibility ok. So, if something else comes during the interview process, we have easy option to exclude them ok. It may happen that the subject who is responding towards the question on this field may introduce some new information. Those information for this particular research may not be useful. However, maybe it is useful for some other research or it can lead to some other direction. But for this for this case we have very specific three points, three agenda points we will be discussing that only while analyzing the data. However, if it is a semi-structured or unstructured interview, we can have information, we can gather information, we can record the information, however we will not be able to use it ok. That way we we can use our interview data.



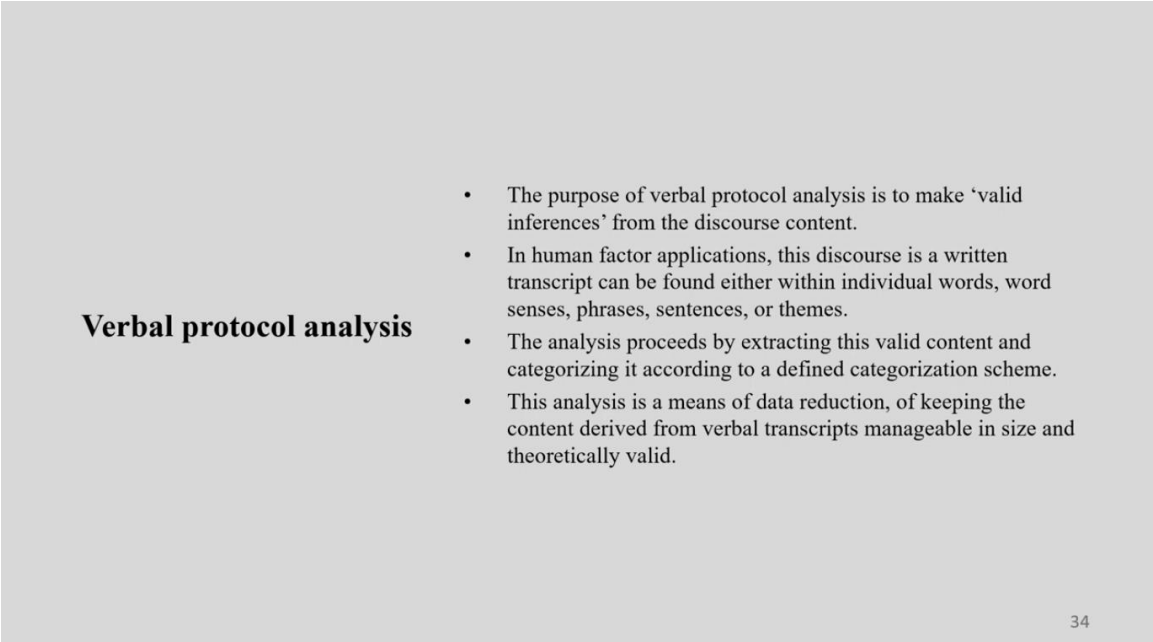
So, some related method also I will talk about the advantages and disadvantages of the questionnaire. So, interviews are very closely related to the questionnaire as I mentioned. However, if it is a structured interview, it is very very similar to the to the questionnaire. However, there are very specific differences that we can discuss in some other forum. So, questionnaire can take many forms, but they can be thought of as an extreme form of structured interview as I mentioned. So, there are some advantages and disadvantages. Let me tell you the advantages of questionnaire. It can be completed on paper by the participant, very important thing. So, you give the questionnaire, they will answer you on the you know paper itself or nowadays in the through internet you can collect data. So, enabling huge sample of data collection with relatively minimal effort on the part of the experimental, very important ok. Whereas, there are some disadvantages. So, it is concerned the inflexibility of the questionnaires and the inability to pursue interesting lines of enquiry or follow up on the answer that may be unclear ok. Whereas, this is possible in the interview. So, clearing the doubts that is possible in interview whereas, in the questionnaire it is not really possible. So, observation can be used in conjunction with the post trial interview output to corroborate the benefits and the problem with the products particular design. Whereas, the interview reveals subjects opinion and perception of the product usability, the observation really demonstrate the actual errors and performance time when the person is using that particular device. So, now, you can understand how the observation, interview and the questionnaire these three things are connected with each other ok. We can have based on the requirement, based on the aim and objective of my study I can decide which component to choose and where to introduce it ok. Hopefully you understood it ok. So, what we need if we want to collect information through interview.

So, the interview is relatively a very simple tool and can largely be conducted as a pen and paper exercise. However, in current scenario whatever interviews we conduct we try to do a videotape. So that it becomes very easy for us to analyze it and there is less chance to lose any data. So, audio recording also possible, video recording is also possible.

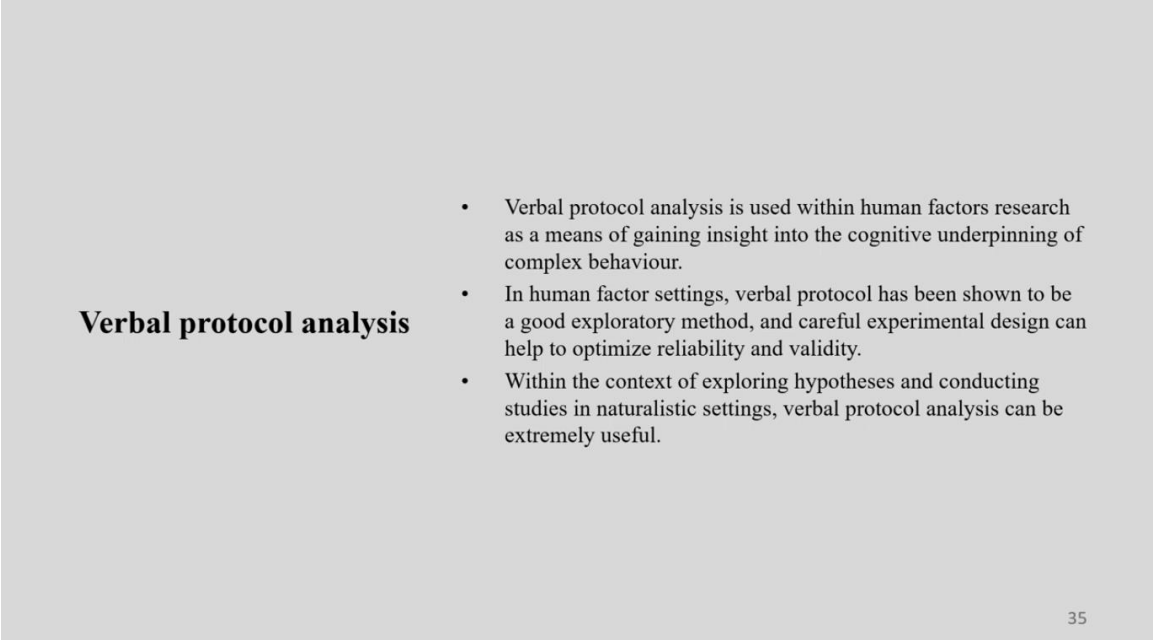


So, in summary we can say the purpose of interview is to gather key basic information about the circumstances and give a concise guide to its content. It is very important. It gives gives a very precise information about that particular content and it is qualitative

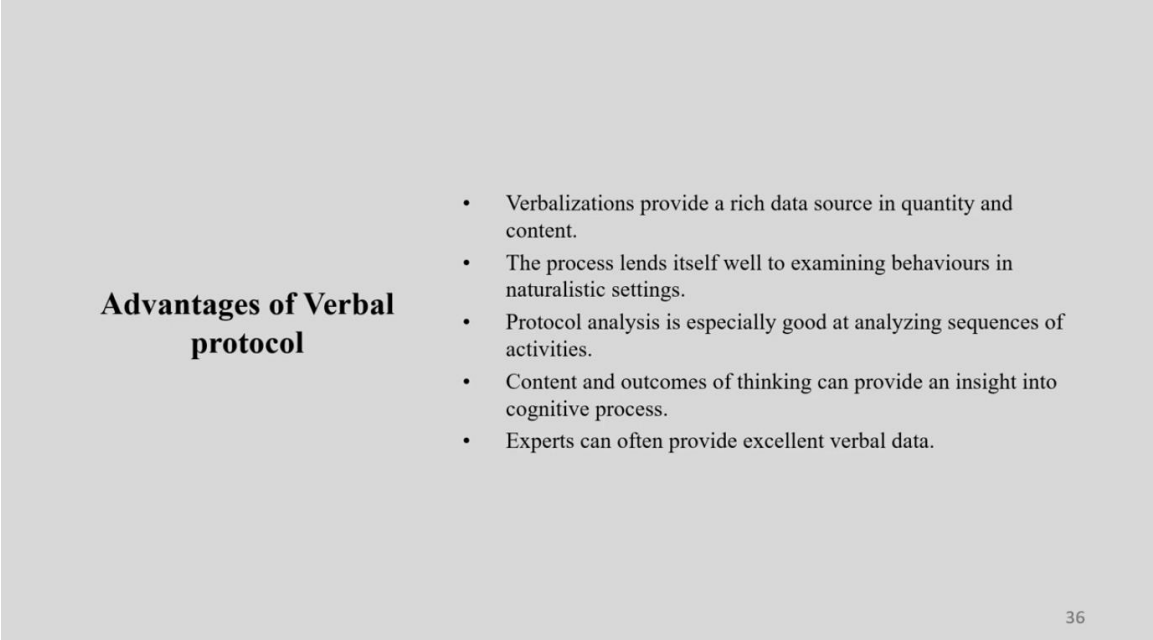
research technique. So, how do we use the data for our statistical treatment or for our further data analysis? We should be very clear before we introduce this tool for our data collection ok.



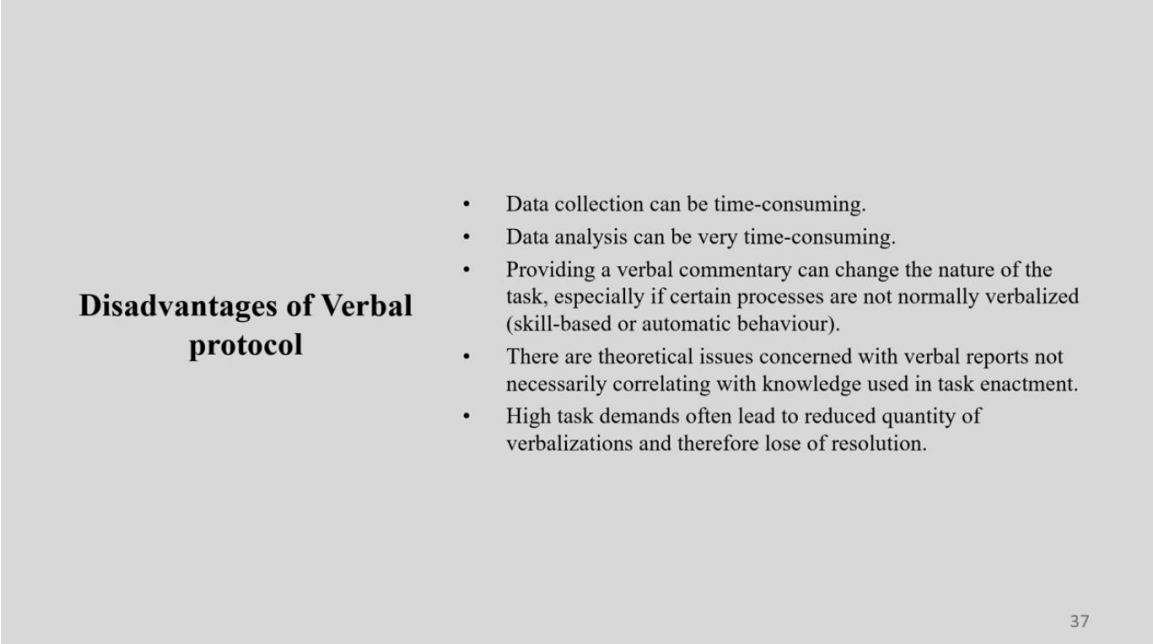
So, let us move to the next which is known as verbal protocol analysis ok. What it says? The purpose of verbal protocol analysis is to make valid inferences from the discourse content. Very important ok. Valid inferences which is really valid for our objective. So, from a discourse content we should find out this valid inferences that is the agenda for the verbal protocol analysis. So, in human factor application this discourse is a written transcript. Normally it is a written transcript can be found either within the individual words or word senses, phrases, sentences or themes. It is possible ok. So, we can have combination, we can have single single ok. So, the analysis proceed by extracting this valid content and then categorizing ok. You have to do a categorization. Once we find the valid content from all this we should categorize them and define those categorization scheme very important ok. So, we have a set of words, set of sentences, phrases, theme from that we have to create the baskets. We have to create the baskets and then you should you should understand understand that where these what do does this basket mean? What this basket mean? Ok you have to correlate how they are connected with each other. So, that is verbal protocol analysis. So, this analysis is a means of data reduction very important. It is a means of data reduction of keeping the content derived from the verbal transcript. It is a reducing the size that is why it becomes manageable. It becomes easy for you to handle the data. So, that is the major purpose for the verbal protocol analysis.



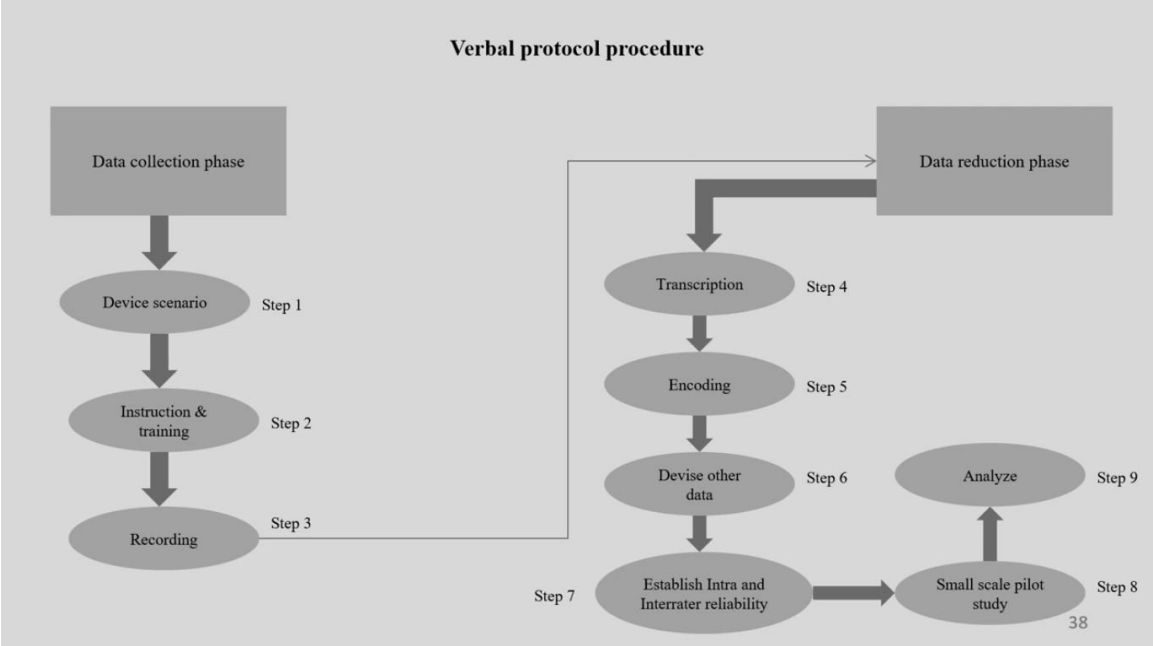
Little more about it. So, verbal protocol analysis is used within human factor research as a means of gaining insight into the cognitive underpinning of the complex behavior ok. So, when behavioral analysis are there we really need to understand what are the interconnections, what are the influences, what are the relations available. So, from this from this particular tool we may get a direction. So, in human factor setting verbal protocol has been shown to be a good exploratory method ok. So, it it helps you to explore the situation. It helps to helps you to explore the behavior of a person in a particular setup ok. If you design the experiment very carefully it may give you an optimized reliability and validity of the situation ok. So, within the context of exploring this particular hypothesis and conducting studies in a naturalistic setting verbal protocol analysis can be extremely useful. So, it is depend how you are going to analyze the data. If it is being you know it is being used in the context exploration then it becomes very veryuseful for the researcher to get a further lead.



Definitely it has some advantages. So, it provides rich data source in quantity and in content. As I mentioned it summarize the data right. It it reduces the size of the data. So, it gives somecontent very valid and solid content. So, the process lends itself well to examining the behaviors in a naturalistic setting. So, you know in a particular workspace when suppose somebody is really working in a particular working setup, original setup, natural setup. So, how the how the behavior is, how the informations are we are collecting from their behavior. So, it becomes very very connected to the original setworks setting right. So, this tool actually help us to get such data. And once we get some natural data like which is very much connected to theoriginal work setup, the implementation of the design or implementation of the intervention becomes very useful and very unique ok. So, one setup to another setup it is very unique in that case. So, content and outcomes of thinking can provide an insight into cognitive process of course, it helps because we are actually analyzing the behavior. Whereas in observation it is very very you know physical in nature you know you really count the numbers of the movement, you count the number frequency of any particular action or error. Whereas this verbal protocol how person is using this it it gives a understanding about the perception of the situation, understanding about the situation. Of course, sometimes who are the expert in this particular field will give you excellent data. Whereas as I mentioned the novice researcher may not be really good in this field you should practice it, you should follow many research papers or research studies for this and then you get skilled. Once you are skilled then definitely you can have good data using this particular protocol.

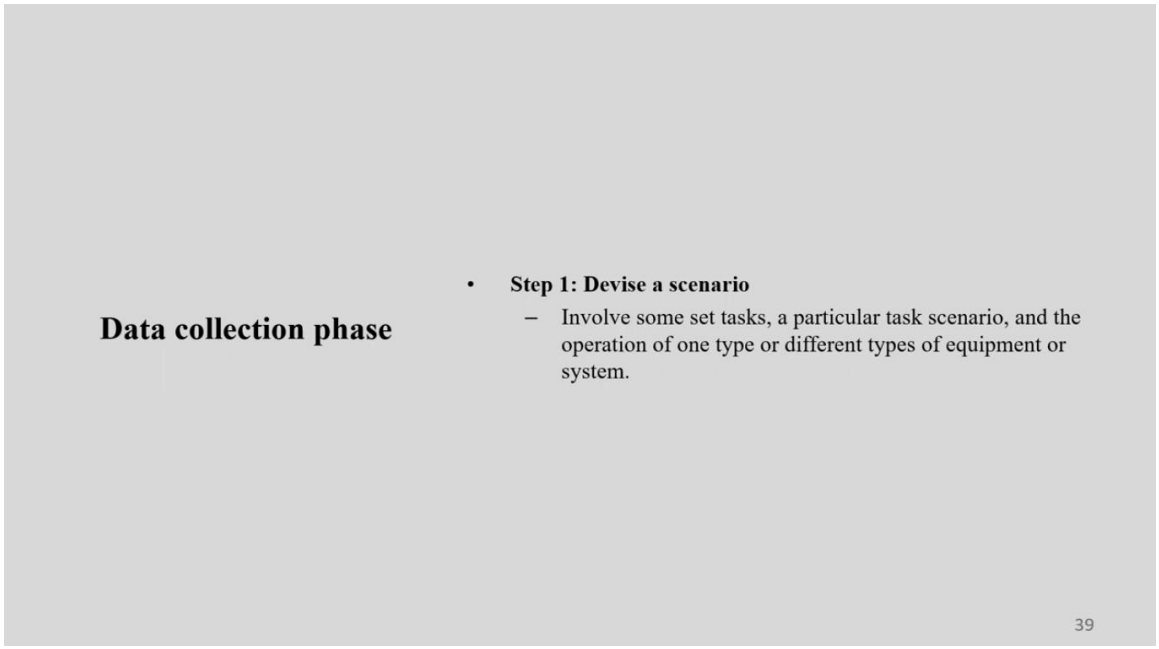


However, there are some disadvantages. It is a time consuming protocol. So, it needs lot of time. Also analysis also very much time because not only data collection, data analysis also very time consuming. It provides verbal commentary and that can change the nature of the task, especially if certain processes are not normally verbalized ok. So, some skilled work, some skilled job which is really difficult to narrate to difficult to explain for those cases this protocol is not a good tool, we should not go for this type of tool in that case. There are theoretical issues definitely. It is being mentioned in different literature that it is really not not really valid tool in some cases. So, it is absolutely depend that which situation you are going to analyze or evaluate using verbal protocol. You please check back the similar literature. If literature says yes in such cases verbal protocol is useful, then go for it otherwise it is advised that you should not use this verbal protocol. So, it is very very important that you should understand what is the background of this particular research area ok. So, depending on the occupation, depending on the activity, depending on the task that you are going to that you are going to evaluate you are going to use verbal protocol or not you have to decide ok. So, it is not that everywhere it is useful. In some cases it is very useful, in some cases it is not. So, you before you choose this tool you should go for the literature.

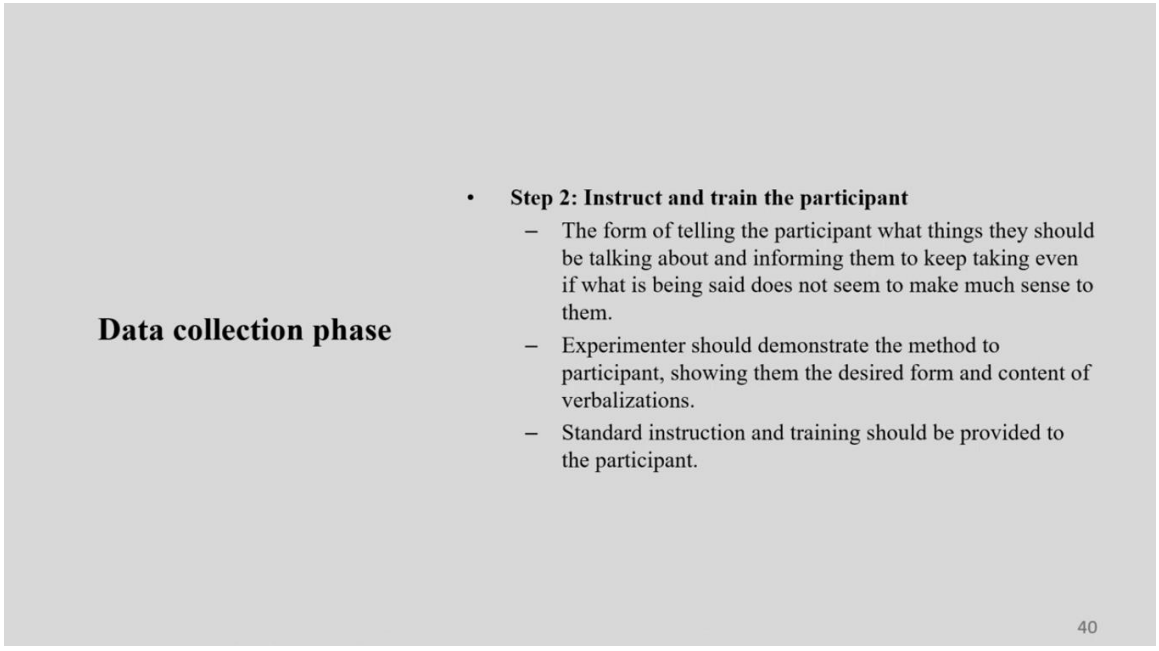


So, this is the process you know. I mentioned it as a step 1, step 2, step 3. In step 1 so what you do you actually check the device scenario, then instruct instruction and you know you give training on that particular step you use protocol, then use the recording you follow the recording once you collect the information. So, once you finish your this recording stage what you do that here it comes the data reduction. So, once you have whole data, then you start grouping them ok group 1, group 2, group 3. Then or maybe many more ok some categories you do and once you do that using your the content of the verbal protocol what you do you give the translation transcription ok. Once you give the transcription, then you do encoding ok you give maybe you give some kind of nomenclature ok typical nomenclature you can give. Suppose I am talking about example. I am talking about using a hand spray ok. So, how do I use it? So, when I am using it is only pushing. So, in pushing pressing, maybe in pressing how I am going to do that. So, for all these detail you can have varieties of information, you can group them and you can keep it as a single component. So, you encode them ok and later you can device with the other data. Once you device them you have group 1, group 2, group 3 like that you can find the relations. So, you can find with the group 1, group 2, group 3 or group 1, group 2, group 3, group 4 something like that type of relation you can establish. Now here which relation to be established which content should be connected with which content it absolutely depend on the objectives that you have set for your research work ok. So, here there is no guideline that how do you analyze, how do you go for the statistical method ok. So, it is not possible. So, you have to have your own understanding based on that you can take this grouping ahead ok. So, you can have the small scale pilot study. Once it is done you can then analyze this particular data. So, this

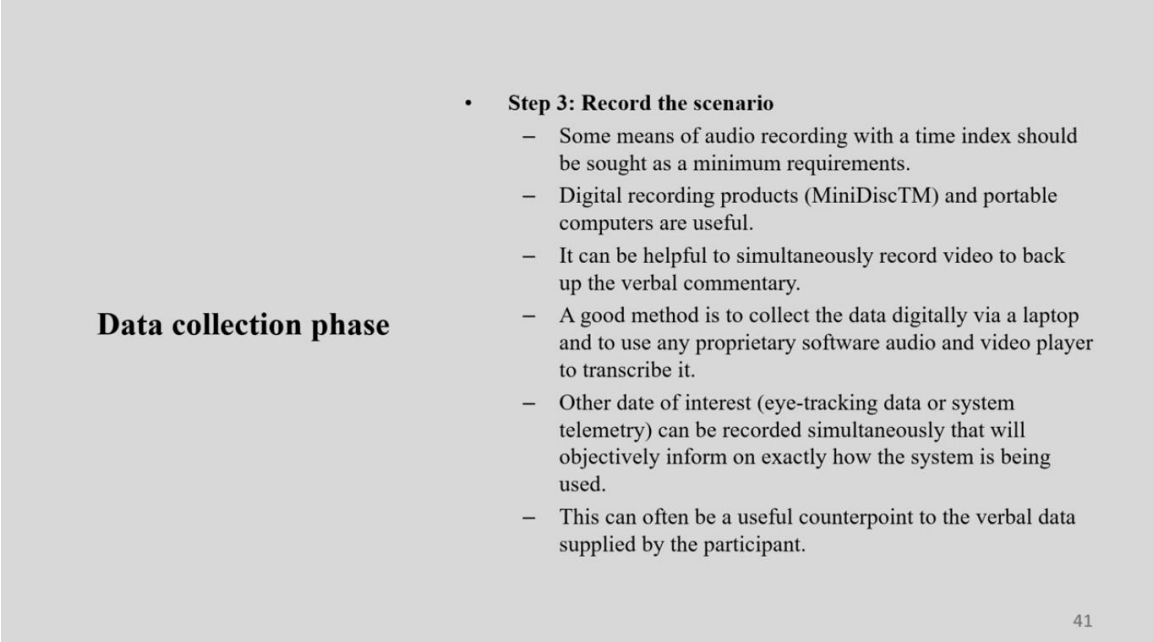
is the basic major steps that you can follow for verbal protocol analysis. So, I will give you detail that what are the steps.



So, first is the device or scenario what you will do involve some set task which is already set ok. Now here it should be connected to your research. A particular task scenario ok a particular task scenario need to be framed properly and the operation of one type or different types of equipment or a particular system. So, you set the whole scenario initially.

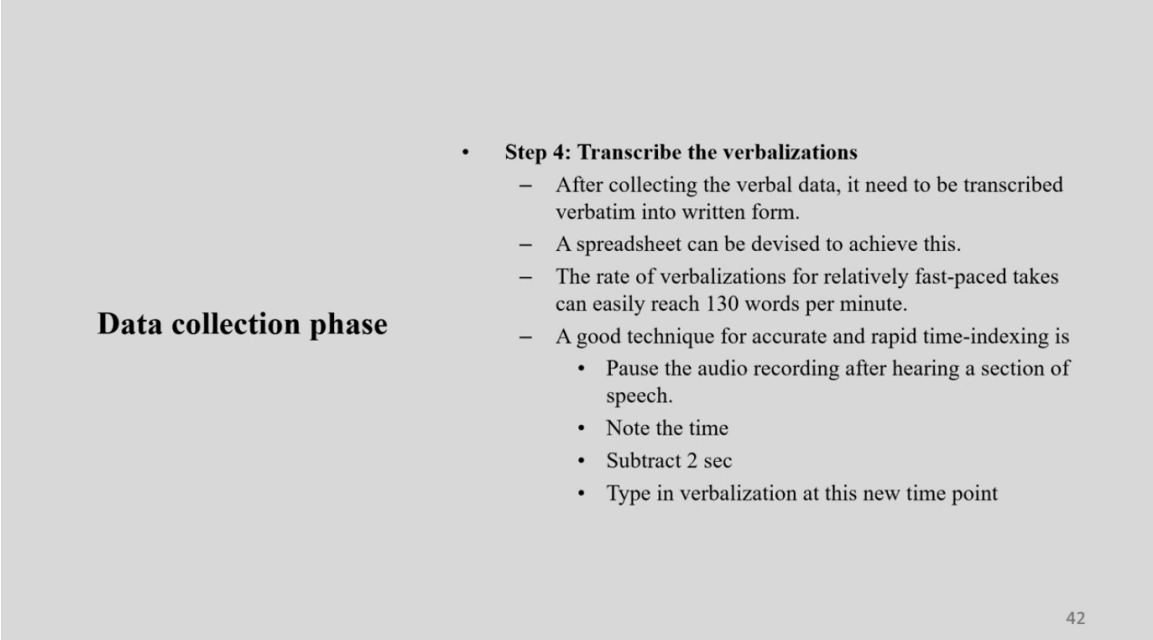


Then instruct and train the participant. It is very important because if the participant do not know that how what to do and how to do, they will not be able to help they will not be able to perform the task. So, you instruct and train the participant correctly. So, the form of telling the participant what thing they should be talking about and informing them to keep taking even if what is being said does not seem to make much sense to them. It is very funny right. So, if they it says that it is not really very connected to them. However, you should inform them yes this is the thing you have to do this is the thing you have to talk. So, experimenter should demonstrate the method to the participant initially showing them the desired form and content of the verbalization very important ok. So, in which form they are actually looking for it they should inform you beforehand. Standard instruction and training should be provided to the participant. So, it is not that for one participant one it is different and participant two it is different it should be standardized. So, before you go for the data collection you set all those thing train the subjects and then you start the train means give the instruction ok then you start the process.



So, record the scenario how do we do that maybe audio recording with a time index it is possible. Sometimes digital recording products also can be used. So, portable computers also sometimes useful. It can be helpful to simultaneously record video to back and up you know to the verbal commentary it is possible. A good method is to collect the data digitally via laptop. It is very useful because nowadays it that is the way how do we collect data. Similar data of interest like eye tracking data or you know system telemetry all these thing can be recorded simultaneously that will be objectively informed on exactly how the system is being used. So, you should inform that ok. It should be it

should be informed to the subject previously. This can often be useful to counterpoint the verbal data supplied by the participant.



Now, the step 4 transcribe that verbalization whatever is happening. So, how do we do that after collecting that verbal data. So, participants is giving you the whole set the whole narratives right. So, you once you collect it, it need to be transcript verbatim into written form ok. So, first is the audio recording or video recording right. So, you will listen and then you will transform it. So, a spreadsheet can be devised to do this particular process. The rate of verbalization for relatively fast paced text can easily reach up to 130 words per minute it is possible. However, it is not mandatory there will be some changes. A good technique for accurate and rapid time indexing is pause the audio recording after hearing a section of speech, note that particular time subtract to second type of verbalization at this new time point. So, that way you can do the transcribe ok.

Data reduction phase/ Content analysis

- **Step 5: Encode the verbalizations**
  1. Decide whether to encode words, word senses, phrases, sentences or themes
  2. Establish a conceptual framework for the encoding scheme
  3. Devise encoding instruction
  4. Complete encoding

43

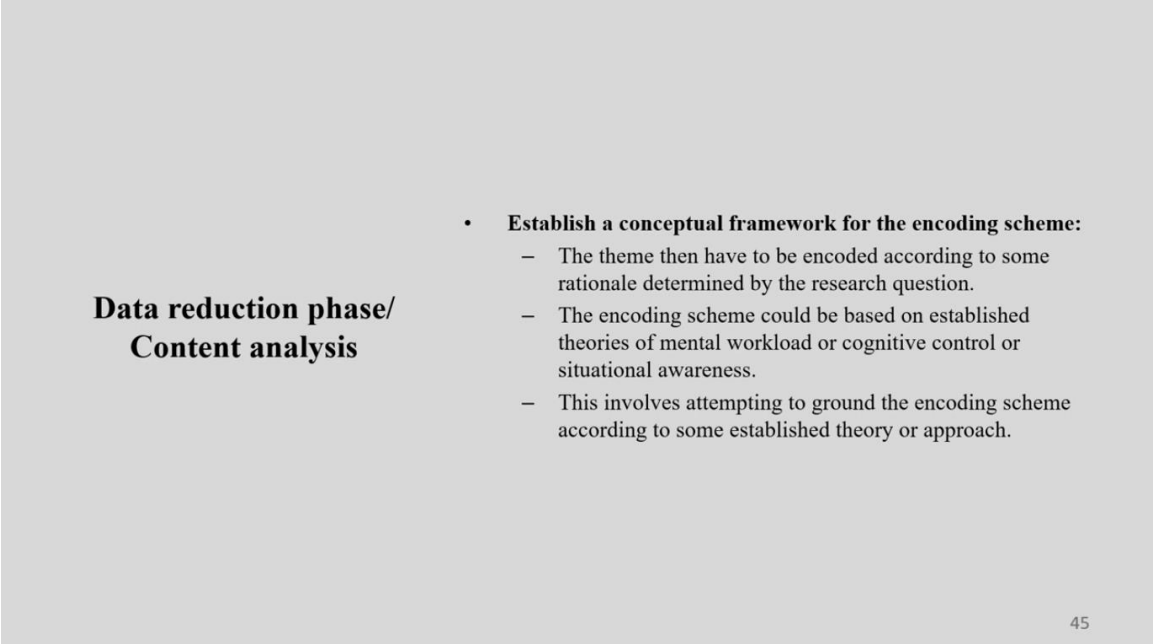
So, then you encode it. How do you do that? Decide whether to encode word or encode senses or phrases or sentences or theme which one. So, based on the research objective research interest you can encode any one of them. You should establish the conceptual framework for encoding this particular scheme. Encode the encoding instruction because you are not only the person who are going to use it maybe your co researcher also going to use it. So, you should give the device for encoding this instruction and then complete the encoding.

Data reduction phase/ Content analysis

- **Decide whether to encode words, word senses, phrase, sentences or themes**:
  - After transcribing the verbal commentary into written form, it has to be categorized:
    - *Words*- Encoding of occurrence of discrete words
    - *Word senses*- Encoding of words with multiple meaning
    - *Phrase*- Encoding of phrases that constitute a semantic unit
    - *Sentence*- Encoding of what particular sentences refer to, or express
    - *Theme*- Encoding of meaning of phrases and sentences into shorter thematic units or segments
  - A protocol analysis based on themes provides the richest and most flexible source of data and can be recommended as a starting point.

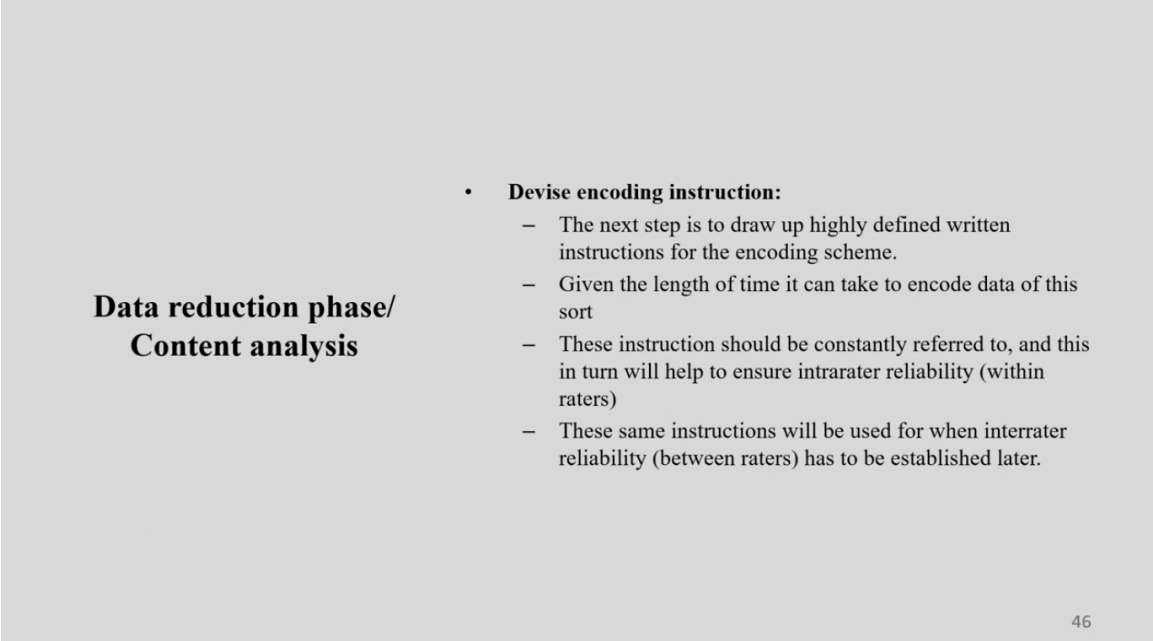
44

So, decide whether to encode word, senses or phrases. So, how do we differentiate them? So, if it is word encoding the occurrence of discrete word ok. If we are talking about only encoding the word, then we should encode the discrete word. If it is word sentences then encoding the words with multiple meaning, a single word with multiple meaning. If it is phrases then what we will do? Encoding the phrases that constitute a semantic unit. If it is a sentence then encoding of what particular sentences refer to what or refer to something some expression right. So, that is very critical. This really needs your experience. Second is theme, encoding the meaning of phrases and sentences into shorter thematic units or segment. Normally we try to go for this portion, this becomes very easy, like you know you know thematic encoding. So, when we are getting the verbal protocols that whole data we try to categorize them under small small theme. So, a protocol analysis based on the theme provides a richest and most flexible source of data as well as I was saying. It is very useful when we go for the theme and can be recommended as a starting point of next part of the research. So, so you know theme is very very important when we go for this type of data collection.

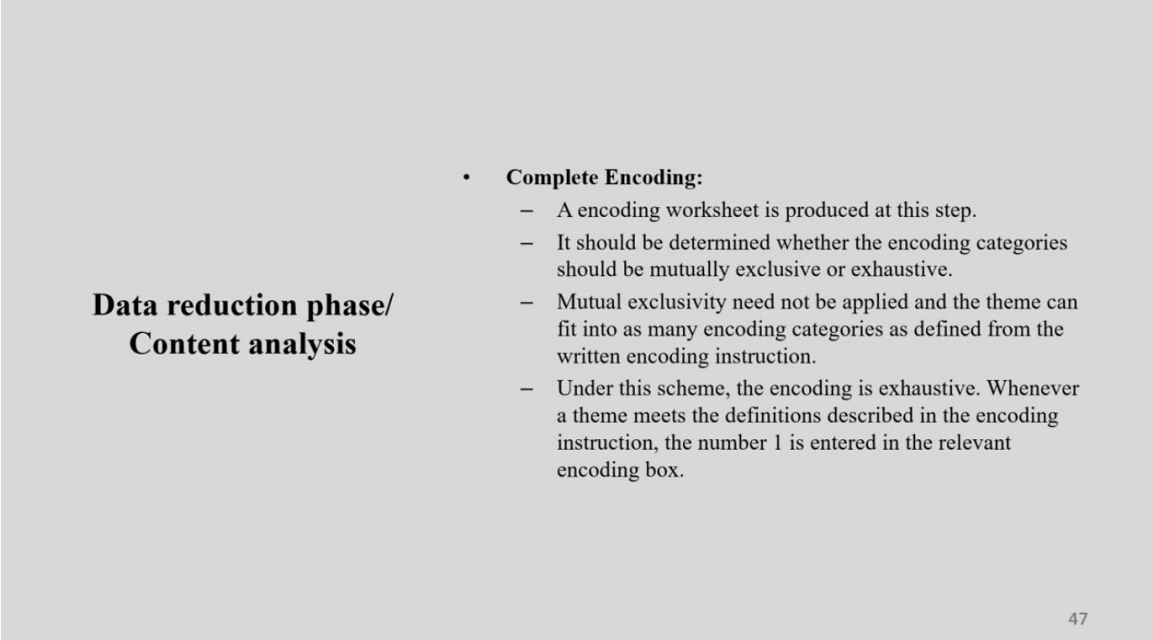


So, then what we do? Establish a conceptual framework for the encoding scheme. The theme then have to be encoded according to some rational determined by the research question because you know you have pre established research question. So, accordingly you have to set them, according to that rational you have to set them. So, the encoding scheme could be based on the established theories of mental workload or cognitive control or situational awareness anywhere right. So, whatever themes, whatever encoding you are getting you have to establish the you have to connect them with something which is already established ok. So, this involves, so here you know you need to go back to the literature, you have to connect them again, repeat, relook into it. So,

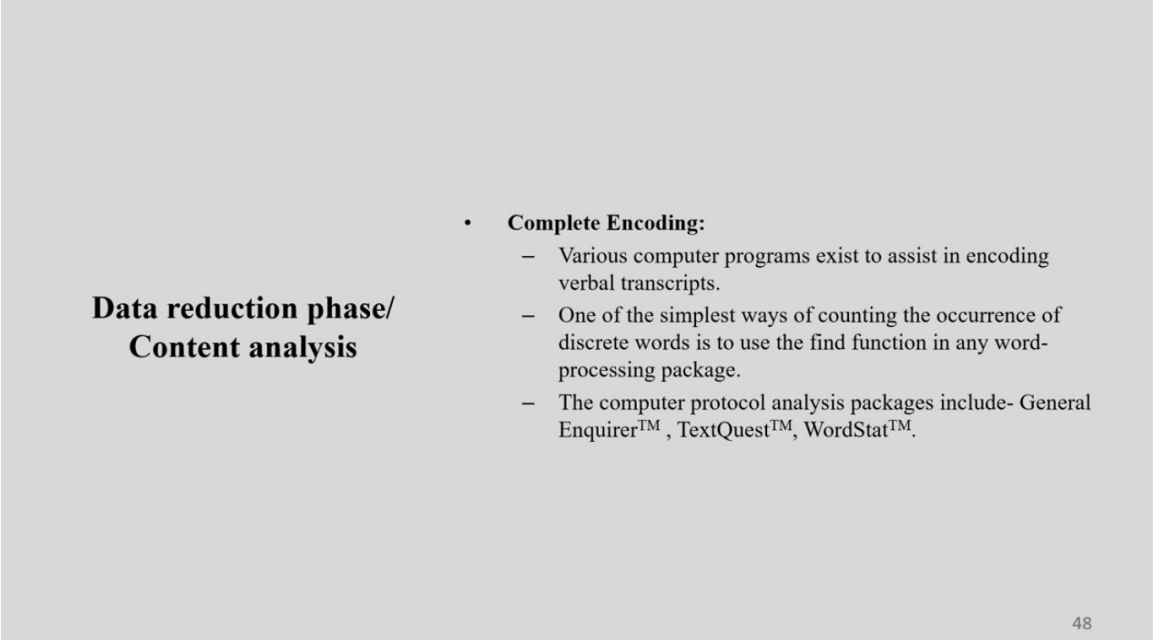
this is a very detailed process ok. It never happens very quickly. So, beforehand you should learn some literature. Also once you have your themes ready, again you go back to literature and check for the different types of you know method or models available or not. So, this involves attempting to ground the encoding scheme according to some established theory or some kind of method or approaches ok.



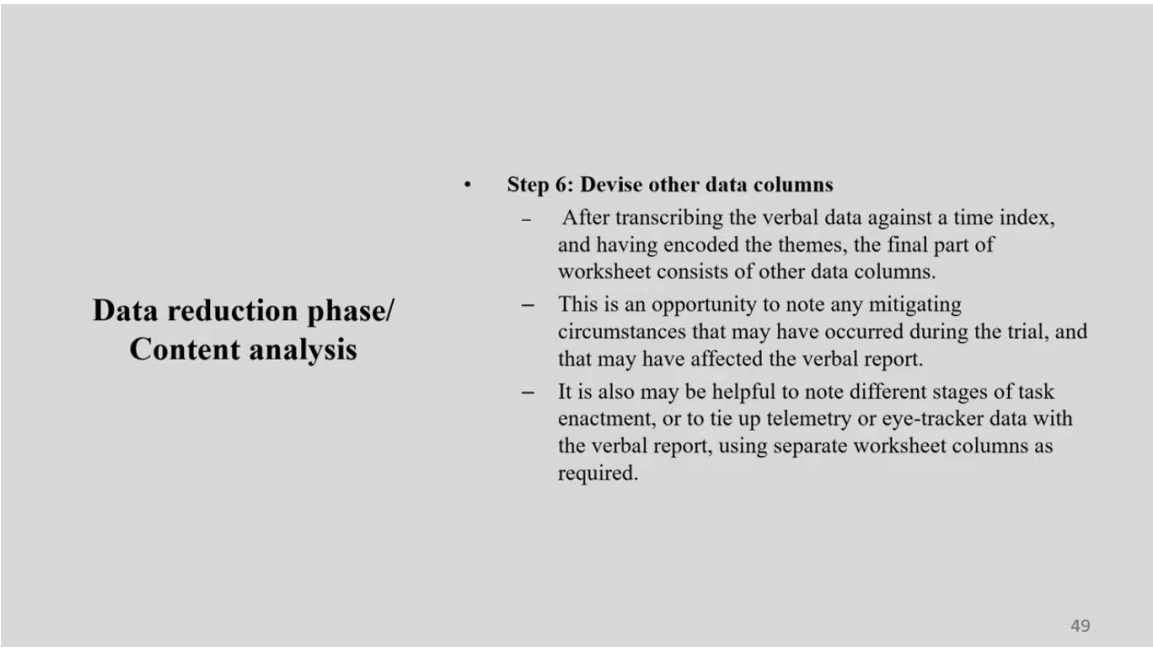
So, then what you do? You devise the encoding instruction. How do we do that? The next step is to draw up highly defined written instruction for the encoding the scheme because if you do not have that, then it becomes very difficult in the next phase. How do you take it further right? Given a length of time it can take to encode data of this particular sort, these instructions should be constantly referred to and this in turn will help to ensure inter-rater reliability or within-rater reliability. These same instruction will be used for when inter-rater reliability has to be established in the latter stage.



Then you complete it. How do you do that? In an encoding worksheet is produced at this particular shape. So, earlier you are listing them, you are detailing them, here you are creating the worksheet. It should be determined whether the encoding categories should be mutually exclusive or exhaustive ok. Mutual exclusivity need not to be applied, it is not, it is not always and the theme can fit into as many encoding categories as defined from the written encoding instruction ok. So, it is very iterative process, you need to really learn it in detail ok. So, under this scheme the encoding is very much exhaustive. Whenever a theme meets the definition described in the encoding instruction, initially how do you encoded them? The number one is entered in the relevant encoding box and then you start for 2, 3, 4 and like that ok.



Now you complete it. So, how do you do that? So, various computer programs exist to assist in encoding the verbal transcript. So, there are different packages available here I mentioned few. However, you may have your own as well ok.



The next step is device the other data columns after transcribing the verbal data against that time index and having encoded the themes, the final part of worksheet consists of the other data column. This is an opportunity to note any mitigating circumstances that may have occurred during the trial. It is very important right. So, you really get a detailed view of it and that may have affected the verbal report. It is also may be useful to note

different stages of task enactment or to tie up telemetry or eye tracking data with the verbal protocol because that definitely we do and we will have a lab practice where we will be really doing all these ok. So, how do we connect them or integrate them with the eye tracking system? How do we telemetrically we we see them ok using separate worksheet column.

Data reduction phase/ Content analysis

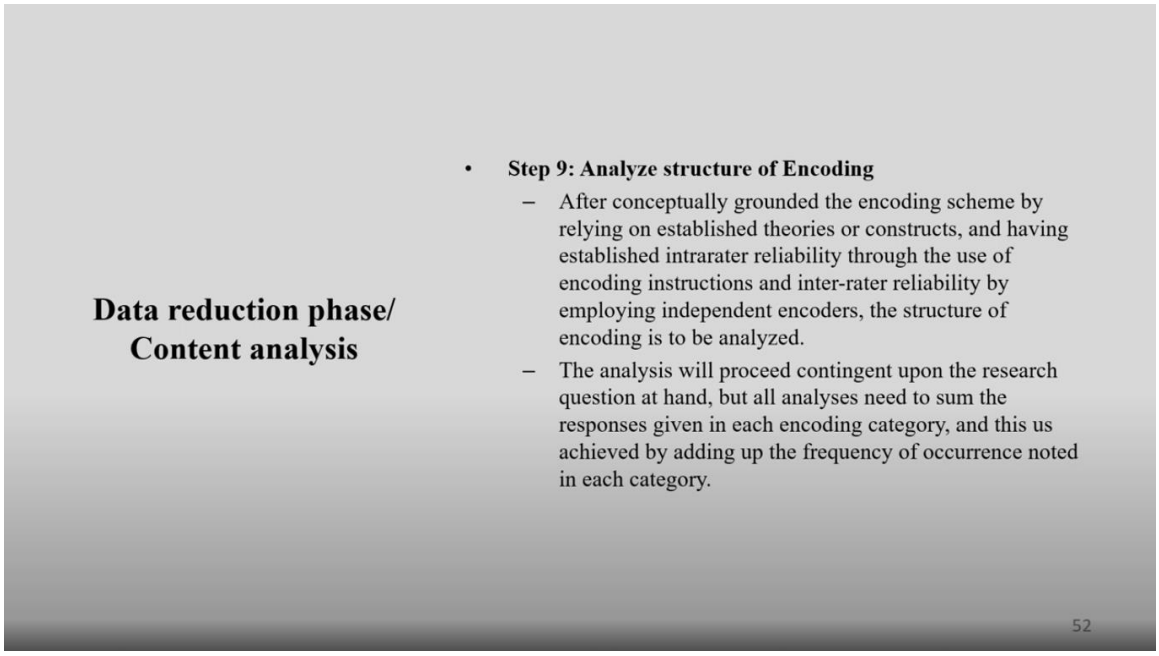
- **Step 7: Establish Inter and Intra-rater Reliability**
  - After completing the encoding process, the reliability of encoding scheme has to be established.
  - Intrarater reliability will help to measure any potential drifting in encoding performance over time.
  - In protocol analysis, reliability is established through reproducibility.
  - The independent raters make use of the same categorization instructions that the original rater employed before beginning their own encoding.
  - The dual encoding of the same analysis can then be analyzed using basic correlational statistics.

50

Data reduction phase/ Content analysis

- **Step 8: Perform small-scale pilot study**
  - The protocol analysis procedure should be put to the test within the context of a small pilot study or pilot run.
  - This will demonstrate whether the verbal data collected are useful, whether the encoding system works, and whether inter and intrarater reliability are satisfactory.

51



So, we use the inter and intrarater reliability and then perform the small scale pilot study. So, once you have all these thing you really do a pilot study. So, what do you do? The protocol analysis procedure should be put to the test within the context of a small pilot or pilot run and this will demonstrate whether the verbal data collected are useful or not, whether the encoding system works or not working, the whether the inter and intrarater reliability are satisfactory or not satisfactory. So, this pilot study definitely helps you to give an understanding your data process that the collection is correct or not and then you analyze the structure of encoding because what you did in the encoding process now you have small groups right you have reduced the data. Now, you can have an understanding and you can have the building to to those themes. So, what you do after conceptually grounded the encoding scheme by relying on established theories because literature you are connecting back to the models or theories available or the construct and having established in intradator reliability through the use of the encoding instruction and inter-rater reliability. First one is the intrarater and the next is the inter-rater reliability by employing independent encoders ok. So, here you should introduce the independent encoder the structure of encoding is to be analyzed. The analysis will produce a proceed contingent upon the research question at hand because you already have your research question how they are connected, but all analysis need to sum the responses given in each encoding category. So, you have 2, 3, 5. So, each portion will have separate ok. Each portion will have separate group and this will help you to achieve by adding up the frequency of occurrence and which you can note it down for each group or each sub categories and that will help you to understand the whole situation.

Example

- **Step 1: Devise a scenario**
  - Performance of a normal driver in a driving simulation.
- **Step 2: Instruction & train the participants**
  - The drivers were instructed with proper verbal information by the instructors.
- **Step 3: Record the scenarios**
  - The entire instruction and experiment was recorded by videotape.

53

So, this is an example. First one device a scenario what we did performance of a normal driver in a driving simulator it is a example which is being taken from a book. So, what they have done here instruction and train the participant. So, in that case the driver were instructed with the proper verbal information by instruction. And second the entire instruction and experiment was recorded by the videotape. Then what the transcribe and verbalization how they have achieved the 2 second incremental time index the actual verbalization provided by driver's viral commentary and the encoding categories event column and protocol structure.

Example

- **Step 4: Transcribe and Verbalization**
- The driver's verbalization and other data gained from the scenario were transcribed into the transcription sheet.
- It illustrated-
  - The 2 sec incremental time index
  - The actual verbalizations provided by the driver's verbal commentary
  - The encoding categories
  - The event columns
  - The protocol structure

54

Example

Step 4: Transcribe and Verbalization

TIME	VERBALIZATIONS	ENCODING										EVENTS	PROTOCOL STRUCTURE
		BEHAV			COG			F/B					
mm: ss		OB	BC	RE	OT	PC	CM	PR	AC	SD	CD	IN	
01: 34	70mph, 5th gear		1			1					1	1	Glances at gear lever	
01: 36	2800 rpm		1			1						1		
01: 38	that's quite smooth		1				1							
01: 40	he's slowing down				1	1							Other car crossing from lane 3 over	
01: 42	don't know what's wrong with him	1			1		1						to hard shoulder in front of driver	
01: 44														
01: 46														
01: 48														
01: 50														
01: 52														
01: 54														
01: 56														
01: 58														
02: 00														
02: 02														
02: 04	it's all clear ahead				1	1								
02: 06														
02: 08	chap behind has eased off a bit luckily				1	1	1							
02: 10														
02: 12	make my intention clear that I'm going right	1						1					Indicating right	
02: 14	so I'll stick to the right side of that slip lane	1		1			1							
02: 16														
02: 18														
02: 20	bit worried about overtaking him	1			1		1						Passing other vehicle	

55

This were all illustrated and this is how all these thing being recorded. So, you can give the numbering you know encoding like this and you can record them you can you can you can say this one here here here here. So, like that you can have a data sheet ok.

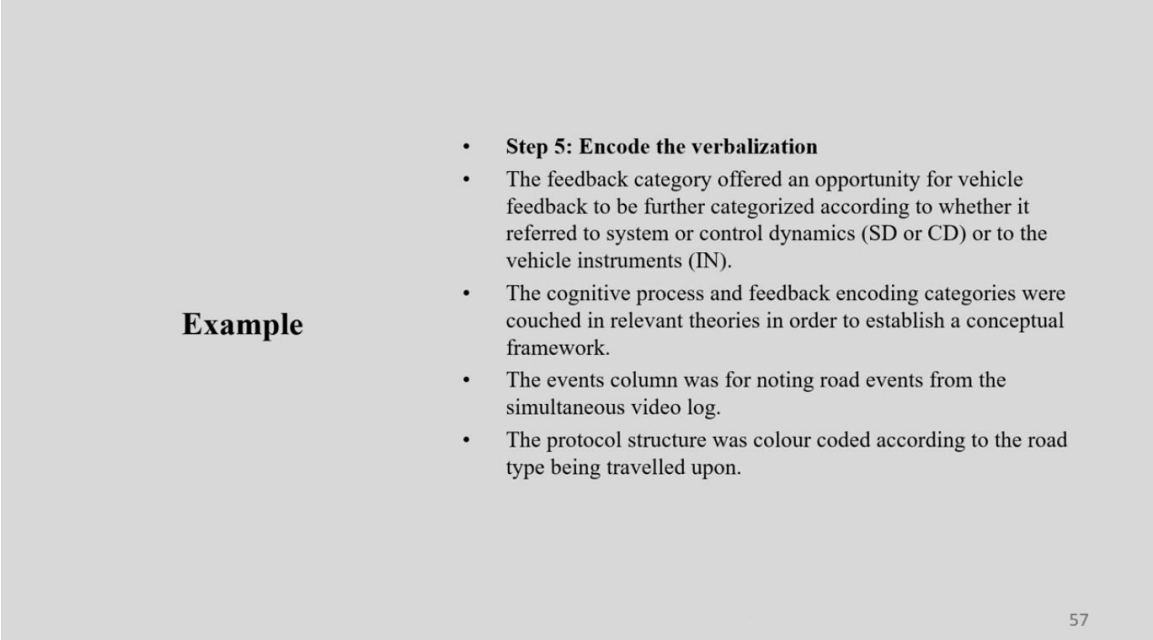
Example

- **Step 5: Encode the verbalization**
- The encoding group was defined:
  - Behaviour
  - Cognitive process
  - Feedback
- The behaviour group was defined the verbalizations as referring to
  - The driver's own behaviour (OB)
  - Behaviour of the vehicle (BC)
  - Behaviour of road environment (RE)
  - Behaviour of other traffic (OT)
- The cognitive process group was defined into
  - Perception (PC)
  - Comprehension (CM)
  - Projection (PR)
  - Action execution (AC)

56

So, encode the verbalization the encoding group was defined majorly here they did with the behavior cognitive process and feedback ok. And the behavior group were like driver's own behavior behavior of the vehicle. So, they gave the nomenclature differently, behavior of the road environment and other traffic and cognitive process also

perception comprehension projection and action execution that way they gave the nomenclature ok collectively.



Then again definitely what they did they encoded the verbalization. So, what they did here the feedback category offered an opportunity for the vehicle feedback to be further categorized according to whether it refer to the system or control dynamic. So, either system dynamics or control dynamics or to the vehicle instrument ok. So, how that is happening? So, that feedback categorization happen. The cognitive process and the feedback encoding categories were caused in relevant theories in order to establish a conceptual framework. The event column was for noting road events from the simultaneous video log and the protocol structure was colored coded according to the road time being road you know type of road like you know it is based on the terrain ok one traveled.

Example

- **Step 6: Devise other data columns**

Mitigations Events	Stage of Task Enactment
	Inputting command
System responding slowly	
Figure z on screen	
	Executing command

58

So, device the data column. So, mitigating the event how it happened and stages of task enactment.

Related methods

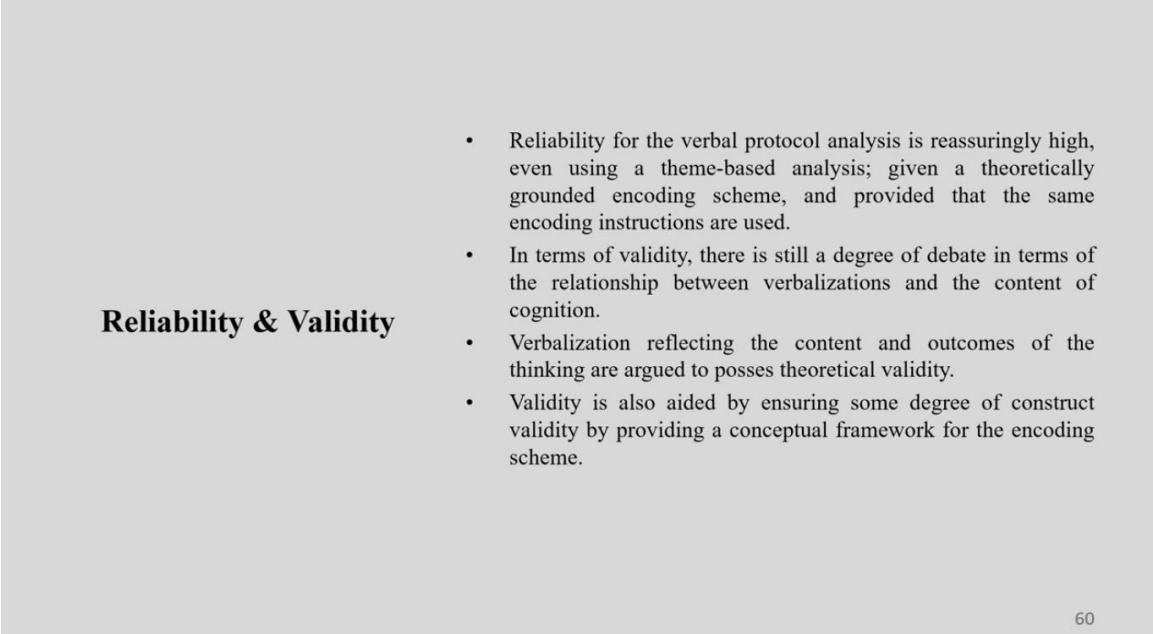
- Verbal protocol analysis is related to observational methods.
- The modification of this method and the addition of an ongoing verbal protocol will turn an observational study into a satisfactory protocol analysis paradigm.
- Observational methods and/ or task analysis can be helpful in discerning the scenario and hypotheses to be analyzed via verbal protocol analysis.
- Eye tracking and various other system telemetry can be a useful adjunct to the method, providing additional information to correlate or contrast with the verbal data.

59

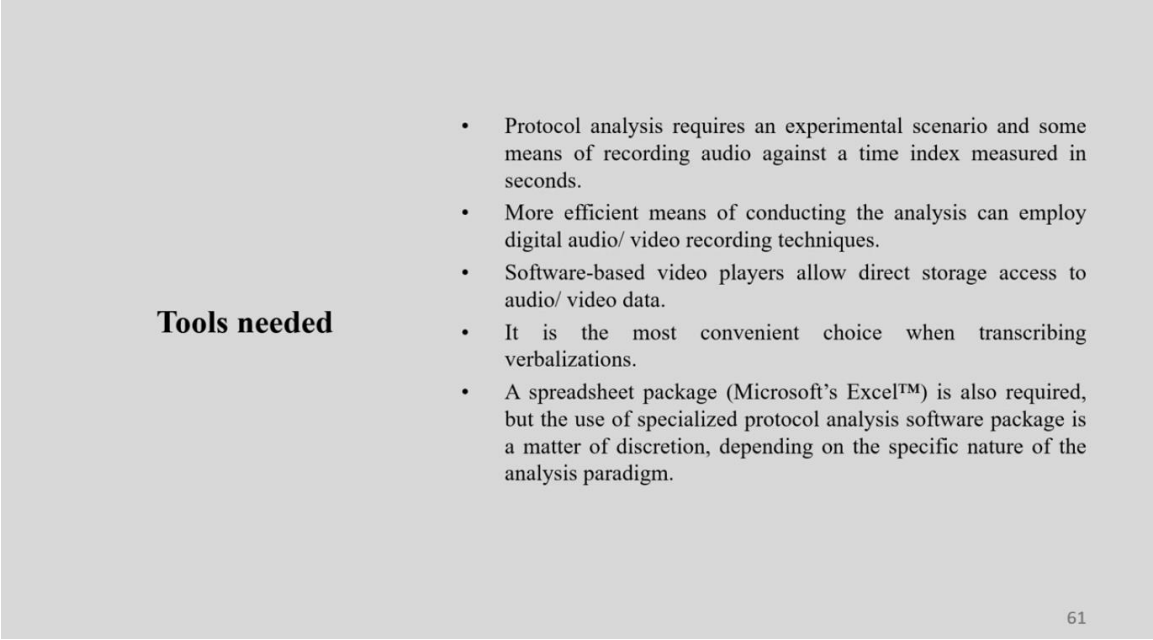
So, you know there are some related protocols from these verbal protocol analysis we can have some related protocol. Of course, observation is very much connected the modified modification of this particular method and the addition of an ongoing verbal protocol will turn to the observational study. So, it is very much connected with each other.

Also observational method or task analysis can be helpful in discriminating the theories,

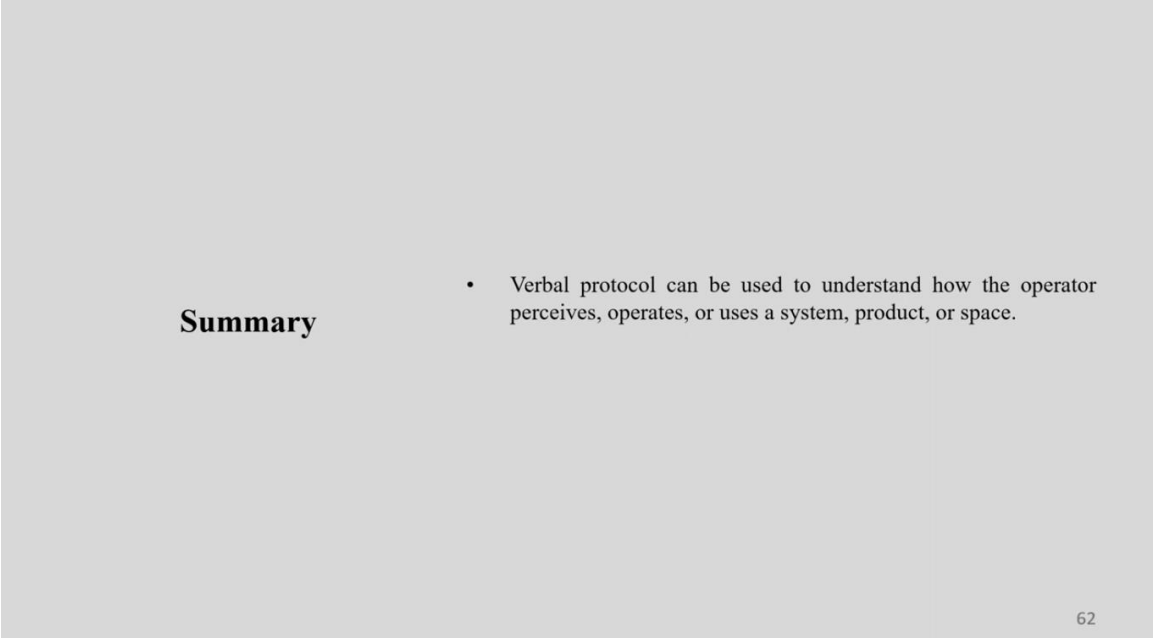
specific scenario and the hypothesis that we are actually talking about in our research. Of course, eye tracking. Eye tracking is an very important instrument or a very important connected method that we can use with this verbal protocol.



If we talk about the reliability and validity, reliability for the verbal protocol analysis is it is it is really high it is very high because you know it is it gives you quantitative data it is very high. So, even using a theme based analysis if you still if you are using a theme based analysis given a theoretical ground encoding scheme and provide that the same encoding instructions are used. So, it is it is very highly reliable. In terms of validity, there is a still degree of debate in terms of you know relationship between the verbalization and the content recognition ok. There there is some kind of you know difficulties. And verbalization reflecting the content and outcome of the thinking are argued to possess theoretical validity and validity is also aided by ensuring some degree of construct validity. So, here lot of statistical treatment you should take up to to to take this particular data ahead ok.



Tools you can understand. What are the tools are required for this type of for this technique? So, protocol analysis requires the experimental scenario. So, you should build the experiment beforehand and some means of recording the audio against this time index measure in particular seconds. So, you need this type of setup. More efficient mean of conducting the analysis can employ digital audio or videotape as I mentioned earlier. Sometimes software based video players allow direct storage and you know access it to the latter half. And it is the most convenient choice of you know transcribing the verbalization. Of course, some kind of spreadsheet packages also is helpful because you really need to store the data. So it is it is not a big deal. It is it is like very easy you can use your excel file to you knowcollect those type of information.



So, in summary we can simply say the verbal protocol can be used to understand how the operator perceives, operates and use a system product or space. So the whole thing the whole concept you knowif we are talking about the if we are talking about the situation if we are talking about a particular workstation, workplace or product analysis or system analysis we can really understand the how the operator is behaving, how the information they are perceiving. So it is a very very useful tool in terms of cognitive ergonomics ok. Till herefor today and maybe we will continue further in the next class. Thank you. Thank you.