Extra samenvatting Chi

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Het gebruik van deze samenvatting is bedoeld als studeerhulp na het lezen van de verplichte literatuur. Gebruik van deze samenvatting is geheel voor eigen risico.

Soms wordt er verwezen naar bladzijden of tabellen in het originele boek.

Succes met studeren!

Quantifying Qualitative Analyses of Verbal Data: A Practical Guide

Systematische analyse

The main goal of the analyses discussed here is to formulate an understanding of the representation of the knowledge used in cognitive performances and how that representation changes with learning.

Collect and analyse 'messy' data: trend toward studying complex activities in practice or in the context in which they occur.
Verbal and observational data have been used for some time but it has been discouraging (ontmoedigend) for novice students of cognitive science and education to adopt these methods for various reasons:

- The restricted applicability of the protocol analysis method
- The subjectiveness of the observational methods
- The time-consumingness of both of these methods

The goal of this article is to attempt to provide guidance for how one can approach an analysis of verbal data more generally. The interpretation of the results will be less subjective. The time-consuming nature will remain.
Contrasting the protocol analysis method with the verbal analysis method is necessary because the two methods share a number of surface similarities in the mechanics of the coding. Protocol analysis: information-processing approach.
The verbal analysis method is one approach to analysing verbal data, there are numerous other equally methods in literature using verbal analysis.
Both qualitative and quantitative analyses have shortcomings and strengths, some kind of method that can integrate elements of both methods seems desirable, especially for answering complex questions such as learning in context.

Introduction to verbal analysis

Verbal analysis is a methodology for quantifying the subjective or qualitative coding of the contents of verbal utterances (uitingen). In verbal analysis, one tabulates (rangschikken), counts, and draws relations between the occurrences of different kinds of utterances to reduce the subjectiveness of qualitative coding. This quantification is not the same as direct counting methods. Verbal analysis is also to be differentiated from methods whereby a researcher undertakes qualitative observations in a messy context, but then analyses only the quantitative data from that messy situation.
The verbal analysis method is embedded in research that tries to understand cognition, and in particular, the kind of knowledge one gains from learning.

Theoretical bias

The goal of verbal analysis is to capture the representation of knowledge that a learner has and how that representation changes with acquisition.
The key difference between what knowledge representation researchers do and the method described here is that they are generally concerned with representing 'ideal' knowledge that can be interpreted by a computer problem solver or reasoner to draw correct inferences (gevolgen). The goal of the verbal analysis method is to attempt to figure out what a learner knows and how that knowledge influences the way the learner reasons and solves problems,

whether correctly or incorrectly. Analysing verbal data can provide a much richer, more detailed and perhaps more accurate representation, so that one can ultimately use such a representation to devise instruction to revise (herzien) what the student has misconceived or add to a student's missing knowledge.
To uncover what a learner knows requires an analysis of the content of the verbal utterances (what the student said), along with a procedure to organize the content in some way (relate what is said) so that one can assess its overall structure. To explore the overall structure, one must then assess the relations among such a set. Structure simply refers to the relations embedded in the content knowledge.

Contrast to protocol analysis (Newel, Simon, Ericsson)
Five key differences: the instruction, the goal or focus, the analysis, the validation, and the conclusion.

- The instruction: the way the verbal data is collected. Protocol analysis method: think-aloud protocols; verbalize the information they attended to while solving a problem. It is important to note that subjects verbalizing their thoughts while performing a task do not describe or explain what they are doing, they simply verbalize the information they attend to while generating the answer. Think-aloud instruction should not effect the performance of the primary task, whereas explaining does, in that it improves the subject's performance, such as learning.
- The goal or focus: in protocol analysis the focus is to capture the processes of solving a problem or making a decision. Cognitive task analysis and solution path. The goal of the protocol analysis is to see whether there is a match between the path that a solver took and the sequence of states that a simulation model generates. The focus of the verbal analysis method is to capture the representation of the knowledge that a solve has and less on the processes of problem solving. The goal of verbal analysis method is to seek the model that a subject has, without creating an ideal template a priori. The goal of protocol analysis is mainly to test a model, rather than to uncover what the subject is actually doing.
    - Protocol and verbal analysis do share many of the mechanical details and concerts. What is different about the analyses of the two methods is the emphasis (nadruk) and the workload: in protocol analysis, because the elements and operators are defined a priori, the analysis consists of identifying what vocabulary in the protocols is used to refer to these elements and operators. In verbal analysis, in contrast, the referents are unknown, so that there is the added complexity of first determining what the referents are.
- The method of validation: the validation of the protocol analysis is the 'degree of match' between sequence of protocol utterances and the sequence of states generated by the model. In the verbal analysis method, validation is obtained by either applying statistical tests of the quantified qualitative codings to see if the results support a hypothesis or validation is determined by some qualitative analysis of the structure and its correspondence to some other measure.
- Conclusions: protocol analysis is coupled with a particular approach to problem solving and decision making, and the approach is modelled by the sequence of states. In verbal analysis, the theoretical bias is on the knowledge representation, hence, no

conclusion is drawn about the strategy of problem solving. The conclusion reached by the verbal analysis method is often in terms of the representation the solver has and claims that it is the solver's representation that determines the problem-solving processes. In the protocol analysis method, the sequencing of the utterances are of utmost importance because it conveys information about the processes of solving problems. Sequencing is of much less relevance in verbal analysis because all utterances are taken to reflect the underlying representation, to some degree, irrespective of when exactly they were uttered.

Integration of quantitative and qualitative methods

The main advantage of qualitative research is that it can provide a richer and deeper understanding of a situation. Qualitative methods usually suffer from subjective interpretation and nonreplicability. Quantitative methods have the advantage of objectivity and replicability, but the shortcoming is that one can only make conclusions about the specific hypothesis at hand. The sterile laboratory environment of experimental studies limits the generalization of the results to a real-world context. The verbal analysis method attempts to satisfy these goals by removing subjectivity and yet maintaining the richness of context.

Ways to integrate quantitative and qualitative analysis

- Interpretation approach: use the qualitative data to help interpret the quantitative results. One uses the qualitative data (explanations) as an aid in the interpretation and understanding of the quantitative data (factor analyses). The predominant emphasis is still on the quantitative data.
- Complement approach: use some kind of quantitative measures along with the qualitative measures. The quantitative data collected can serve as confirmation of the qualitative analyses and vice versa.
- Use the qualitative analysis as a backdrop for generating hypotheses, which are then tested by experimental methods. This two-step approach can be decoupled in the sense that researchers in other laboratories can undertake the second step. Notice that in this approach the emphasis is beginning to be placed more on the qualitative analyses. The quantitative analyses now play a confirmatory role.
- The verbal analysis method is one whereby the researchers rely strictly on the qualitative data, but they quantify the analyses. The qualitative data is examined for impressions and trends, methods of coding are developed to capture those impressions and the codings can then be analysed quantitatively. The quantitative-based qualitative approach basically operationalizes one's subjective impression by coding the verbal evidence for that impression and comparing the frequencies of the codes quantitatively.

Specific technique for verbal analyses

The specific technique for analysing verbal data consists of eight steps, excluding the initial collection and transcribing of the verbal protocols.

Unit of analysis: analogous to a single trial in an experimental design.

Although the preceding summary of the technique implies a sequential ordering of the steps in quantifying qualitative analysis of protocol data, that is really not the case. In undertaking

an actual analysis, a researcher obviously must look ahead of the sequence of steps to assess whether the result of the decision at a current step is meaningful or appropriate.

1. Reducing or sampling the protocols
2. Segmenting the reduced or sampled protocols
3. Developing or choosing a coding scheme or formalism
4. Operationalizing evidence in the coded protocols that constitutes a mapping to some chosen formalism
5. Depicting the mapped formalism (optional)
6. Seeking patterns in the mapped formalism
7. Interpreting the patterns
8. Repeating the whole process, perhaps coding at a different grain size (optional)

→ stappen worden doorgenomen in de sheets van HC7

Technical aspects of collecting verbal data

The analysis of qualitative data is only as good as the way the data was collected. Ericsson and Simon have addressed several issues.

- Verbal explanations affects the cognitive process
- The amount and kind of interruption posed by the experimenter while collecting verbal protocols will affect the data in a number of ways:
    - All of the questions addressed to all of the subjects should be the same
    - There should be an objective guideline about what format the follow-up questions can take
    - There should also be a decision made a priori about when the protocol answers or explanations should be terminated.

  → if it is necessary to vary the amount of probing (voorzeggen, aanmoedigen) between subjects, one way to handle non-equivalent amounts of resulting verbal utterances is to analyse the protocols up to the point of probing separately from the protocols generated after probing.
- Some people are more verbose (verbaal) than others. One way to factor out verbosity might be to gather some baseline verbosity data, such as how much a subject normally talks about another topic or while engaged in another task.
- It is also possible that people who know more about a topic actually talk less. This is why it is particularly important in verbal analyses to focus on the content of the utterances. Individual differences in verbosity can be factored out by focusing on what the subjects say rather than how much they talk.
- Inarticulateness: the subject may choose not to utter (uiten) anything at places where it is mandatory for the researcher to know what the subject is thinking about. To avoid this 'completeness' problem, it is important not to allow the subject to remain silent for a prolonged period of time.

Interrater (beoordelaar) reliability

- How carefully one has to define the categories a priori, before each rater codes the data. Start coding with only a very preliminary discussion of what is being sought. Once such a preliminary coding is done, one can then identify and specify more precisely the features by which one is categorizing, so that the second coding can be done on the basis of these features. If there is a great deal of discrepancy between

two raters in the first pass, then this should caution the researchers to redefine the categories, rather than to concentrate their efforts only on resolving the interrater discrepancies.

- The second issue has to do with whether discrepancies between two coders should always be resolved. In the one kind, both coders have firm ideas about which code a particular segment of protocols should be assigned. A second kind of discrepancy can occur not because the coders disagree with each other but rather, each coder is unsure which code should be assigned to a segment, because the segment is very ambiguous (dubbelzinnig). Instead of resolving the discrepancies between the two coders, it may be better just to complete the coding and then count the number of these ambiguous cases as the uncodable portion of the data.
- When discrepancies of the first kind should be resolved (between two coders when the segment is interpretable). Not resolve the interpretation of the segment in the midst of coding because resolving them can actually bias the interpretation of subsequent codings. One should attempt to code a section and see how much reliability is achieved.

Interrater reliability should be calculated at various steps of the verbal analysis technique.

Within-subject analysis

Cross-sectional analyses: multiple subjects' data were averaged together and quantitative analyses were then carried out.

Single subject analyses: capture the knowledge representation more precisely and make explicit predictions about which underlying conceptual representation enables which kind of performance. Within-subject analysis: very labour intensive. More difficult to support this using statistics.

- One mean of demonstrating validity is using a predictive method.
- Another method is to compare results to the literature at large.

Top-down and bottom-up processes of interactive analysis

Top-down means that questions and codes used, for example, are driven by theory. Bottom-up means that the codes can be refined on the basis of the protocols, and new hypotheses can be generated from the data. In undertaking an actual analysis, many specific decisions are mad bottom-up, on the basis of the nature of the data.

Summary and conclusions

Two aspects are involved in doing both the traditional quantitative type of research involving experimental design and the current qualitative type of research involving verbal analysis. One aspect concerns the generation of the right questions, which then determines what kind of experimental conditions to test in the quantitative method case an what kind of coding and formalism to use in the qualitative case. This is the theory part: that is, one's theory generally drives the questions, which then drives the analyses. The second aspect of research in both experimental design and verbal analysis is the mechanics part. In any research paradigm, there is a theory part and a mechanics part. This article laid out in the previous section an example of how a theory of conceptual change contributed to the selection and the formulation of codes for the verbal analysis. It would probably make no

sense to use this guide unless the researcher is already armed with some questions or a theory, because this guide basically lays out only the mechanics of doing the analyses.