Qualitative data analysis using data displays

The amount of data generated in qualitative research can be difficult to manage. In this paper Tracey Williamson and Andrew Long discuss how the use of data displays can improve data management and also how the process can help to make the routes from raw data to research findings in qualitative research more transparent. Data displays can take several forms but share the benefit of helping to condense large amounts of data into more manageable forms. They can also help to convey information in a visually stimulating format where presentation time or column space may be limited

key words
- ▶ data displays
- ▶ qualitative data analysis
- ▶ methodological rigour
- ▶ shared governance

Introduction

One of the many challenges facing anyone undertaking qualitative research is how to organise and analyse the copious amount of data generated. These often take the form of pages of interview transcriptions, memos and field notes, sometimes together with observational data, that are cumbersome and time-consuming to manage (Morse and Field 1996). Many approaches to getting to grips with the volume of data are evident in the literature. These range from the use of computer packages such as N-Vivo™, thematic analysis (for example, using the 'framework' approach of Ritchie and Spencer 1994) to the classic paper-and-coloured pens approach, with data placed in separate piles in a large work space. Between these extremes lies the struc-

tured approach outlined by Miles and Huberman (1994) which involves a three-pronged strategy: data reduction (the process of selecting, abstracting and transforming the basic data, that is, its initial coding and search for themes); data displays; and conclusion drawing and verification.

This article explores the second part of their approach. The aim is to provide an insight into the range of possible data displays and critically to examine their use as aids to qualitative data analysis. The paper draws on our experience of using this approach during a doctoral study of group decision making in shared governance (Williamson 2003). Shared governance, a relatively new concept in the UK, concerns the empowerment of healthcare staff to contribute to decision making that will in turn influence practice and the corporate agenda. The study sought not only to identify factors affecting decision making in shared governance, but also to understand the processes between these factors that led to effective decision making.

Data were generated from over 200 hours of participant-observations of shared governance council meetings and a range of individual (31) and focus group (three) interviews, plus secondary data such as strategy documents and minutes of meetings.

What are data displays?

Miles and Huberman (1994) describe a data display as 'an organised, compressed assembly of information that permits conclusion drawing and action'. Data displays can take a number of forms. Extended text itself is a data display (Box 1). Others include matrices, graphs, charts and networks. These can be in the form of basic data displays, such as time-ordered matrices, of condensed versions of data spread out over many pages. Or it may be advantageous to stack these to form meta-matrices that also respect chronology. Or, again, during complex analyses, where many variables exist and may relate to each other – that is, they are 'conjunctural' and affect each other – more advanced data displays such as causal networks are indicated. These, too, permit cross-case analysis and rely largely on the accuracy of preceding analyses and displays that have determined the variables for inclusion within them.

Whichever display type is used, the process of writing narratives to describe what is presented in each display is a necessary part of the analysis.

Case notes. The council member bringing this issue self-nominated as lead. The task was clearly set out on a white board. A group discussion ensued. A problem-solving model was selected and implemented. All contributing and lead pointed out that they could not lead on two large council issues at the same time. No one wanted to take over as lead. Agreed to find information in own areas. More discussion around advantages of electronic case notes.

It promotes the examination of the data, the making of comparisons and the identification of themes or patterns. The completed narratives serve as a record of what is depicted.

Data displays thus provide a means to condense large amounts of data into a more manageable form. They aid the basic description and summary of the data. Their purpose does not end there. Different displays provide different ways of teasing out promising analytical lines of enquiry, further comparisons in the coded data and the wider datasets, or for searching for verification, contradictory evidence and so on. Ultimately, they may lead to the development of theoretical propositions.

Data displays not only permit illumination of the route from analysis to conclusion; they also enable theoretical conclusions, and their underlying rationale, to be retraced. A logical chain of evidence (Hunter *et al* 2002) can be created. This is important in the context of the common criticism of qualitative studies, that they often present inadequate details of the overall methods used (Popay *et al* 1998) and/or insufficient information as to how the end products of analyses were arrived at (Mays and Pope 1995). Accompanying narratives developed alongside the individual data displays also make plain the researcher's emerging thought patterns concerning connections between the data. Importantly, displays represent an effective means of communicating study findings (Averill 2002) in a visual and simple way. Data displays thus not only provide a means of organising, summarising and analysing qualitative datasets, but also of promoting transparency of the process of analysis that is helpful to readers and researchers alike.

Using data displays in practice
How then, can the various data displays be used in practice to assist data

Figure 1: Extract from a checklist matrix

Influencing factor (AIDS)	Participant observations		Interviews					
	Human Resources Council	Mental Health Council	Human Resources Council			Mental Health Council		
			1	2	3	1	2	FG
Appropriate time							7/221	86
Impact of decision			2/151		8/186			66
								246
Monitoring progress		11-00/43			8/204		7/283	290
Options								86
								52
Gather info					8/183	5/113		239
					5/107			49
								19
								23
Informants	2-00/75	11-00/158	2/161					
	2-00/53	11-00/103						
	11-99/69	11-00/87	2/135					
	10-99/23	10-00/144						

analysis and theory building? As each of the possible data display types has different purposes and utility, deciding which one(s) to choose must be made against the underlying aims of the research study. In the shared governance example, two objectives needed to be met. To:

- Identify the key factors that affect shared governance decision making
- Display the data in such a way as to show the processes of shared governance decision making over time.

Basic data displays I: checklist matrices

To meet the first objective, checklist matrices were indicated. These provide a way of organising the data according to a key theme, variable or domain of interest. In our example, matrices were devised to depict factors affecting decision making within two shared governance groups: the Human Resources Council (HRC) and Mental Health Council (MHC). Column headings identified the data source as being participant-observations or interviews. Each row was assigned a factor affecting decision making identified through prior thematic

Figure 2: Extract from a checklist matrix summary table

Influencing factor (AIDS)	Participant observations		Interviews					
	Human Resources Council	Mental Health Council	Human Resources Council			Mental Health Council		
			1	2	3	1	2	FG
Appropriate time							IF	IF
Impact of decision +			IF		IF			IF
Monitoring progress		IF			IF		IF	IF
Options								IF
Gather info ++					IF	IF		IF
Informants +++	IF	IF	IF					

KEY:
IF = identified factor + = strength of influence (moderate +, strong ++, very strong +++)

Box 2: Extract from a narrative

The suggestion to develop multi-professional case notes was presented by a council member and was clear at the outset. Discussion of whether it fitted the council remit led to it being accepted.

The fact that it was a clear issue seemed to have some influence on its acceptance. Its having 'trust backing' (as described by council members at interview) also influenced the decision to accept it as a council issue.

Following acceptance a lead was allocated and a clear aim agreed. Brainstorming was instigated to examine the issue, which was subsequently analysed by use of a decision-making model due to the large scale and complexity of the issue. This led to a decision to collect background information including views from own areas and allocation of a lead to take over from the proposer to spread the workload out.

No action ensued at the next meeting as a result of the lead being absent and so the issue was deferred.

analysis of data. For their completion the identity tag for each of the previously coded data segments was entered into the corresponding cell (Fig. 1).

As the main sub-cases of the case study, data from the HRC and MHC were presented together. Use of identity tags made tracking back to the original data source much simpler. While the complete segments of text identified through thematic analysis could have been inserted along with the identity tags, this would have been visually too cumbersome. However,

use of identity tags alone still meant that the matrices covered several pages and were over-elaborate for presentation purposes.

To aid presentation, the checklist matrix can be further condensed into checklist matrix summary tables (Fig. 2). The original matrices then provide a reference point to permit a counting exercise of the frequency with which factors were evident. In the above example, a rating, which gave an indication of strength of influence, was created by establishing the number of occasions on which a factor was evident during fieldwork. As would always be the case, narratives need to be written for each of the summary tables (Box 2).

Using of summary tables makes the visual examination of the displays considerably more manageable. Establishing the frequency with which factors occur and representing this with symbols facilitates examination of each factor's importance. In this instance, it also enabled identification of patterns of agreement and disagreement between researcher and participants, leading to a more critical examination of these discordant instances. The summary tables can also be used to verify the emerging analysis with participants.

Basic data displays II: time-ordered matrices

To meet the second objective, time-ordered matrices were developed. These provide a way of displaying the data so that its chronological sequence is preserved and to facilitate identification of what may lead to what and why. Key choices include the appropriate time sequence and what data to include and exclude.

In our example, columns were numbered to show each consecutive month in which the council issue was being addressed (Fig. 3). The time interval was chosen because council meetings occurred monthly. Each row was assigned a heading under which evidence was recorded of elements that were emerging as significant in early analysis of the decision-making process for each of the issues the councils addressed (for example, was a lead for the issue allocated?). To enable focus on more complex decision making, the only issues included were those lasting in excess of three months' duration and where the events and processes were directly evident through participant-observation, interviews and secondary data. Blank boxes indicate that no evidence was identified. Again, narratives were written for each of the matrices.

Figure 3: Extract from a time-ordered matrix

Event	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
Clarify issue	CLEAR idea from council					
Fit remit	YES					
Background info	Provided by proposer initially	All to collect further info				
Consultation		Various views sought				Some areas sent a draft for consultation
Clear aim	To review case notes system					
Lead person	YES Proposer	New lead allocated				
Level of authority	NO					
Engage informant						Informant to be contacted
Decision model	90 degree Problem solving					
Work process	Discussion whether to take on agenda next time.	Brainstormed problem via mind map. Divided up collection of background info.	Reviewed sets of notes. Fed back info gathering. Divided up outstanding info gathering to forward so so that action plan can be developed by lead.	On agenda. Deferred as lead absent.	Lead gave 2 options: multi- or uni-professional notes. Discussed pros and cons trying to reach a consensus. Agreed option 2. Split 2. groups to generate contents. To type up and send for comments.	Not circulated fully by accident. Costing implications. Decided need a pilot and level of authority from PSMT. Agenda next time. More comments to be sought.
Approval sought						
Completed						

The combination of the checklist and time-ordered matrices helped to identify key variables around shared governance decision making and, for the latter, also began to show their chronological order in the decision-making process. Yet condensing and displaying data in this way, coupled with the need to be selective about what to include in the time-ordered displays, means a risk of over-simplification and a loss of the 'wider picture'. To maintain a sense of the whole, further analyses are necessary to ensure that no major variables had been overlooked and inadvertently excluded. These should be aimed at gaining deeper insight into the inter-relationships between the variables so as to develop their explanatory power.
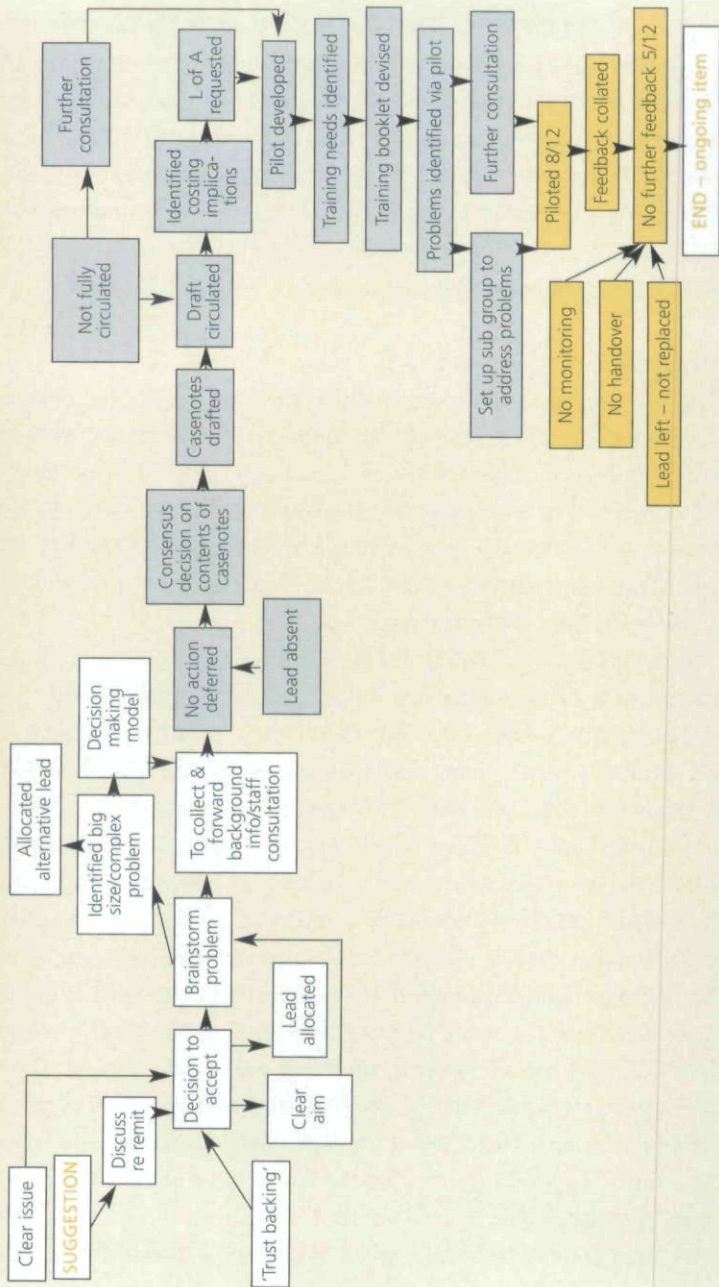
Advanced data displays: causal networks
To overcome the limitations of the basic displays and further meet the second objective, causal networks were developed. A causal network is a display of the major variables or themes arising from the data showing their inter-relationship. In our example, a multi-phased process was used to arrive at a causal network for each council issue (Fig. 4).

The first step was to identify variables for inclusion. Initially all factors identified in the checklist matrix summary table (Fig. 2) were selected. Each factor was situated in a box and placed in order of chronology. Each network diagram was drafted and refined and designed to be read from left to right. Use of arrows indicated the direction of influence and the relationships between factors, and colour coding was used to depict chronology. Each draft diagram was compared with the corresponding time-ordered matrix to verify its completeness. Frequent references back to the original data were made to check the ordering of events, investigate any perceived gaps and unexplained occurrences and keep a sense of the whole decision-making process. Any minor inaccuracies were addressed so that the final network diagrams were as accurate as possible. As before, narratives were written to accompany and elucidate each diagram.

Causal network development makes it possible to identify and include additional events and occurrences that impact on decision making. In this way a more complete appreciation of causal influences in decision-making processes can be achieved. This is only possible through the careful selection of which factors to include or exclude without loss of detail. In this example,

Figure 4. A casual network

Clear issue

SUGGESTION

Discuss re remit

Decision to accept

'Trust backing'

Lead allocated

Clear aim

Brainstorm problem

Identified big size/complex problem

Allocated alternative lead

Decision making model

To collect & forward background info/staff consultation

No action deferred

Lead absent

Consensus decision on contents of casenotes

Casenotes drafted

Not fully circulated

Further consultation

Draft circulated

Identified costing implica-tions

L of A requested

Pilot developed

Training needs identified

Training booklet devised

Problems identified via pilot

Further consultation

Set up sub group to address problems

Piloted 8/12

Feedback collated

No further feedback 5/12

No monitoring

No handover

Lead left – not replaced

END – ongoing item

incorporation of the factors identified in the basic displays in the more complex network diagrams effectively over-simplified some of the decision-making processes being investigated. Although labour-intensive, a return to the original data sources may be necessary to ensure that all key factors are included in finalised network diagrams. Symbols for positive or negative influence can be added to the diagrams themselves or alternatively, made clear in the accompanying narratives. Once again, network diagrams can be useful verification tools with participants.

Discussion

Checklist matrices, time-ordered matrices and causal networks are only three of the many possible forms of data display. Other organising variables for basic displays include roles, cases, concepts and themes (Miles and Huberman 1994); similarly other ways to aid the ordering and explaining of the data are possible, by case, variable and cross-case. The key is for the analyst to organise the data in the way that matches the research questions and/or underlying theoretical framework.

Data displays offer a number of advantages. At a basic level they make the management of large data sets much more practicable in line with other qualitative data analysis tools such as N-Vivo™. But rather than replace other means of data management and analysis, they have considerable potential as adjuncts to those processes. At a deeper level, multiple data displays can be viewed simultaneously in a way that is not permissible through use of computer packages where there is limited viewing space on the monitor screen. This may facilitate making comparisons and identifying differences and similarities quickly and accurately. However, these will only be as accurate as the comprehensiveness of the displays. Care is needed to ensure adequate and correct data are included, whatever display type is selected. As Averill (2002) argues, the key to successful use of data displays is to ensure methodological rigour in their development. Apparently incongruent data should not be discounted without first checking for their potential relevance. Data display development thus has the added value of minimising the risk of jumping to ill-founded, over-simplistic conclusions.

Yet another advantage is the utility of data displays as aids to the verifica-

tion process. Early and finalised displays can be shared with participants or other stakeholders to establish their accuracy, omissions, claims to relationships or effect and truthfulness. While this could identify a difference of opinion between the researcher and participants, the examination of inconsistent views is an essential means of promoting rigour in the analysis process and making of defensible interpretations (Averill 2002, Hunter *et al* 2002).

Used incorrectly, data displays run the risk of oversimplifying the phenomena they seek to represent. The researcher must decide how much detail is sufficient for the purposes at hand. While over-simplification is a potential problem, there is a major strength of the approach – the creation of a decision trail. The steps taken by the analyst can be tracked backwards to see how they were determined. This process was evident in our example, whereby logical chains of evidence were built and refined through constant reference back to the coded data, earlier displays and narratives. While useful in themselves, such decision trails also provide mechanisms for examining and challenging the conclusions drawn by 'critical friends' (Marshall and Rossman 1989), thus further enhancing rigour.

By their very nature, basic data displays such as checklist matrices and time-ordered matrices may contain minimal data and be somewhat simplistic in design. A major limitation of basic displays is their inability to illuminate connections between variables. This can be reduced considerably by the writing of narratives to describe each display including inferences as to what these relationships may be. Furthermore, in studies that seek explanation and perhaps prediction, displays may well progress to, or even begin with, more complex forms. It is not uncommon for researchers to progress through display types as analyses deepen (Miles and Huberman 1994). Indeed in the study example, it was the inadequacies of basic displays that spurred development of more advanced displays to gain a more comprehensive insight into decision-making processes and the interconnectedness of decision-making factors. The more advanced causal network displays were successful in identifying the key factors affecting decision making, establishing their relationship in terms of the direction of impact and depicting chronology.

The development of displays is a very 'hands on' and often lengthy process. Miles and Huberman (1994) warn that even simple display development can

be time-consuming, not least as development involves a degree of trial and error. In the study example, comparison of displays was a valuable means of triangulating the multiple data sources in the displays. However, spending adequate if extensive time on ensuring rigour in analytical procedures is an investment that should enhance the overall quality of the study. Furthermore, it can mean the difference between execution of a well-planned study or a study design that evolves more haphazardly. Integration of data gathering with analysis is beneficial, as the research design can evolve in the light of insights emerging through earlier analyses. Flaws identified in the design can be corrected and new avenues of enquiry initiated. These principles are embraced by data displays. There is an expectation that designs will evolve over time as they are tried out in practice and their fit with the data is fine-tuned. Data displays have the potential to address a key concern of case studies in that the plans for the analysis of case study evidence are often weak and ill thought out (Yin 1994).

Arguably, condensing data into displays is constraining and limiting. While successfully used in our study example, data displays have been described as 'template' approaches that are orderly and formal (Drisko 2000). For some researchers, the systematic and rigorous approach to developing displays may be misconstrued as imposing excessive logic and stifling creativity. Yet data displays evolve as analysis develops and this requires a degree of creativity on the part of the researcher. Hunter et al (2002) argue there are a number of psychological barriers to creative qualitative analysis, including preference for order, intolerance of ambiguity and reluctance to let ideas incubate sufficiently. Thus, successful use of data display methods may in part depend on the creative aptitude of those who devise them.

Conclusion

Data displays have particular merit as means of displaying summaries of analyses or findings to a variety of audiences in an easily comprehensible way. Whether as part of a report, presentation or published article, displays can convey much information in a visually stimulating format where presentation time or column space may be limited. Moreover, they allow the decision trail to be traced. Selection of an approach to data analysis is a matter of personal

preference although data displays may appeal to those researchers less adept with computerised analysis packages. Overall, it remains for individual researchers to appraise and apply data displays as an alternative or additional source of aid to their qualitative data analysis activities.

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