Using QSR-NVivo to facilitate the development of a grounded theory project: an account of a worked example

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This paper demonstrates how the software package QSR-NVivo can be used to facilitate a grounded theory approach. Recent research evidence has questioned the methodological quality of many studies that claim to utilise grounded theory. This paper argues that qualitative data analysis software can be used to encourage good quality grounded theory research by facilitating many of the key processes and characteristics associated with this approach. To achieve this, the paper identifies a number of grounded theory characteristics, common to all revisions of the methodology. It then describes the development of a recent study, which examined how people successfully maintain long-term physical activity behaviour change. The purpose of this is to demonstrate how different functions of QSR-NVivo may be used in conjunction with the key grounded theory characteristics. In summary, QSR-NVivo is a powerful tool that, if used appropriately, can facilitate many aspects of the grounded theory process from the design and early sampling procedures, through to the analysis of data, theoretical development and presentation of findings.

Keywords: grounded theory; QSR-NVivo; qualitative data analysis; software

Introduction

Grounded theory is a systematic yet flexible methodology, designed to assist with the development of substantive, explanatory models grounded in relevant empirical data. Since it was first described by Glaser and Strauss (1967), its popularity has increased significantly (Hood, 2007). However, alongside this growing acceptance, considerable debate has emerged regarding how best to achieve grounded theory and a number of quality control issues have been raised (e.g. Bringer, Johnston, & Brackenridge, 2004; Charmaz, 2003). Specifically, grounded theory has been interpreted and described in a variety of different ways based on differing epistemological viewpoints (e.g. Charmaz, 2003, 2006; Glaser, 1978, 1992; Strauss & Corbin, 1990, 1998). This has led to the development of a number of different approaches that reflect different epistemological and theoretical perspectives. While this continued refinement may represent a healthy evolutionary process, it also has the potential to present conflicting information regarding how to conduct grounded theory research.

Despite the different approaches to grounded theory, a number of common characteristics that represent the underlying tenets of the methodology have been
identified (Hutchison, Johnston, & Breckon, in press). Consequently, to encourage good quality research, it is important that users of grounded theory can recognise the key characteristics (Table 1) and incorporate them into their study designs.

Research evidence suggests that many grounded theory studies fail to recognise a number of these common characteristics. For example, Charmaz (2003) argued that there is a tendency to construct conceptual analyses instead of substantive theories (i.e. results identify a descriptive account but fail to demonstrate interrelations between concepts, to create a theory from which hypotheses can be generated). Further, while many researchers engage in techniques commonly associated with grounded theory (i.e. coding and memo-making), they fail to engage in processes such as an in-depth analysis of categories (Charmaz, 2003), and/or the iterative process of concurrent data collection and analysis (Hutchison et al., in press). In addition, many studies fail to present a transparent account of the research process (Bringer et al., 2004), which has implications for quality assurance (Dixon-Woods, Shaw, Agarwal, & Smith, 2004; Dixon-Woods et al., 2006).

**Computer-Assisted Qualitative Data Analysis Software (CAQDAS)**

Advances in computer technology led to the development of a range of software packages designed to assist with the analysis of qualitative data. This in turn fuelled
debate about the impact of software on method (e.g. Hutchison, Johnston, & Breckon, 2008a; Johnston, 2006; Richards, 1998; Richards & Richards, 1995; Weitzman, 2000). For example, it has been suggested that CAQDAS has the potential to turn qualitative research into a rigid automated process that neglects the role of human interpretation and reflection (Kelle, 1995). Further concern has been voiced that computer analysis programmes allow users to do complicated analyses without fully understanding the principles of the techniques they are applying (e.g. Johnston, 2006; Richards, 1998; Weitzman, 2000). However, if the capacity of computers for recording, sorting, matching and linking is harnessed, then the efficiency of the data analysis process can be greatly enhanced (Bazeley, 2007). Consequently, it is generally accepted that CAQDAS can enhance the data handling/analysis process if used appropriately (Bringer et al., 2004; Bringer, Johnston, & Brackenridge, 2006a, 2006b; Johnston, 2006). However, the use of computers is not intended to replace the ways people learn from data, but to increase the effectiveness of such learning (Bazeley, 2007). Richards (2002), explains that researchers should not attempt to fit their research to a particular software package but instead, make the software work for their project.

**CAQDAS and grounded theory**

Bringer et al. (2006a) have demonstrated that CAQDAS can be used successfully to facilitate a grounded theory investigation. They explained that the software package QSR-NVivo (Version 1) helped the analysis move beyond thick description of the studied phenomena, to an explanatory model grounded in the data. Specifically, it was demonstrated that NVivo can facilitate many aspects of the iterative process associated with grounded theory and can help provide a transparent account of this, which should ultimately enhance study validity (Bringer et al., 2004). Similarly, di Gregorio (2003) described how the various functions of NVivo relate to different grounded theory processes. However, the processes described in her paper reflect a more objectivist stance, which is unlikely to be congruent with all researchers underlying ideologies. In order to demonstrate how CAQDAS can assist with grounded theory research, it is important to acknowledge the different interpretations of the methodology and subsequent choices that researchers may be presented with.

A limitation with Bringer et al.’s (2006a) paper is that although grounded theory is described as iterative, the authors failed to demonstrate how all the different techniques and processes they described may link together to contribute to an emergent theory. In order to capture this ongoing theory building process, it is important that the techniques are presented in a logical manner to enable the reader to follow the analytical process. In addition, Bringer et al. (2006a) refer to the paradigm model as a heuristic tool often adopted by grounded theorists to assist with theoretical development, but fail to demonstrate how NVivo may facilitate its use. Further, both di Gregorio’s (2003) and Bringer et al.’s (2006a) papers were based on much earlier versions of NVivo.

**Grounded theory, NVivo and physical activity behaviour change**

Our own grounded theory and CAQDAS-related work has centred on understanding how people successfully change their physical activity habits in order to improve their own personal health and/or wellbeing. The decision to adopt grounded theory
occurred in response to a number of limitations with existing work (e.g. Hutchison et al., in press). After reflecting on our own epistemological stances and theoretical perspectives, a decision was made to move away from traditional positivistic approaches and adopt grounded theory to develop a more ecologically valid theoretical account of this human change process (Hutchison, Johnston, & Breckon, 2008b). This involved in-depth interviews with people who had successfully changed and maintained their physical activity habits. The interviews were conducted and analysed in line with the tenets of the grounded theory methodology (Table 1). Figure 1 provides an overview of this process.

To facilitate this grounded theory process, the software package NVivo (Versions 7 then 8) was used. Originally, this decision was centred on the organisational benefits that CAQDAS can provide. However, we soon realised that if used appropriately, NVivo could help facilitate many of the key characteristics of a grounded theory approach. To demonstrate this, the current paper describes how CAQDAS was used throughout our own grounded theory investigation.

**Creating a memo structure to manage the grounded theory process**

Managing the iterative process of grounded theory (Figure 1) presents researchers with a significant organisational challenge. One analytical strategy that helps to facilitate this is keeping a research diary to detail the ongoing theoretical development, and all sampling and analytical decisions made. A research diary was started in NVivo as soon as we had identified a research question and since then it formed the spine of the entire research process. We created a number of different memos (self-contained text files within and NVivo project) for different purposes and linked these back to the central research diary. These were originally based on the types of memos that Bringer et al. (2004) presented. However, as our research developed, a memo structure was created to suit the specific needs of the project. Initially, a general research diary
A memo was created, which contained a detailed account of our research activities. This included summaries of our reading activities, meeting records and details of sampling and early analytical procedures. While this was sufficient during the early stages, it soon became apparent that a more complex memo structure was required. The memo structure detailed in Table 2 encouraged us to record all relevant information to facilitate sampling decisions consistent with a grounded theory approach. It also provided us with a workspace to conduct and reflect on the range of analytical procedures and techniques described in this paper, thus encouraging progressive conceptual development (Charmaz, 2006).

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Research diary</td>
<td>Records and documents the evolving events that take place during a grounded theory study.</td>
</tr>
<tr>
<td>1.1. Conceptual development</td>
<td>Describes all analytical processes and decisions made. Can be linked to more detailed conceptual memos where necessary. These memos facilitate an iterative process, theoretical sampling, initial and advanced coding and ongoing conceptual development.</td>
</tr>
<tr>
<td>1.2. General events</td>
<td>Records general events such as meetings with the research team, training courses attended, important discussions, etc.</td>
</tr>
<tr>
<td>2. Reflective</td>
<td>Provides an opportunity to reflect on events and processes such as interviews or analytical procedures. This can provide valuable personal feedback to inform subsequent sampling and analytical procedures. These memos facilitate an iterative process and theoretical sampling.</td>
</tr>
<tr>
<td>3. Conceptual</td>
<td>Can be attached to nodes and should contain information about the related concepts or categories and about the analytical procedures being carried out to explore them. They provide a workspace for concept development. Conceptual memos can be linked to the research/conceptual development diary. These memos facilitate initial and advanced coding, use of the constant comparative method, asking questions of the data and ongoing conceptual/theoretical development.</td>
</tr>
<tr>
<td>4. Emergent questions</td>
<td>Summarise emergent themes, thoughts and questions so that they can be addressed by further appropriate sampling and analytical procedures. These memos facilitate an iterative process and theoretical sampling.</td>
</tr>
<tr>
<td>5. Explanatory</td>
<td>Can be linked to, to provide more detailed information or descriptions where necessary.</td>
</tr>
<tr>
<td>5.1 Literature related</td>
<td>A type of explanatory memo that summarises potentially relevant literature. Can be used to link relevant literature into the project. For example, if the emergent data refers to a previously identified theoretical construct then this can be incorporated into the analysis to help the researcher ask appropriate questions of the data.</td>
</tr>
<tr>
<td>5.2 Technical</td>
<td>A type of explanatory memo. Provides descriptive information about the technical and analytical procedures used. The memos encourage transparency and reflection.</td>
</tr>
<tr>
<td>5.3. Model descriptions</td>
<td>A type of explanatory model that summarises or describes any models that have been created during the analysis. These help encourage theoretical density.</td>
</tr>
</tbody>
</table>
Incorporating literature to facilitate early sampling decisions

Due to the exploratory nature of grounded theory, there is some debate surrounding the use of prior knowledge or previous literature. While some authors encourage the use of general discipline based knowledge (e.g. Strauss & Corbin, 1998), others advocate entering the field with no prior influences or preconceptions (e.g. Glaser, 1992). Despite this, it is generally agreed that it is inappropriate to conduct an exhaustive literature review too early in a grounded theory study (Glaser, 1992; Strauss & Corbin, 1998). However, to identify an appropriate research question and provide a rationale for the proposed methods, and initial sampling strategy, it is likely that researchers will refer to some literature sources at an early stage. As previously demonstrated by Bringer et al. (2006a) NVivo can be used to facilitate the process of incorporating relevant literature into a grounded theory study. By importing reading notes into NVivo, it is possible to link these to the research diary and use additional linked memos to justify their role in the ongoing conceptual/theoretical development.

Early in our own study, we were required to consider what initial sampling strategy would be most appropriate. Therefore, relevant literature on the different methods was reviewed and imported into NVivo (in either word or PDF formats) where they could be compared to allow for an appropriate purposive sampling strategy to be identified. This process was recorded in the research journal, where links could be made to relevant sections of the imported documents or to the analysts own reading notes (i.e. literature memos). Later in the analysis, there were occasions where concepts emerged from the data that were closely related to a body of existing literature (e.g. self-confidence/efficacy). We allowed this literature to inform the ongoing analysis by using it to identify potentially important questions that may be explored in future (theoretical) sampling. This was achieved by using literature-related memos to summarise relevant reading. These were then linked to the research journal, and in turn to an emergent questions memo, to identify any questions that may need to be explored further. Incorporating literature into NVivo in this manner helped us to monitor the use of literature sources and facilitated purposive and theoretical sampling procedures.

Managing data documents

Having explored relevant literature sources, it was deemed that to obtain rich data concerning the processes involved in PA behaviour change, individuals with experiences of change in this context represented an important source of data. Consequently, an initial sample of six participants was recruited from a countywide physical activity referral scheme database (Gidlow et al., 2007; James et al., 2008) to take part in this study. The data obtained for this study were all interview transcripts; however, NVivo can accommodate a number of additional types of data (e.g. audio files, videos, digital photos, Word, PDF, rich text and plain text documents). This is an important feature of the software because grounded theorists are encouraged to remain open to new possibilities emerging from the data (Charmaz, 2006) and as a result be flexible with regards to potential data gathering approaches. Therefore, the choice to use CAQDAS did not limit the data gathering and analysis options available.
Importing data documents – cases and attributes

When transcripts were imported into our NVivo project, a number of analytical options were available to us. Firstly, NVivo allows for attribute information to be created and stored for each case (each interview). The attribute function was used to record descriptive information pertaining to each interview (e.g. age, sex, marital status of interviewee). The purpose of this was to facilitate future analytical procedures, such as asking questions of the data and making constant comparisons to advance theoretical development. Attributes provided an easy way of differentiating between cases based on known characteristics. Consequently, if a concept behaved differently for different cases then attribute information often provided some early insight into this. However, this type of procedure does have the potential to compromise the iterative nature of grounded theory because it is difficult to know in advance which demographic factors will actually be relevant. As a result, we only created attributes if they emerged during the coding or concept identification phase as being potentially important. Figure 2 presents an extract from our NVivo casebook.

Early concept identification

An early stage in developing a grounded theory is concept identification, where concepts are identified from distinct events in the data (Corbin & Holt, 2004). This is usually referred to as open or initial coding, where the text (i.e. interview transcript) is opened up and broken apart for intensive scrutiny (Corbin & Holt, 2004). Coding refers to attaching meaning labels to segments of the data (Charmaz, 2006). Through coding, the analyst attempts to explain what is happening in the data. NVivo facilitates this process because it allows for the creation of nodes, which provide storage areas in NVivo for references to coded text (Bazeley, 2007). Therefore, every time we identified a concept from our interview data, a node was created to represent it and the relevant text that pertained to that concept was stored at that node.

To facilitate theoretical development, grounded theorists are encouraged to always think about the codes they are identifying. Charmaz (2006) outlines a number of questions designed to assist with initial or open coding. These include: What process(es) is at issue here? How can it be defined? How does this process develop? How does the research participant act while involved in this process? When, why and how does the process change? By thinking about these questions, grounded theorists are already moving beyond thick description to a micro-analysis of their data (Corbin & Strauss, 2008). During open or initial coding, we used linked memos to facilitate analytical thinking. Specifically each time a node was created, we also created a new memo that

Figure 2. Extract from NVivo casebook.
was linked to that node. In that memo, analytical ideas designed to stimulate further exploration of concepts were recorded. These provided a valuable workspace for the exploration of our emergent ideas and their integration into the emergent story. These memos were also linked to and from the research diary to provide an analytical audit trail. This early micro-analysis facilitated the iterative process because it encouraged future sampling directed at finding answers to any early emergent questions.

Creating a node structure
As more concepts were identified, the number of nodes created increased. To organise these, NVivo allows nodes to have more than one dimension (tree branch). Therefore, we were able to identify where concepts may have more than one dimension or group them within a more general concept. This is useful in grounded theory because it prompts the analyst to think about their concepts in more detail, facilitating conceptual clarity and early micro-analysis (Bazeley, 2007). Sorting concepts into branches in trees prompted us to identify common properties and make early comparisons. However, in grounded theory it is important to avoid forcing concepts into categories, therefore tree nodes were only used for concept management and not as an analytical tool. Consequently, our early tree node structure identified very broad categories (Figure 3) and this only changed once we had conducted a number of more in-depth analytical procedures. To avoid an overcomplicated tree structure and unnecessary duplication of nodes, we included a branch of descriptive nodes to allow for the different dimensions of concepts to be coded for (e.g. to differentiate between high and low levels of a particular concept). This avoided having to create dimensional

![Tree Nodes](image)

Figure 3. Tree node structure after initial interviews.
branches for each node but still allowed us to explore the different dimensions of concepts using coding queries (described later).

Despite the fact that open coding does represent an early analytical procedure, it is crucial to recognise that grounded theorists should oscillate between this and more focussed analytical procedures (Charmaz, 2006). This ensures that analysts always remain open to new possibilities emerging from their data. NVivo helped facilitate this, because if at anytime during the analysis a new concept was identified in the data, we simply created an additional node to represent it.

**Conceptual and theoretical development**

Grounded theory attempts to move qualitative enquiry beyond descriptive studies, into the realm of explanatory theoretical frameworks (Glaser, 1978; Glaser & Strauss, 1967; Strauss, 1987). This is achieved by implementing more advanced analytical and coding procedures to ask appropriate questions of the data and further develop emergent concepts and categories. The techniques used and how they are employed, depends largely on the revision of grounded theory being followed. For example, one common technique for encouraging conceptual and theoretical development in grounded theory is axial coding. Axial coding refers to the process of relating categories to their subcategories. It is termed axial because coding occurs around the axis of a category, linking categories at the level of properties and dimensions (Strauss & Corbin, 1998). The purpose of axial coding is to begin the process of reassembling data that were fractured during open coding (Corbin & Strauss, 2008). During axial coding the initial codes are scrutinised to ascertain how some of the identified categories relate to one another and to the overall phenomenon. However, due to the epistemological debates surrounding grounded theory, not all researchers advocate conducting axial coding because some of the techniques associated with it have the potential to cast a technological overlay on the data (see section on relationship nodes for further discussion). Arguably this can serve to restrict the analytical codes constructed and ultimately jeopardise the emergent, iterative nature of grounded theory (Charmaz, 2006; Glaser, 1992).

Given our constructivist stance, we treated any axial coding related procedures with caution to encourage an iterative process, whereby sampling and analytical procedures were dictated by previously collected data and the emergent findings. Specifically, to encourage conceptual and theoretical development, we utilised a number of more advanced comparative procedures and analytical techniques. This involved examining relationships between concepts, identifying higher order categories and uncovering dimensions such as conditions, contexts, processes and outcomes that ultimately relate to the studied phenomenon. Consequently, our approach to conceptual development was more akin to the theoretical coding related techniques described by Glaser (1978). Like axial coding, this focuses on developing early codes and concepts, created during initial coding, by specifying potential relationships between them (Charmaz, 2006). However, to assist with this Glaser (1978) proposed a number of relatively broad coding families designed to help researchers explore how different concepts might relate to one-another. By acknowledging a wide range of potential relationships, we were encouraged to explore all our emergent concepts in considerable depth. A number of different NVivo functions are now described with specific reference to how they contributed to the development of our grounded theory study. As explained in section ‘Creating a Memo Structure…’, memos provided a
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valuable link between all the analytical procedures described in this paper and the overall theoretical development and emergent explanatory account of the studied phenomenon.

Coding stripes

One function of NVivo we found particularly useful for early conceptual development was the coding stripes function. Coding stripes allow the researcher to view segments of text or whole documents and see what additional nodes are coded to that particular selection of text. Consequently, they facilitate the task of comparing categories and concepts (Bringer et al., 2006a). We used coding stripes to provide a visual overview of how the nodes created (emergent concepts) might relate to one-another. For example, one of the most commonly referenced initial nodes after the first six interviews was enjoyment. To gain insight into how this might contribute to successful PA behaviour change, we examined all the data coded at this node and used coding stripes to identify any potential early relationships between other emergent concepts (Figure 4). This revealed that much of the data coded at high levels of enjoyment was also coded at the willingness to participate node whereas low levels of enjoyment were often coded at reluctant participation. The coding stripes also provided potential contextual information about the enjoyment concept by identifying some of its potential sources. The most prominent of these were social interaction with peers and health professionals, and a comfortable environment. Therefore, coding stripes provided us with a valuable exploratory tool that facilitated the iterative theory building process by helping us to address emergent questions, and in doing so, generate subsequent lines of enquiry.

Coding queries

Corbin and Strauss (2008) explain that good questions should enhance the development of the evolving grounded theory. Questions such as who, when, why, where, what, how, with what results etc. are commonly encouraged. Devising more specific
questions based on these encourage a thorough examination of concepts, categories and subcategories (Charmaz, 2006). To facilitate appropriate questioning of our own data, we regularly used the coding query function to scrutinise specific segments of data deemed relevant to a particular line of enquiry. This usually involved searching for intersecting coding (i.e. search for text coded to more than one node). For example, during the examination of the enjoyment node, coding stripes revealed that references to enjoyment were also coded at a concept labelled emotional arousal. We identified emotional arousal during initial coding to reference instances in the data where people described emotional responses or affective states. By viewing all of the references coded at emotional arousal, we also observed that the majority of these emotional responses had also all been coded at either the positive or negative descriptive/dimensional nodes. Using a coding query, we were able to retrieve two separate data sets, which represented positive and negative emotional arousal. By saving the results of this query, it was then possible to utilise the coding stripes function to make comparisons between these two types of emotional arousal (Figure 5). Comparisons revealed that positive emotional arousal included references to enjoyment and described instances of excitement/adrenalin rushes, whereas negative emotional arousal

Figure 5. Comparing two coding query results using coding stripes.
included references to emotions such as anxiety and depression. Consequently, the coding query helped us to identify higher order categories by allowing us to view and examine data relevant to the emergent questions we were interested in.

An additional strategy for advancing theoretical development that relates closely to advanced coding procedures, questioning and the constant comparative method is the flip flop technique (Strauss & Corbin, 1998). It is a comparative procedure which we used to obtain further insight and bring out potentially significant properties. It involves turning a concept ‘inside out’ or ‘upside down’ to obtain a different perspective on the event, object, or action/interaction (Strauss & Corbin, 1998). The query function of NVivo easily facilitates this because coding queries are based on Boolean logic and so allow the analyst to select from a number of options (e.g. AND OR NOT).

As we were interested in understanding successful PA behaviour change and long-term adherence, during the coding of the initial interviews we created a node to represent instances where the data described willing physical activity participation. To explore these instances in more detail, we began by viewing the data coded at willing participation with coding stripes turned on. This helped to identify whether any of the previously identified concepts may be related to willing participation. After closer inspection of the data, we observed that a number of health and competence-related perceptions represented potential determinants of willing participation. However, coding stripes on the willing participation node also demonstrated that large sections of the data stored at that node were not coded to either health or competence-related perceptions. This suggested that there may be additional factors contributing to willing participation, which had not yet been identified from the data. To gain insight into these, the coding query function was used to view data coded to willing participation but NOT any of the concepts that represented competence or health perceptions (Figure 6). This allowed us to view only the data we were interested in and helped to identify a number of additional socially orientated concepts, which appeared to act as important physical activity participation determinants.

**Sets**

Another valuable NVivo tool for advancing theoretical development is sets. We used sets to cluster nodes together into broader concepts based on potentially meaningful relationships. They represented a useful exploratory tool because by grouping project
items into sets we were not changing the node structure or duplicating items, but simply saying that these items may belong together in some way (Bazeley, 2007). The sets created were often also incorporated into queries as single units of data. This allowed us to ask questions of the broader concepts we had identified. For example early in the analysis, the data revealed that successful maintenance can possess a number of different characteristics. To account for this a higher order concept labelled *stability* was identified. Stability described how willing people were to continue participation, which seemed to be directly related to how much effort they needed to invest and the likelihood of temporary behavioural lapses (i.e. reduced PA participation levels). In other words stable maintenance was deemed to be characterised by willing, effortless, enduring participation and unstable maintenance by increased feelings of reluctance, greater investment of effort and an increase in participation lapses. To represent this, sets were created for instances of both stable and unstable maintenance. These were made up of the corresponding initial concepts mentioned above. Having created these sets, it was then possible to conduct further analytical procedures on these higher order categories (see next subsection on matrix coding queries).

**Matrix coding queries**

Another type of NVivo search tool that we used for conceptual and theoretical development is the matrix coding query function. This, allowed us to investigate relationships between concepts and categories by searching for data coded to multiple pairs of items simultaneously. Specifically, we used matrix coding queries to identify potential sub-categories and dimensions of higher order concepts and to make multiple comparisons between cases and concepts. For example, in order to make comparisons between the sets we had created to represent stable and unstable physical activity related outcomes; a matrix coding query was set up to examine the factors commonly associated with these two extremes. The results of this provided me with an indication as to whether any of the previously identified concepts (i.e. any of the nodes created during coding) were commonly associated with either stable or unstable maintenance. These results are presented in a table or matrix (Figure 7) where each cell in the matrix displays chosen information concerning the corresponding pair of items (e.g. number of sources, cases, words, references coded to both concepts or percentage coverage values for the corresponding coded data). In Figure 7 the numbers represent corresponding coding references. Consequently, from these results we were able to identify a number of concepts which appeared to be closely associated with either stable or unstable maintenance. It was then possible to select the relevant cell in the matrix to display only the data coded to both concepts, in order to investigate these potential relationships in more detail.

In some instances it was necessary to conduct a series of queries in order to address particular emergent questions. For example, during initial coding, codes were created to represent different time periods (e.g. during the referral scheme and post-referral scheme). After subsequently identifying *lapses in participation* as an event which appeared to occur on occasions for many of the participants, we decided to explore the prevalence of these at different time periods for each individual participant. To achieve this, we first set up two separate coding queries to view data coded at *pre-referral* and *lapses* and at *post-referral* and *lapses*. We then saved the results of each of these as new nodes which could then be incorporated into a matrix coding query to
identify the number of references to pre- or post-participation lapses for each case (Figure 7). This helped us realise that participation lapses appeared to be exclusive to the post-scheme time period and it also indicated the extent to which different participants experienced these lapses.

**Relationship nodes**

To assist researchers with axial coding, Strauss and Corbin (1990, 1998; Corbin & Strauss, 2008) introduced the paradigm model or coding paradigm. They explain that axial coding involves relating structure with process, where structure or conditions set the stage or create the circumstances in which issues or happenings pertaining to a phenomenon arise and process denotes the action/interaction over time of persons, organisations and communities in response to issues or happenings (Strauss & Corbin, 1998). Therefore, the paradigm provides an organisational scheme to help capture the dynamic nature of events (Strauss & Corbin, 1990), encouraging analysts to gather and order data in such a way that structure and process are integrated. However axial coding related procedures, like the paradigm, assume quite an objective stance because they encourage researchers to fit their data to a relatively limited framework (Dey, 1999). Consequently, it is not congruent with all epistemological perspectives and their related revisions of grounded theory. However, Strauss and Corbin (1998) do stress that the paradigm should be used with caution and that its components are intended as a guide to help analysts ask appropriate questions of their data and not as a framework to fit their data to.

Given that we were concerned about forcing our own data to fit a given framework, we chose to only use the paradigm as a source of information to stimulate in-depth exploration of concepts. We did not look for specific conditions, actions/interactions and consequences, but by acknowledging it alongside Glaser’s coding families, it did help us to recognise the complexities of potential relationships. To facilitate this, we used NVivo’s relationship node tool. Relationship nodes can be used to record a connection of a particular kind between two project items. The relationship can be a simple association, or it can have one or two-way (symmetrical) directionality.
The particular type of relationship can also be defined (e.g. encourages, reduces, supports, leads to, etc.). Because relationships are stored as nodes, it is also possible to code data to them. Consequently, when we identified a potential relationship between any emergent concepts (e.g. between internal locus of control and stable maintenance – revealed by the query results in Figure 7), we defined these in NVivo using the relationship tool and created relationship nodes to represent them. As we discovered more about the nature of these relationships by exploring other concepts and segments of potentially relevant data, we could then code any evidence deemed relevant, to the corresponding relationship nodes. This enabled us to examine all the potentially relevant data, for each relationship, in one place and meant we could use functions such as coding stripes to assist with this process. This helped to identify any other concepts or processes which contributed to that relationship and what their role was (e.g. do they act as mediators, moderators, consequences or conditions). Consequently, the relationship tool provided us with a valuable way of exploring the complexities of potential relationships without forcing data to fit specific categories. Figure 8 demonstrates data coded at the relationship between internal locus of control and stable participation.

**Models**

Another technique used commonly by researchers to facilitate the development of grounded theories is the use of models or diagrams (Holt & Dunn, 2004). NVivo facilitates this because it contains a model building tool, which allows project items (e.g. nodes, relationships, sets) to be presented diagrammatically. We used models throughout the research process to visually examine many of our analytical observations. As our grounded theory project developed, analytical observations became more complex.
and multi-dimensional. However, by producing visual representations of these increasingly complex observations (e.g. showing the various dimensions of a particular category and how they interact/relate to other concepts and categories), it became easier to explore relationships which may otherwise have been difficult to conceptualise. Models also helped us to identify gaps in the emergent understanding because we used them to summarise findings. For example after each iteration (the data collection and analysis phases depicted in Figure 1), we created NVivo models to summarise the theoretical and conceptual development. These models were accompanied by linked explanatory memos (Table 2), which together were used in subsequent data gathering (interviews), to stimulate questioning directed at either the further development of concepts and categories or addressing gaps in the emergent understanding. Finally, all models created in NVivo can be ‘static’ or ‘dynamic’. This means that if changes occur to associated NVivo project items, the analyst can choose whether or not to allow models to be automatically updated. When we used models to explore specific concepts, they were usually ‘dynamic’ to allow us to continually visualise the evolving nature of our analytical observations. However, in order to preserve an audit trail of the overall model development, the summary models created after each iteration were ‘static’. Figure 9 demonstrates a summary model created to represent the various analytical observations described in this paper.

The end of the grounded theory process

The end of a grounded theory study is marked by what is referred to as theoretical saturation. Charmaz (2006) explains that saturation is reached when collecting

Figure 9. Summary model.
additional data no longer sparks new theoretical insights. We used the memo function of NVivo to keep a detailed account of the ongoing theoretical development, and all sampling and analytical decisions made. As well as helping identify gaps in the emergent data, this also provided an indication of when categories had reached saturation. Specifically, by following the links we had created to associated models and conceptual memos, it was possible to see whether there were any outstanding emergent questions or theoretical possibilities that had not been explored.

The final grounded theory should represent an explanatory model of the studied phenomenon grounded in relevant empirical data (Glaser & Strauss, 1967). Consequently, it is commonly accepted that there must be evidence of theoretical density or depth to the observations presented, resulting in the presentation of a theory from which hypotheses can be generated (Charmaz, 2006; Corbin & Strauss, 2008; Glaser & Strauss, 1967). NVivo helped to present this evidence because we were able to go back through the conceptual development diary and highlight the specific lines of enquiry and analytical techniques that were conducted along the way. The model building tool also helped provide evidence of theoretical density because it ultimately allowed for a visual representation of the core categories and their various dimensions to be presented.

It is generally accepted that when communicating the findings of qualitative work, transparency is essential (Bringer et al., 2004, 2007). It is important to recognise that researchers will inevitably conceptualise differently and put different emphasis on the data depending on factors such as their professional background and their underlying ideologies (Corbin & Holt, 2004). Consequently, researchers must provide a clear description of the analytical processes and the procedures they employed, so that others are able to follow the logic that led to the concepts and categories proposed. This paper supports previous claims that NVivo can be used to encourage greater transparency (Bringer et al., 2004; Johnston, 2006) because an NVivo project ultimately represents a complete record of the evolving grounded theory research process. Therefore, the researcher is able to easily integrate this information into a written report to demonstrate how the study progressed in line with a grounded theory approach.

Conclusion
This paper supports and strengthens previous arguments that QSR-NVivo can be used to facilitate many aspects of a grounded theory approach, by presenting a recent worked example of how a grounded theory-based research study developed using NVivo throughout. Because this paper is based on the research activities of the authors, the techniques reported were heavily influenced by their own sampling and analytical decisions, which in turn were dictated by a constructivist epistemological position. While attempts were made to describe characteristics common to most revisions of grounded theory, some of the techniques and procedures described may not be congruent with every grounded theorist’s epistemological viewpoint or theoretical perspective. There are also a number of additional NVivo functions, which were not utilised by the example study and as a result were not discussed in this paper. Consequently, future research may consider how different types of grounded theory studies may benefit from both the NVivo functions described in this paper and any additional software features (e.g. incorporating and working with a range of different multimedia data sources). In summary, QSR-NVivo is a powerful tool that, if used appropriately,
can facilitate many aspects of the grounded theory process from the design and early sampling procedures, through to the analysis of data, theoretical development and presentation of findings.

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Notes
1. This article is based on research conducted and supervised by the authors of this paper; therefore, the first-person pronoun is used regularly to refer directly to them.
2. Literature was only used in this way to stimulate further exploration of concepts, not to force pre-existing ideas onto the emergent data.

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References


