

Metaphors for integrated analysis in mixed methods research

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Introduction

This paper, essentially, is about integrating methods and analyses in mixed methods research. In it, I will focus on the ways people think and write about integrating methods, by drawing on the *metaphors* they use to describe the process. My purpose is to clarify the metaphors used, and in so doing to clarify the processes involved and then to identify principles for engaging in mixed rather than multiple methods.

A metaphor carries over, or transfers, meaning from one conceptual domain to another (Lackoff & Johnson (1980), thus I *consume* and *digest* information and *construct, build* or *grow* theories. Metaphors create images that facilitate understanding, communication, and remembering through using something familiar—such as eating, building, or agriculture—to explain or describe something new or more difficult to comprehend (Bonner & Greenwood 2005).

The problem is that mixed methods researchers are assuming a shared understanding of commonly used metaphors which may not exist because the field is still so young and complex—yet precise use of metaphor is revealing, and so there is value in clarifying and analysing the metaphors we use to illustrate some of the roles, purposes and ways of integrating data.

Mixed methods and integration

Mixed methods, for the current context, is broadly defined to include any study in which more than one paradigmatic or methodological approach, method of data collection, and/or type of analysis strategy is employed for a common purpose, regardless of whether those methods or approaches might be defined as quantitative, qualitative, a combination of, or somewhere in between approaches that might be classified as qualitative or quantitative.

Integration of methods involves, therefore:

- Having more than one approach, method, source of data and/or strategy for data analysis
- Having a common purpose or goal
- Interdependence of these different elements in reaching the goal
- Having a sum greater than the parts (Bazeley, 2010).

My approach recognizes “the reality that there can be many different ‘mixes’ or combinations of methods” (Yin, 2006, p. 41) and rejects a clear differentiation between qualitative and quantitative methods or approaches to research (Bergman, 2008).

There are multiple rationales given for mixing or integrating methods (Caracelli & Greene, 1997; Tashakkori & Teddlie, 2003; 2010).

- The value most often expressed by people is that this assists them to build stronger conclusions, as the strengths of one approach or method serve to compensate for the weaknesses of the other (e.g., Johnson & Onweugbuzie, 2004). The strengths approach implies use of a complementary or extension design for mixing methods to more effectively support the outcomes, and indeed this is the most common design recorded in published studies (Bryman, 2006).
- Mixing methods, alternatively, is seen as a way of initiating new understanding of the topic at hand (Caracelli & Greene, 1997). A dialectical approach, for example, with its goal of initiation, celebrates tensions created through use of different approaches and methods, as a means of prompting further exploration and deeper understanding (Greene, 2007).
- Alternatively, again, mixing methods is seen as a way of providing a more complete understanding, for example, of causal processes. A realist approach demonstrates the need to consider both regularities that are assessed through empirical observation and mechanisms that are identified through a qualitative approach (Maxwell, 2004; Maxwell & Mittapalli, 2010). Thus, integration of component parts of the study will be shaped quite differently, depending on the rationale or purpose for the study.

Increasing recognition of the utility of concurrently applying more than one approach and multiple methods to many research problems is leading to widespread adoption of mixed methods as a valid methodological approach in social research. Concomitantly, the focus of theorizing about mixing methods has shifted from paradigmatic issues and design typologies to methods issues including sampling, analysis, and validity. The challenge of how methodologies might interact across integrated designs remains not fully resolved, however (Flick, 2007). Integration has been variously described as “not achieved and difficult to do” (Bryman, 2008, p. 93) and as being undertheorized and understudied (Greene (2007).

I haven’t done a systematic review of articles purporting to be employing mixed methods, but in reading a large number (primarily in health related disciplines), I also became very aware of the lack of integration present in a very large proportion of them (see also O’Cathain, Murphy, & Nicholl, 2007). Lack of integration is problematic, for example, in studies where better or more valid results might have been obtained if all types of available data had been considered together (Bazeley, 2009). Typically, in those I have read (and in many I have heard presented here) any quantitative results, usually from surveys, are presented first, to be followed by a necessarily brief thematic analysis of interview material or answers to open-ended questions. Sometimes the threads from both strands were drawn together as a basis for a model or other conclusion—but not always. Thus, not only is integration of methods undertheorized and understudied, the level of integration practised in many (if not most)

mixed methods studies, also, remains underdeveloped, although, on a more positive note, I would suggest that this situation is changing for the better as more people accept and explore the use of mixed methods approaches to research.

Metaphors for integrating qualitative and quantitative data/analyses

Researchers adopt metaphors to describe the integrative process they are using and metaphors for integrating methods abound, but they are used often without particular thought as to exactly what is being conveyed (Bryman, 2008). The term triangulation, for example, is possibly one of the most abused metaphors in the entire methodological language. Certainly within writing about mixed methods it has been used to refer to any kind of combination of methods (particularly by novice researchers), and more specifically, to both corroborative, or convergent, and complementary designs. When I started analyzing the particular metaphors I had found in the literature, I found I often disagreed with the way in which they had been used. Thus, by examining the use of metaphors for methodological integration—describing each group, providing details of particular metaphors and noting their usefulness—it is hoped to both clarify meanings and advance thinking about what is going on when methods are integrated.

Combining for completion

The first group of metaphors are probably the weakest in terms of integration. They include those where separate components, maybe several from each source or type of source, are simply placed together to complete an image, usually without changing the essential structure of any component part. The metaphors in this group vary in the degree of integration achieved, but the greater the degree of integration, the more likely it is that the combined product will create an impression that is quite different from the separate components.

Bricolage

A bricolage is something that is made or put together with whatever materials happen to be available, including pieces that may be discards from other projects. The pieces may or may not have meaning on their own; the final product doesn't necessarily need (or receive) a lot of design. The outcome could be a bit 'patchy', drawing attention to some bits and not others. Denzin and Lincoln (2000) referred to the qualitative researcher as a *bricoleur* or quilt-maker who borrows from many different disciplines, perspectives, theories, or methods, working between and within competing and overlapping paradigms and perspectives, with the resulting quilt, collage or montage being a "set of fluid, interconnected images and representations" (p.6).

Mosaic

In a mosaic, the combination of different elements, each of which is (usually but not always) structurally similar, is necessary to make a complete design or picture. Each piece retains its integrity, but on its own is of no significance; it has meaning only when combined with others, yet each contributes to the total. Design is critical: the integration has to be purposeful.

Jigsaw

A jigsaw is similar to a mosaic, except that each part has to fit into a particular place to make the whole picture so the design is very much pre-set. Jigsaws suggest puzzling, as the pieces are gradually matched on colour and shape and fitted together to contribute each building block to the whole.

In all of these metaphors that involve completion, information only makes sense in the context of the different component parts being combined in a complementary way to create a comprehensive picture or to achieve a single, unified outcome. Pieces typically have no clear meaning on their own, and the pieces are not put together in any particular sequence. Methods may be of equal or unequal status, and integration is incomplete before all pieces are placed to make the final product. Lack of completion will be particularly evident in a mosaic or jigsaw, although even then, an impression of the final product might be obtainable.

To explore residents' preparedness to evacuate in the event of eruption of the Katla volcano in Iceland and consequent glacial outburst flooding into the southern and eastern hazard zones, Deanne Bird (2010) used maps of the hazard zone that showed rivers, roads, settlements etc., observed an evacuation trial, interviewed emergency workers, and survey-interviewed residents and tourists. Residents in the three of the farming communities are to be evacuated due to the risk of flooding, while houses in the low lying coastal area of a fourth area are to be evacuated due to tsunami risk. Evacuation for the three farming communities is a more complex process involving disconnecting electric fencing and releasing livestock, and one of these will be given only 15 minutes warning in contrast to 30 minutes for everyone else.

When the maps, box plots indicating levels of preparedness, and resident comments are viewed in conjunction with each other, a clear picture emerges of some of the factors influencing residents' preparedness. Very few residents across the region feel completely prepared for an evacuation. The group that will get less warning time than others feel least confident about their preparedness for evacuation, whereas the residents of the coastal town, who have to travel only 5 minutes to reach the evacuation centre, generally feel more prepared. Residents in one community are generally better prepared because they have worked together on developing an alternative plan to the official one, as it requires that they leave their higher homes and cross a low-lying area in the direct path of the flood in order to get to their evacuation centre. Additional social factors occasionally override these geographic influences, for example unprepared people who are recently arrived residents, and the completely prepared person in another area who keeps in constant touch with events,

having actively sought information on previous eruptions from Katla and risk mitigation procedures. And thus the picture is built from placing the various components together, and seeing them in relation to each other.

Combining for enhancement

These metaphors are somewhat similar to the previous, but the combination serves a different purpose. As with the previous ones, whether they represent mixing methods depends primarily on whether added components are given consideration when results are being formulated and written.

Sprinkling

David Karp (quoted in Hesse-Biber, 2010, p. 23) referred to sprinkling methods as being “like going to the ice cream store and throwing a few M&Ms onto the top of the ice cream to make it look pretty, and it might taste a little bit better.” He did not regard this as a valid mixed methods approach. Typically, qualitative quotes or vignettes are “thrown in” to satisfy an agenda, or give meaning to a statistic. Alternatively, a few numbers might be thrown in to enhance a descriptive report and to impress policy makers. If this is all the sprinkling consists of, then I would agree with Karp. Quotes (and numbers). Sprinkling is at best a minimalist form of mixed methods integration, as disassociated numbers or single quotes on their own are not evidence for anything. They must always be undergirded by data from across the sample more generally, and hence are they are valuable primarily as illustration.

With this strategy, then, component approaches are typically unequal, with the secondary approach being more supplementary than complementary to the primary approach. Supplementary data is used to illustrate or enhance analysis that uses an alternative primary source or approach. The primary method may be complete but inadequate without the supplementary method, but the latter is unlikely to be in a form which could comprise a complete analysis in itself.

Stirring

When things are stirred together, such as when making a stir fry or salad mix, the degree of mixing is greater than for sprinkling and this time the mix is more to enhance the taste and the nutritional value rather than to improve the image. Ingredients remain mostly distinguishable within the mix, there may not be a lot of design about how they are put together, but in the eating the merging of the multiple ingredients is completed and the flavor reflects the merged as well as the individual components—with the quality of the flavor and the nutritional value dependent on the skill applied to its creation.

For example, Julia Brannen and her colleagues, (1994) undertook a study of youth, health and risk-taking which involved a survey followed by interviews with subsample of teens and parents. Data were collected sequentially, but then “juxtaposed”, that is, they were interwoven in the report so that different sources were drawn together for each topic/issue discussed (even though the interviews occurred quite a long time after the survey).

In my earlier days I produced a number of consultancy reports that would have fitted one or other of these metaphors for enhancement. Do they constitute mixed methods, and do they demonstrate integration of methods? My argument for including these strategies is that they are at least one step along the way, simply because, in the writing process, the various sets of data have been brought together in order to build the argument/s being made. The different components are still quite distinguishable, and initial analyses were undoubtedly done separately, but they have not been written up separately, and the researcher/writer has had to think about how they come together. In best cases, writing the methods together would act as a prompt for the analytic path to develop into something more iterative, particularly where discrepancies emerge.

In a stronger version of stirring, one might combine categorical data with qualitative data to create sub components of the data which can then be compared. This can contribute significantly to analysis through alerting the researcher to subgroup differences (so then, why are they different?), to different dimensions in the data revealed through nuances in the text, or by providing evidence for or against scale validity (Bazeley 2010).

Combining to create something new or different

This is an extension of the previous, but perhaps the combination of different ‘breeds’ of research will create some hybrid vigor?

Blending

Blending of ingredients occurs when one makes a cake, or when members of an orchestra blend or meld their different sounds to create a symphony. Blending goes beyond stirring, by extending the degree to which ingredients can be combined. Stirring suggests a lesser application of energy, with parts of some ingredients possibly remaining distinguishable within the mix. Blending suggests more effort to generate a finer mix in which the original ingredients become largely inseparable, while with melding they become, possibly, even indistinguishable. In the process, something new is created from what went into the mix, and regeneration of the original components would require a complex process that may have less than satisfactory results.

There are at least two ways to think about blending:

- In one approach to blending, information from a variety of sources are merged together to create a richly detailed portrayal of a case, experience, event, process such that it would be difficult for any reader to deconstruct it into the particular bits that were put together to make the whole.

To arrive at a definition of early career in research, I integrated insights/info from multiple different sub-studies that included surveys, reviews of documentary evidence, observations, emails and interviews. From these combined sources I was able to identify five critical milestones on the path to becoming a successful academic researcher:

- gaining a high level research qualification,
 - acquiring an academic appointment,
 - balancing the demands of teaching with the need/desire to research
 - maintaining a research profile when promotion brings increased non-research responsibilities, and
 - achieving established researcher status (Bazeley, 2003).
- In another version of blending, one or more new variables might be created from a combination of qualitative information with an existing scaled or categorical variable.

Jang et al. (2008) used a survey to identify the characteristics of successful schools. Their problem was that the 9 factors derived from their 75 survey items didn't differentiate between the schools, so they created blended variables by redefining survey items into new 'factors' based on 8 of 11 qual themes (no items were available for three of the themes). These were not so internally consistent (α), but they showed more variation across schools and were more sensitive to the sociodemographic environments of the schools.

This latter version of blending, in particular, can often be the key to moving beyond an impasse in analysis. Either way, the integration of data through blending has created something that goes beyond what was possible with the original components treated separately.

Pointers to a more significant whole

These might provide the foundation, or point to a goal. They share some similarities with metaphors re completion, but they point to something bigger than completion.

Triangulation

Triangulation is the most used and perhaps the most misused metaphor in the mixed methods language. Use of the term in the methodological literature derives from Webb et al. (1966), who suggested that "once a proposition has been confirmed by two or more independent measurement processes, the uncertainty of its interpretation is greatly reduced. The most persuasive evidence comes through a triangulation of measurement processes" (p. 3). It was popularised, as I'm sure most will know, by Denzin (1970; 1978). Of Denzin's four types of triangulation, by far the most commonly referred to is triangulation of methods, and following Denzin, this was most often seen as a tool for validation.

In surveying (and the mathematical fields of trigonometry and geometry on which surveying is based), however, the fields from where the metaphor is drawn, triangulation allows the surveyor to fix the location of an observable point and calculate its distance from each of two known points based on *three sources of two kinds of information*: the length of the baseline between the two known points, and the angles at each end of the baseline to the focal point. The points and lines established by this procedure, in land surveying, then provide the baseline information for further triangulation, until the whole area is covered.

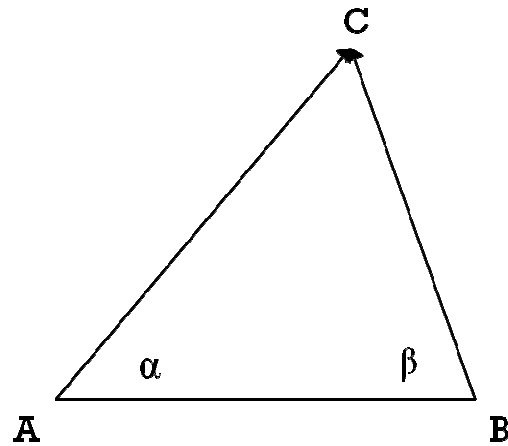


Figure 1: The exact location of the point C, and the lengths of the lines AC and BC are determined from the location of the points A and B, given the length of the line AB and the size of the angles BAC (α) and ABC (β).

From this metaphor I draw four points about triangulation in mixing methods:

- a) *you need to have an identified goal point in focus* – it is just its exact location that is to be determined,
- b) *you need at least two types and three sources of information* in order to determine the location of that point,
- c) *each source of information contributes equally* to the calculation of its location, and
- d) because neither method nor any source is adequate in itself to provide the necessary information, information derived from the various sources needs to be *integrated during analysis and preparation of the results* in order to achieve the goal.

This metaphor, therefore, suggests an approach involving a complementarity of methods to point to information beyond what is known in order to complete a map or picture, rather than a corroboration or validation of approaches through comparison of conclusions. One could also argue that such studies could have a developmental focus as well, providing baseline information for further exploration and mapping. Following this line of argument, one can conclude that many of those studies that claim to be using a triangulated approach are, in fact, not doing so.

As both Greene, Caracelli & Graham (1989) and Bryman (2006) found, studies where results are used in a complementary way are far more common than those in which the results of one method are used to corroborate those from another. Even where corroboration is the stated goal, complementarity is the more likely outcome. Complementarity is epistemologically more justifiable as well, as it is unreasonable to expect that exactly the same question can be answered by studies carried out using different perspectives and approaches.

The health and health service usage of homeless youth in Germany was investigated by Uwe Flick (2010) using three methods: observation, interviews with youth, and planned interviews with experts. The interviews with youth included both closed and open (narrative) questions. His initial expectation had been that the perspective gained from each approach would converge, but he found instead they worked in a complementary way, so that together they

generated a fuller picture of the conditions under which medical care became difficult to be claimed or supported when the issue of housing was ignored.

Triangulation can often be facilitated by the use of metamatrix in recording and combining the different sources of data (Happ et al., 2006; Wendler, 2001). In a study of a medical procedure, Wendler (2001) created a descriptive matrix on a case-by-case basis with columns for physical data, participant comments, nurse comments, other observations, and reflective thoughts by researcher.¹ The metamatrix provided the researchers with an opportunity to determine if patterning existed that was not captured through the separate quantitative or qualitative data analyses. They found also that by using the meta-matrix, spontaneous comments and naturalistic events could be captured and considered within the context of the case.

Drawing an accurate line

Treating triangulation in this way leaves us without a metaphor for validation. I am reminded, however, of the many times I have had to rule a straight line for cutting when doing carpentry. In order to ensure the line was correctly placed, I would always measure the distance from the base for at least three points as a means of checking that I had measured correctly. In describing validation, this analogy (rather than metaphor) again points to the need for three sources of information as two are insufficient to ensure accuracy. If there is a discrepancy, then a further measurement (i.e., data source) will be necessary to determine which of the three was misplaced. Seeking three concurring sources overcomes the problem that in using just two, both may be wrong in the same way or if one is wrong, the conclusion drawn may be skewed.

If this is seen purely as a technique for cross-validation, insofar as there is no intention to integrate the data or the writing of the results from the several sources and/or approaches, then it would be better described as use of multiple methods rather than mixed methods.

Archipelago

The archipelago metaphor is one which is less precise than triangulation, but which similarly uses the integration of information from multiple sources of data to point to something larger than that which is seen from a simple combination of those sources. The sources that evidence the whole may be somewhat random, and the outline of the whole more difficult to exactly determine.

An archipelago is a set of islands connected underwater to form a group, such that the separate yet connected islands that show above the surface are just the tips that evidence the presence of a much larger underwater structure (Lawrenz & Huffman, 2002). Some evidence is in plain view, but much remains more or less hidden and can be difficult to reveal. Some islands are outliers, some may not in fact be part of the archipelago, but exist in their own right. Not all islands are the same size.

¹ This kind of matrix can be readily set up in Excel, and then sorted to reveal patterns in the data (cf Bazeley, 2010).

Thus, in evaluating a teacher development program for science teachers, these authors used multiple sources of information, including student achievement scores, classroom observation, surveys, semi-structured interviews, and case studies. The data collection occurred pre and post implementation, but was also emergent in design and analysis. They report that

the archipelago concept was a particularly helpful way of viewing the various types of mixing because it allowed us to link the different methods in a way that respected the uniqueness of different data and analysis methods while at the same time helping to form inferences about the “truth” of the program we were evaluating. This metaphor goes beyond more linear ideas of triangulation and bracketing by viewing the interrelationships in multiple dimensions. (Lawrenz & Huffman, 2002, p. 337)

Linkage via a network

Linking might suggest simple connection or continuity rather than integration. If so, then it is more likely to constitute an example of multiple methods rather than mixed methods integration—it really depends on what is being linked and the way in which the linkages are put together.

Chain

A simple chain, for example, suggests a series of equal status sources of the same general type which are intertwined with each other. It is more indicative of a longitudinal study than a mixed methods study.

Web

A web is multi-directional in form. It radiates from a centre, and necessarily has ties to larger structures. Its purpose is to catch items of value to feed the one who developed the web.

Maxwell and Loomis (2003, p. 263), in describing Festinger et al’s (1956) classic field study of cognitive dissonance, *When Prophecy Fails*, describe the different data components as “tend[ing] to grow ‘tendrils’ backward and forward, integrating both qualitative and quantitative elements into all components of the research” thus transforming the study from a quantitative or multiple method study into one which demonstrates integrated methods.

Social network analysis can supply very useful integrating tool for mixed methods data, with network diagrams having a particularly web-like quality. Such networks might be based on qualitative coding, attribute data can be attached to the nodes in the network, the relationship between different layers in the network, based on different kinds of data, can be examined, the network data can be analyzed statistically or interpreted qualitatively, or the network information might simply comprise one component of, say, an ethnographic study.

William Whyte, for example, mapped the changing networks of the Nortons gang as part of his classic study of *Street Corner Society*, while Mark Fleisher has more recently examined the role of the girls in particular as bridges in social networks in *Dead End Kids*.

In a different application of network techniques, Stoddart et al. (2010) coded the discourses in various communications related to disputes over land use in each of two wilderness areas,

mapped as a network the links between the variously coded passages, and then also used a two-mode network to map the relationship relating types of discourse to sources.

Meshing or Weaving

Brewer and Hunter (2006) recommend “a creative and at times even playful meshing of data-collecting methods to encourage serendipity and openness to new ideas” (p. 69). They saw this as relevant to theory-generating, exploratory research—like a web, with a capacity to lead the researcher off in a number of different directions as part of that exploration.

When things are meshed or woven, the various strands retain their individual character but they are completely intertwined with each other, such that their individuality is surpassed by the overall construction that they generate. Typically, however, the weaver would have a reasonably focused image of the goal they are working toward. In this sense, then, meshing or weaving shares characteristics with a mosaic or archipelago, here the combination of pieces makes for something more significant than the components on their own.

Iterative exchange

One component of a study may inform or prompt another component, often iteratively, in the search for a solution to a dilemma, or an answer to a research question, thus generating iterative exchange between methods.

Conversation

A conversation moves back and forth between two or more speakers. Sometimes in speaking, one is dominant, though in a genuine conversation, there is equality. As well as working iteratively, a conversation might involve using numbers, strong statements or some other stimulus to prompt a response from the other party. Each conversant maintains their identity, although their ideas and form of communication might be modified in response to the other speaker.

I can view a conversation, most often, as an exchange of ideas, and in this sense it speaks to the use of mixed methods for iterative development of a project in which different segments (or components) progressively (and sometimes recursively) contribute to prompting, and perhaps also to interpreting and understanding the next part of the conversation.

DNA

Kemp (1991) described DNA as a metaphor for doing integrated analysis, to capture an iterative process of reconciliation and progression that is particularly useful when data analyses in a mixed methods study provide divergent results, or in a study designed to initiate new thinking. The double helix of DNA is comprised of a sense and an anti-sense strand, which twist around each other, unwind, reorganise or transform through a process of protein transfer between the strands, and rewind to reform, in an iterative process of reconstruction. Unlike a conversation in which it is impossible to undo what has been said, this process

allows for both undoing and rebuilding as the different strands come together to build a cohesive organism.

When presented with divergent results, the first step in achieving an integrated and reconciled analysis is to determine the sense strand of the analysis. This might be what best accords with previous literature or with empirical observations. The dissonant (anti-sense) findings, such as people's interpretations of experiences, are then considered in counterpoint. (It could equally well be that it is reported experience that 'makes sense' and the literature or numbers which are dissonant.) The divergence of findings can then be used as a promoter (or initiator) for questioning, transferring, combining, rearranging and resequencing the data, and rebuilding the analysis as ideas and information are transferred between the strands of the analysis. These processes can continue in a series of iterations. At each iteration the sense and anti-sense strands may be derived from words or numbers or, increasingly, an integration of these. Thus, reconciliation may be achieved by undertaking analysis which facilitates a dialogue or exchange between the multiple data being used to understand the phenomenon of interest, such that each strand transforms the other in the process to make something different and distinct, rebuilding the analysis in much the same way that genetic material reconstructs itself. DNA analysis, therefore, typically involves the use, also, of blended or transformed variables.

The rigor of this type of integration derives from an inability to force any part into the organic helix; each component in the DNA sequence has a key and it has to fit in place. As in the construction of DNA, only certain sequences are possible, and only particular proteins (data) can bind together, yet variation and improvisation are important and, as in nature, infinite variety can result. Ultimately, at the conclusion of the process, everything must 'fit' and 'work' and the rigor and the validity of the integrated analysis can then be judged by the functionality of the resultant organism.

In Lynn's original study of the community service needs of people with spinal injuries in New South Wales, she found a miss-match between need and care delivery. Her initial problem was that there were many different ways of defining and assessing need. This was compounded by finding that, while her quantitative data revealed a desperate shortage of community services, the qualitative data spoke of people feeling ambivalent about whether they would access services they had most complained about not having. She started from the 'sense' strand, that there was a quantitatively demonstrable shortage of services for people with spinal injuries. She then took the 'anti-sense', counter-intuitive qualitative data, that people were ambivalent about not having services, which had been coded using qualitative data analysis software, and imported the codes reflecting feelings about services into the project's statistical database. These data were blended to create a quantitative variable that reflected both the current use of services, and the desire for services. Subsequent rebuilding of the quantitative analyses revealed that the qualitative ambivalence to services was the respondents' response to the apparently arbitrary distribution of community services for the spinal injured population, rather than its being based upon their need for the service as defined either quantitatively or qualitatively.

Data from policy documents, however, clearly indicated that services were legislatively mandated to be allocated according to need. Once again, there was dissonance. Rebuilding of the qualitative analysis then proceeded by adding the permutated quantitative data to the qualitative database for inclusion in the qualitative analysis. Quantitative service satisfaction scales augmented by the previously created use and desire variable, were combined with respondents' qualitative responses about the beneficial and detrimental effects of services. When reanalysed qualitatively, the quantitative arbitrariness of service provision was, in fact, not so arbitrary. Services were allocated on the proviso that persons with spinal injuries adopt life plans which met the expectations of service providers, demonstrated by being 'just right', that is, not being too independent, nor too dependent, evidenced in demonstrating suitable levels of gratitude and humility.

As can be seen from these descriptions and examples, iterative models for mixing methods are especially valuable

- for exploration
- in developmental studies
- for initiation,
- or for resolution, that is, where it becomes necessary to resolve emerging issues in the data

Transformative (change) metaphors

These metaphors involve a process of change in the structure of the data from one form to another. It makes sense to do so primarily when

- data needs to be added to/or compared with information that has an alternative structure, or
- to facilitate additional, alternative forms of analysis.

Morphing

Morphing describes the smooth transformation of an object (usually a digital image) from one form into another, typically through a series of stages.

Teddle and Tashakkori (2009) note that a single source of data, may change form several times as part of an iterative sequential design. Although iterative or gradual, it is this element that makes it different from conversation. The morphing may result in quantitative (numeric) data progressively becoming qualitative (text based), or more commonly, in qualitative coding being quantitized. In the latter case, the transition may be more rapid and complete than in the former.

In her review of educational articles, Niglas (2004) applied cluster analysis to tabulated characteristics of those studies to derive eight groups, which she then described qualitatively. Nickel et al. (1995) similarly used cluster analysis of survey data to define and profile

clusters of young people in terms of their sexual attitudes and practices, as a basis for further sampling.

Conversion of qualitative coding to quantitative is especially common for open-ended responses in survey analysis, as it allows a recombination of those responses with the bulk of the data for additional analyses—without losing the availability of the original text. Given an adequate sample size, quantitized qualitative coding might also be considered in relation to other variable data using correspondence analysis, and the pattern of interrelationships of qualitative codes can be treated as a similarity matrix and analyzed using multidimensional scaling. One advantage of multivariate exploratory analyses is that they do not presume normality of distribution for the included variables. Appropriate software is needed for quantitizing transformations and analyses.

Fusion

Fusion can occur on several levels:

In partial fusion, as in blending, components are combined (joined) to create a single new whole that cannot easily be taken apart (if at all), but it differs from blending in that the identity of each component within that whole continues to be partly or fully distinguishable. One might imagine strands of plastic being fused together through the application of heat, with elements of the original colors still evident in the combined result, or fused joints now working as a single entity, but which still evidence the structure of the original bones.

In cell fusion a new single cell is created from two pre-existing cells, either from the same organism, or as a hybrid cell from cells of two different species. For example, HIV infects the body when the virus binds with specific receptors and thus fuses with the membranes of immune system cells.

Nuclear fusion generates (dangerous) energy! It is an ultimate form of blending that can set off an almost uncontrollable chain reaction. The process involves forcing multiple atomic nuclei to form a single heavier nucleus. If the elements being fused are light enough, energy is released; if the elements are heavier than lead, production of the fused nucleus absorbs rather than emits energy.

In a study of conceptual understandings of research performance, I asked respondents to describe researchers exhibiting each of eight different positive characteristics. They were also asked to quantitatively rate the relative importance of those characteristics for undertaking high quality research, and for assessing research. I then used the dichotomized data derived from the qualitatively coded descriptors and weighted each code for each person by the relevant (individualized) quantitative rating, and summed the resulting scores, repeating the process for both doing and assessing research. I also played with factor analyses and other exploratory multivariate techniques using both weighted and raw (unweighted) data.

Just as cell fusion can potentially create a hybrid that is either sterile or disastrous, and nuclear fusion can fail if the nuclei to be fused are too heavy, so my attempt at fusion, on this occasion, took me nowhere fast. It involved a heavy amount of computation (even when this was automated as much as possible by using form letters to create syntax files), and the

results were no more enlightening than when I simply added raw, dichotomised scores! In fact, my attempt at concept development on this occasion ultimately only went somewhere when I set aside the statistical analyses and worked interpretively with the data (Bazeley, in press, Goertz, 2006). I am sure fusion of this kind could well be valuable in other studies, but there are no guarantees.

Fission

Fission, in contrast to fusion, generates energy through splitting atoms apart. While it may serve an integrative purpose *during* analysis, at the end point it is antithetical to integration. For example, the same data might be analyzed both qualitatively and quantitatively, but a further integrative technique is then needed to bring those analyses together.

Anells (2006) described a study in which she used two samples from the same population to construct a grounded theory and for phenomenological exploration of the experience being described. She described this process as fusion, when in fact each sample and analysis was quite separate—not even were the data being analyzed shared. This then is something that I consider better described as fission, with the study being an example of multiple rather than mixed methods.

Dimensions revealed by the metaphors

Processes described by the metaphors were observed to vary on a number of critical dimensions with relevance to integration. They differ with respect to:

- The purpose for integration.
- Their design—whether that is a priori or emergent.
- The timing of integration within the project.
- The integrity of each component part—whether each has meaning on its own or only when together.
- The approach to analysis—descriptive or analytic/theory building.
- The degree of integration, seen in the extent to which each contributing method retained recognizable individual identity, and the capacity to disaggregate them once integrated.
- The complexity of the integration, seen in the amount of change and exchange in and between data gathered by different methods as the process of integration progresses.

Conclusion—Principles for integration

These metaphors are not mutually exclusive, but they do illustrate that there are many different ways of integrating data. I have viewed metaphors that combine

- for completion
- for enhancement
- to create something new

- to point to a more significant whole

or that illustrate

- linkages or networks
- iterative exchange
- transformation.

None of these is simply about bringing results of separately researched study components together in a conclusion. When we are integrating data or analyses, we are bringing different elements or processes together in some way to reach a common goal or serve a common purpose. For a project to be mixed methods, as distinct from multimethod, there must be integration of component approaches during the analysis and analytic writing processes (i.e., as results are being formulated). Just having different sources of data does not necessarily imply mixing of methods, and simply drawing conclusions on the basis of more than one approach, also, does not mean that the methods have been mixed.

Thus:

- There are many kinds of mixes and ways of mixing.
- Integration might occur at any stage throughout a study.
- It needs to occur before conclusions are drawn—usually during analysis, or analytic writing of results. Usually and where possible, earlier is better.
- Integration should involve connection at the most basic unit of analysis possible. (i.e., link data at individual level if possible, not just groups;)
- More is better (in general).
- The ways in which each varied component is dependent upon or enriched by other(s) should be clearly evident.
- The sum must be greater than the parts, i.e., the product of the integration should be something that would not have been available without that integration.
- An integrated study should not be written up in separated components.
- The write-up of an integrated study should be organised around the issues dealt with in the research, rather than the methods used.

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