Article

How Useful is Thematic Analysis as an Elicitation Technique for Analyzing Video of Human Gait in Forensic Podiatry?

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Abstract: The aim of this study was to evaluate how useful thematic analysis is in the elicitation of observations of gait from a video recording. This was undertaken by providing a video recording of human gait to "novice" and "expert" podiatry students. The observations were explored using the qualitative tool of thematic analysis. The exploration of human gait using this technique gave a rich abundance of information and demonstrated that a basic level of experience or knowledge is required to provide a simple description of human gait. With more expertise came a richer description of observation of human gait by the "expert" group compared to basic observations by the "novice" group. Thematic analysis allows the use of language and the depth of the information to be evaluated when observing human gait from a video recording.

Introduction

Forensic gait analysis was first used in the United Kingdom in 2000 when Haydn Kelly, a British podiatrist, provided expert testimony at the Central Criminal Court in London. He provided evidence regarding the defendant's gait, which ultimately led to conviction [1]. Since then, publications and author experience have indicated that this approach has been used successfully in court cases across the United Kingdom, Canada, Denmark, and

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Sweden [2, 3]. Gait analysis has been identified as a potentially valuable tool, when more traditional means of identification (e.g., DNA and fingerprints) are not available [4]. The analysis of gait is noninvasive and does not require the subject to be present for comparisons to be made. Gait can be influenced by external (e.g., clothing, backpacks, carrying objects) and internal (e.g., mood) features [5], although the latter is difficult or even impossible for a forensic gait analyst to determine.

For an analysis of gait to take place, closed circuit television (CCTV) recorded evidence, and a further recording, made either overtly or covertly, are required. The characteristics from those recordings can be used to either confirm or exclude potential identification [2]. However, it has been suggested that, ideally, the subject should be recorded covertly to prevent him or her from altering his or her gait pattern [6]. The role of a forensic gait analyst is to compare the two sets of recordings, looking for both compatible and incompatible features of gait [7, 8]. A significant amount of research has been undertaken in relation to the development of forensic gait analysis [7, 8]. However, there appears to be limited research regarding the clinical experience of the professional who examines the evidence. In a recent court case in the United Kingdom, the defendant was found not guilty, in part because the witness who gave evidence relating to the gait analysis was unable to justify his findings upon cross examination [9]. Although this was not the only reason the case failed, it does highlight the need for experts to have the necessary understanding to support their opinions when called to provide an expert witness statement. It is also essential that experts understand the requirements of their role and present the evidence pertaining to the facts within the confines of their qualifications and skills. In the context of recognizing people by how they walk, an initial study was undertaken by Johansson [10]. This showed that participants were able to identify the type of movement being made from motion patterns, which were generated by light bulbs attached to joints. Cutting and Kozlowski [11] completed the following study: Retro-reflective tape was strapped around the joints of the participants. Bright lighting and dark contrasted background enabled the reflective tape to be visible as a point-light configuration (an array of reflective strips that show the movement of specific aspects of the human body). The participants were able to recognize both themselves and also their friends. Research in this area has continued to expand beyond recognizing people who are personally known, to persons who are not known, and whether they can be identified only by how they walk, without

the aid of facial features. Stevenage et al. [12] considered the learning process of recollection of previously unknown people's gaits. They found in two experiments that (1) we are able to learn other people's gait signatures, and (2) participants were able to identify a target walker out of six other possibilities in with-greater-than-chance accuracy. Databases are being researched for their use in gait recognition [8, 13–15]. From these databases, several different iterations for recognition of gait have been proposed using a variety of methodologies such as quantitative, qualitative, model based, and model-free based. Podiatrists tend to use an approach that is based on experience, clinical judgement, and a nonnumerical evaluation. The main method podiatrists use is to subjectively evaluate a person as he or she walks and moves. An assessment tool has been developed to help the establishment of standards for forensic gait analysis [16].

The development of validated assessment tools would contribute to meeting current standards required in forensic practice.

The forensic science regulator for the United Kingdom has produced codes of practice and conduct for forensic science providers and practitioners in the criminal justice system [17]. In this document, the forensic science regulator makes it clear that whether involving measurement or interpretive approaches, all methods employed in forensic practice should be validated. For interpretive approaches, the requirement for focusing on the competence requirements of staff involved in this work is made explicit, particularly "how the staff shall demonstrate that they can provide consistent, reproducible, valid and reliable results that are compatible with the results of other competent staff".

In the United States, a highly influential report has been produced that was critical of forensic practice in that country [18]. This report stated the need to validate the basic techniques and principles of work in forensic science, with recommendations covering the need for studies to "establish the limits of reliability and accuracy" in forensic practice.

Also in the United States, the Daubert test is utilized in relation to expert evidence being presented [19]. This test is a standard set by the courts in the United States to determine the validity of expert testimony. There are four standards that should be met: (1) the proposed technique or theory has been tested, (2) the technique has been peer reviewed, (3) the known or potential error rate has been established, and (4) the technique has been accepted within the scientific community to which it relates [19]. Although this test is for the United States

justice system, it has previously been proposed that a similar standard be used in the United Kingdom [20]. Again, this came about through concerns of the reliability of evidence. In the forensic podiatry discipline, the International Association for Identification has made it clear that reference should be made to previous literature, relevant databases, and clinical information when making comparisons [21]. Another stated requirement of the United Kingdom forensic science regulator is that when a report is compiled for an analysis of gait, it should be reviewed by a peer to ascertain the reliability of the expert opinion [17]. In other words, verification of the report. The need for such verification is also stated by other authorities [22–24].

Along with additional recommendations made, these requirements provide a sound basis by which forensic gait analysis can not only progress but can also be demonstrated to be a valuable tool to use in forensic science [20].

Forensic gait analysis is still in its relative infancy as a forensic science. There is limited research on what skill level is required to analyze gait for the purpose of contributing toward criminal proceedings. The International Association for Identification has stated that expertise in forensic podiatry can be obtained through a variety of routes ranging from a master's degree program to relevant continuing professional development [21]. This could create a wide variance in practitioner skill and knowledge level. There is no doubt that gait analysis has an important and successful role to play in forensic biometrics. However, the level of experience and skill base that the analyst needs appears to be under-researched.

Boyatzis states that thematic analysis is a method that is frequently used in the analysis of qualitative data. He notes that its focus is to identify patterns in a dataset. From these patterns, categories are produced, and, subsequently, themes emerge from the data [25]. Holloway and Todres identify "thematizing meanings" as one of a few shared generic skills across qualitative analysis. They state that researchers appraise their data, create notes, and begin to sort it into categories [26]. Boyatzis notes that thematic analysis minimally organizes and describes a data set, often in very rich detail. It can be explained as identifying any patterns that are made through observation [25]. In practice, thematic analysis is essentially a means of taking a rich abundance of data, finding patterns (themes) within that data, categorizing these themes, and ultimately using these to suggest a theoretical model, which by definition, is grounded in the raw data from which the themes were derived. Furthermore, Boyatiz

feels that what creates a theme may vary between qualitative researchers, but it captures something essential about the data in relation to the research question. A theme would be something seen by the researcher as having direct relevance or importance to the researcher or those who have participated in the project. He states that there is no one answer to the question, What proportion of one's data set needs to display evidence of the theme for it to be considered a theme? [25]

In the context of forensic gait analysis, thematic analysis is a flexible approach that allows the researcher to consider the data from different analytical perspectives according to the research question being considered. Although such flexibility can be useful in managing an abundance of data, it can also be problematic in that there is no set direction to follow.

An approach to thematic analysis has been presented by Braun and Clarke [27]. Their model involves six named phases:

(1) Familiarization with the data: This phase involves reading and understanding the data. This should make the researcher familiar with the material he or she is going to analyze.

(2) Coding: This phase encompasses generating concise labels (codes) that identify important features of the data. These codes should be relevant to answering the research question. The whole data set will need to be coded and all the codes will be collated for analysis at a later stage.

(3) Searching for themes: During this phase, the codes are examined to identify patterns and potential themes. Data are collated that are relevant to each theme. From this, a researcher can review the viability of each theme.

(4) Reviewing themes: This phase involves checking the themes against the dataset to determine that the themes tell a plausible story about the data. It is important that this answers the research question. Themes are usually developed by splitting, combining, or discarding them.

(5) Defining and naming themes: This phase encompasses developing a detailed analysis of each theme–working out the scope and focus of each theme. From this, a "story" of themes is created. It also involves deciding on an enlightening name for each theme.

(6) Writing up: This phase involves entwining the analytic narrative and the data, thus contextualizing the analysis in relation to existing literature.

Braun and Clarke [27] state that these phases are sequential, with each stage building on the previous one. They feel that the analysis is a recursive process, with movement back and forth between the different phases.

Research Question

How useful is thematic analysis as an elicitation technique for analyzing video of human gait in forensic podiatry?

Method

Participants were fully informed of the study by one of the authors and each participant gave his or her consent to participate in the study.[1] Two groups (30 podiatry students in each group) participated in the study. Both groups were registered in an undergraduate podiatry degree program in the United Kingdom. The first group consisted of first-year podiatry students who had not been previously introduced to human gait during the course (the "novice" condition). The second group consisted of third-year podiatry students who had had three years of instruction on this topic (the "expert" condition). There is no one definition of expertise, but from his work on chess, De Groot [28] suggests that experts can do things that the rest of us are not able to do. Experts are not necessarily more intelligent than nonexperts, but experts retain huge numbers of facts about their expertise. The third-year students in this study were not experts in the strict sense of the definition, but they had undertaken a longer period of formal instruction about human gait, whereas the novices had not. Therefore, the third-year students demonstrated the relative expertise required in this project.

A volunteer, who was unknown to the participants of the study, agreed to be filmed by one of the authors to provide a video clip of his gait. Filming was completed on a home video camcorder (Samsung HMX-F90). The clip was filmed in the frontal plane. The video clip was shown to both "experts" and "novices" groups on separate occasions. Within each group, the participants viewed the video all at the same time, but it was not on a continual loop. They were not allowed to view the video clip more than once. The participants were allowed unlimited

[1] Ethics approval was obtained for this study by the University of Northampton School of Health Ethics Committee.

time for response but were not allowed to discuss the findings with anyone else in the group during the session. The "novice" and "expert" podiatry students were interviewed separately on different occasions. A blank sheet of paper was provided for them to record observations of gait.

To generate categories for the observations of gait, a thematic analysis was undertaken by one of the authors using the six-stage process previously described by Braun and Clarke [27]. This involved one of the authors gaining familiarity with the data through reading the expert and novice transcripts. This generated codes (e.g., labels for heads, shoulders, arms, hips, knees, and feet). Broader patterns were then attached to the codes (e.g., position or movement of the body) and further themes were added (e.g., straight or bow legged). These themes were reviewed in conjunction with another one of the authors to determine whether they explained the data and answered the research question. The findings are presented as diagrams (Figures 1–6). The findings are presented separately for "novice "and "expert" groups.

Results and Discussion

This study revealed that the technique of thematic analysis provided a rich amount of information about human gait and demonstrated differences in expertise between the "novice" and the "expert" group. Novices tended to use layman's language, which is descriptive in nature. For example, when describing the position of the feet, novices stated that feet "point outward", whereas experts described feet as "abducted". Both experts and novices had the ability to observe the same traits of gait, but experts provided much more in-depth information. These findings appear to concur with findings of Birch et al. [5] in that those with greater experience are able to provide more detailed information. DiMaggio and Vernon [1] discuss that forensic podiatrists should work within their own level of confidence and competence. However, findings from this thematic analysis did denote a variation of terminology used by experts, and this could lead to potential confusion of the feature of gait being described. DiMaggio and Vernon [1] have also discussed the forensic podiatrist not extending his or her opinion beyond that with which any other forensic podiatrist would agree. Some comments in this study's results could appear to contradict this, with observations such as "femoral torsion" being made. It could be argued that this would be difficult to see if the person being viewed is dressed in casual loose clothing. There was also a

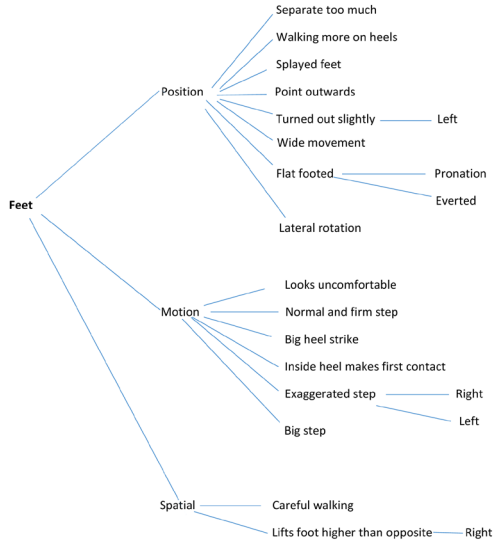

Figure 1

Novice differences for feet.

Figure 2

Expert differences for feet.

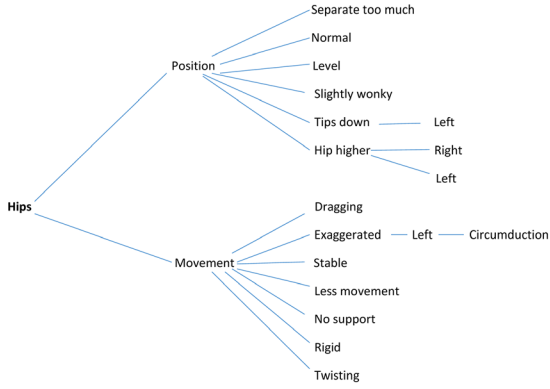

Figure 3
Novice differences for hips.

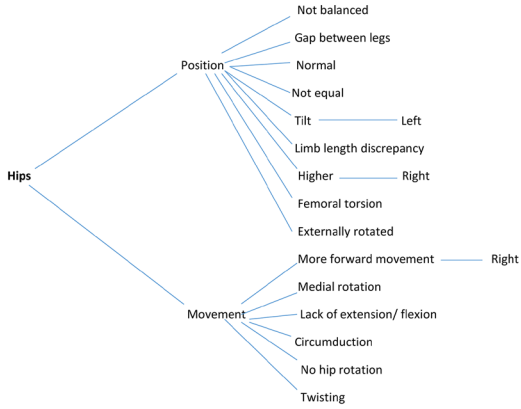

Figure 4
Expert differences for hips.

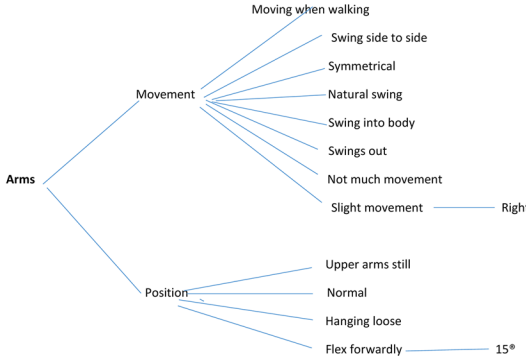

Figure 5
Novice differences for arms.

Figure 6
Expert differences for arms.

difference in both the amount of information and the terminology used when describing upper limb movements as opposed to lower limb movements. Regarding the upper limb, there was no use of terminology for either novices or experts in descriptions of the head, shoulders, or arms, although one novice specified that the arms were flexing forward by 15 degrees. It has been acknowledged that for a complete analysis of gait to be made, the entire body should be observed. According to Birch et al. [8], when analysts considered both upper and lower limb movements, there was a greater percentage of identification made. This study does appear to correlate with other work by Birch et al. [7] that when movements from the entire body are taken into account, a fuller picture of overall gait emerges. It has also been shown by Birch et al. [5] that the more experienced analysts are more able to make a correct identification. This suggests that analysts with greater experience and training would observe the entire body in order to give their opinion, as opposed to the inexperienced analyst, who may make observations on the lower limb only.

However, novice observations were considered in relation to a witness providing information about a perpetrator's gait, as was the aim of Stevenage [12]. It would appear that a relatively comprehensive description would be feasible when using novice observers. Stevenage [12] identified a 50% success rate for nonexperienced volunteers in picking out the suspect walker from an identification parade, being viewed from the sagittal plane. Our study did not allow for identifiable traits to be commented on; it is therefore difficult to directly correlate the results of this study to that of Stevenage [12].

This brings into question whether all cases of forensic gait analyses require experienced analysts who have undertaken additional training, as proposed by Vernon et al. [21], to be able to observe traits that the inexperienced eye would be unable to view. However, low observation rates could also be compared with the earlier studies completed by Cutting and Kozlowski [11] and Stevenage [12]; the rates of recognition for inexperienced observers ranged between 19.4% and 30% correct for Cutting and Kozlowski [11] and 50% correct for Stevenage [12]. In this study, more observations were made on the lower body, indicating that there was an increased confidence about making observations of the lower limbs as opposed to the upper body. Perhaps this is not surprising because podiatrists tend to have specific expertise in relation to the lower limbs and their functions. This could also be related to findings made by Cutting and Kozlowski [11], where correct responses increased as the experiment continued, which was possibly related to the participants' learning the targets' walks or to increased confidence about what the participants were observing.

Conclusion

Thematic analysis allows the expertise of podiatric students to be evaluated in performing gait analysis from a video clip by looking at their use of language and depth of knowledge. The exploration of human gait using this technique provided a rich abundance of information and demonstrated that a basic experience or knowledge is required to provide a simple description of human gait. However, with more sophisticated experience and knowledge on the part of "experts" came a greater depth and breadth of observations of human gait.

Although it was a useful study and elicited differences between "novice" and "expert" groups, it was accomplished using podiatry students. It would be useful to repeat this study with expert podiatrists or forensic gait analysts.

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