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Cognitive bias in forensic anthropology: Visual assessment of skeletal remains is susceptible to confirmation bias

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ABSTRACT

An experimental study was designed to examine cognitive biases within forensic anthropological non-metric methods in assessing sex, ancestry and age at death. To investigate examiner interpretation, forty-one non-novice participants were semi randomly divided into three groups. Prior to conducting the assessment of the skeletal remains, two of the groups were given different extraneous contextual information regarding the sex, ancestry and age at death of the individual. The third group acted as a control group with no extraneous contextual information. The experiment was designed to investigate if the interpretation and conclusions of the skeletal remains would differ amongst participants within the three groups, and to assess whether the examiners would confirm or disagree with the given extraneous context when establishing a biological profile. The results revealed a significant biasing effect within the three groups, demonstrating a strong confirmation bias in the assessment of sex, ancestry and age at death. In assessment of sex, 31% of the participants in the control group concluded that the skeleton remains were male. In contrast, in the group that received contextual information that the remains were male, 72% concluded that the remains were male, and in the participant group where the context was that the remains were of a female, 0% of the participants concluded that the remains were male. Comparable results showing bias were found in assessing ancestry and age at death. These data demonstrate that cognitive bias can impact forensic anthropological non-metric methods on skeletal remains and affects the interpretation and conclusions of the forensic scientists. This empirical study is a step in establishing an evidence base approach for dealing with cognitive issues in forensic anthropological assessments, so as to enhance this valuable forensic science discipline.

1. Introduction

The complexity of data analysis and interpretation in forensic cases has been emphasised as one of the main issues in forensic science [1]. Concerns about the admissibility of evidence and expert witnesses have been raised extensively in regard to validation and error rates in techniques used by forensic scientists [2]. The National Academy of Science in the US and the Forensic Regulator in the UK have highlighted the review of standards and process within disciplines undertaking forensic science and underlined the potential for subjective interpretations and bias [3].

1.1. Cognitive bias

The issues of cognitive bias and its potential effects in forensic science and investigations have been increasingly discussed and described with empirical research demonstrating the effect of cognitive bias in decision-making within numerous forensic fields [4–9]. Research has shown that decision-making can be influenced by cognitive processes and cause forensic experts to modify their judgements [10,11]. The body of literature within forensic science and biasability has over the years recognised different sources and precipitators of cognitive influences, and confirmation bias in particular, that include time pressure [12], expectations [13], pre-existing beliefs [14] and motivation [15] which have been demonstrated to affect the final evaluations of forensic experts [16].

Studies within the fingerprint domain and DNA have demonstrated that experts were more likely to be biased when they were subjected to different types of extraneous contextual information [7,9]. In many cases, experts reached different conclusions on previous decisions when provided with extraneous contextual information [10]. It is clear that bias may impact data collection, analysis, interpretation and conclusions. It is therefore imperative that each forensic discipline examines the potential effects and presence of bias, and take measures to minimise them (appropriate measures, when needed, and that they are proportionate, see [17]), including the field of forensic anthropology.

1.2. Forensic anthropology

Forensic anthropology is a branch of applied physical anthropology that includes a spectrum of methods and skills modified from a multitude

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of disciplines [18]. In the legal context, forensic anthropology applies its methods to questions of medico-legal concerns [19]. Forensic anthropologists are trained to provide a biological profile (osteobiography) by using methods that enable them to provide information about an individual's sex, age, ancestry and stature [20], in addition to assisting in identification and the cause of death.

Recently there has been increased attention and interest in critically assessing some of the techniques used by forensic anthropologists. For example, in the US, the Daubert standard (1993) increased the drive to re-evaluate the methods applied [21,22]. Issues such as validation, biasability and error rates have been highlighted and assessed with recent research and re-evaluation of the methods used in the discipline [23,24].

However, there is still a lack of empirical studies in forensic anthropology examining cognitive influences that might arise and affect the judgement and final evaluation of the forensic anthropologist, especially when applying visual methodologies when assessing a biological profile on skeletal remains. The non-metric method relies on human examiners making a variety of subjective judgments, which could potentially result in experts being susceptible to bias. In a pilot web-based study, Nakhaeizadeh et al. [25] used pictures of skeletons to examine if participants were susceptible to cognitive biases in trauma analysis. This study examined the existence of bias using real skeletal remains, whereby physical anthropologists had to determine sex, ancestry, and age at death. The results indicated that bias played a role in such analysis.

2. Methodology

2.1. Research design

Based on previous research conducted by Dror and Charlton [7] on biasability in the fingerprint domain and the previous pilot study by Nakhaeizadeh et al. [25] on cognitive bias in trauma assessment, an experimental study was designed and developed to examine cognitive biases within forensic anthropological non-metric methods in assessments of sex, ancestry and age at death. To examine the biasability of forensic interpretation, participants within the field of physical anthropology were asked to establish a full biological profile of a skeleton. Participants were semi randomly divided into three groups where two of the groups were given extraneous contextual information before conducting the analysis. The third group was a control group that received no contextual information prior to the analysis. The experiment was designed to investigate whether the examiners would be affected by the extraneous context, when establishing the biological profile.

2.2. Materials

One adult skeleton was selected from the skeletal collections curated by the Centre for Human Bioarchaeology (CHB) at the Museum of London. The skeletal remains used for this research were excavated from St Bride's Lower Churchyard in 1990 by the Museum of London Archaeology Service (MoLAS)—(site code: FAO90, context number: 1474) and were analysed and recorded on to the Wellcome Osteological Research Database (WORD). The remains and cemetery were dated to the Post Medieval period with a date range for the part of the cemetery excavated to 1770–1849. The selection of this individual was made through the search of the online data from the WORD data accessed through the CHB website. The record for the selected individual states that the remains were a probable female, with an age range of 36–45 years, there was no gross observable pathology and bone preservation was very good. Ancestry was not recorded, the methods and applications to ascertain ancestry are not a recorded feature of the WORD database, but if morphological features are observed for an individual they will be recorded. This probable female did not exhibit any marked or pronounced features to suggest that they were anything other than Caucasian.

The skeletal remains were of a full body, and included a complete skull, and mandible, with the majority of postcranial elements presented in a good condition. This made it possible to conduct a visual biological profile on sex, ancestry and age at death determination (see Fig. 1). The skeletal remains also had some ambiguous features, where the morphological traits of the skull and pelvis showed no clear signs of female or male characteristics. This was of particular significance in this study because cognitive biases are more prevalent in ambiguous cases.

2.3. The contextual information

The extraneous contextual information provided to two of the participant groups before conducting their analysis, included elements such as DNA results indicating gender specific information, origin of the skeleton and age at death estimation. To examine if the contextual information had an effect on the judgement of the participants and their final evaluation of the remains, the contextual information provided to the two groups of participants contradicted each other in terms of sex assessment, ancestry and age at death (see Table 1). This made it possible to compare the different groups and determine whether there was a significant difference in the evaluation of the skeletal remains as a function of the contextual information they were exposed to. The third group was a control and was provided with no contextual information regarding sex, ancestry and age at death.

The contextual information also stated that the research was a collaboration between University College London, Museum of London and Law enforcement agencies. This was important so as to make it as authentic as possible for the participants, as it has been shown that if participants do not believe the contextual information provided it is not possible to assess whether there are any biasing effects in the decision-making [11]. The contextual information was audio recorded and played for each participant so as to make things as consistent as possible within each experimental condition.

2.4. Participants

All forty-one participants had experience and qualification in the field of physical anthropology, forensic pathology or osteology. Participants were not informed that the study was being undertaken to assess bias, as doing so would have impacted upon their performance. Participants were instead told that the study was to conduct a biological profile on skeletal remains from one complete individual by applying non-metric methods to analyse self-assessments and confidence level in using some of the most common techniques applied in forensic anthropology. This provided no further risk to participants, and followed standard ethical considerations and approval for incomplete disclosure of research objectives. All participants provided informed consent, and were anonymised following standard data protection protocols. Participants conducted the study over a three-month period at the Museum of London's Clore Learning Centre (CLC) provided by the Centre of Higher Education programme. Each participant was semi-randomly divided into one of the groups in order to ensure that each group had equally divided participants within each level of education, gender and professional background.

2.5. Procedure

The skeletal remains were laid out in anatomical order. Participants conducted the analysis alone with no one else present. The experiment took about 30 min to complete. However, to avoid time pressure, each participant was given up to 1 h to conduct their analysis.

After listening to the audio-recorded information, participants filled in a questionnaire about their own gender, level of education, professional bodies and general confidence level in assessing non-metric methods on skeletal remains. Participants were given access to visual methodology aid sheets for sex, ancestry and age at death estimations, a list combined from the methods used by the Museum of London including the majority of all non-metric assessments available for each stage.

Participants were asked to follow the biological profile form by following the order given, starting with assessing the sex of the individual,

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