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TITLE: Attitudes towards police use of consumer DNA databases in Police investigations

Abstract

Consumer DNA products, such as databases that allow the public to explore familial relationships, have recently been used by police to assist in investigations. This has moved the collection of DNA used in criminal investigations away from the limitations of criminal databases and has opened up ethical concerns regarding privacy and consent. This study explored public attitudes and support towards police use of consumer DNA databases in investigations to assess whether different crime types or moral and attitude alignments influenced the level of public support of police using these consumer products. An international survey of 438 adults, using theory and scales pertaining specifically to retributive punishment and attitudes towards law, courts and police, found that moral alignment and attitudes did influence the level of public acceptability towards police usage of these techniques and that support did vary based on crime type. This research found that higher levels of public support was given for the most serious case types explored (sexual assault and homicide). Participant support for police access to private DNA databases by case type was as follows; 83.5% for sexual assault, 83.2% for homicide, 85.2% for identifying unidentified human remains, 62.8% for robbery and 58.9% for illicit drug related cases. Small to medium effects sizes were observed for these results. Although these findings provided context towards public attitudes, further research specific to international attitude differences and variance between serious crime types and public acceptability could further develop these findings.

Keywords: Police investigations, retributive-punishment, police access to private-consumer DNA.

Attitudes towards police use of consumer/private DNA databases in investigations.

1. Introduction

DNA analysis has moved beyond that of traditional research and police investigative work into mainstream populations [1][2][3]. Where once DNA analysis was only utilised by specialised organisations, private companies now allow consumers access to tools to research their family history through the analysis of shared DNA [1][2][3]. However, as consumer DNA products have been developed for personal use, these privately owned consumer databases have also been identified and used as new investigative tools for the police, creating issues of informed consent and privacy [4][5][6]. This advancement of technology has been rapid and changed the amount of data that is accessible for forensic comparison in a manner that has not been well understood by the public [4][5][6]. The debate around DNA ownership and consent has been brought into the public sphere following the use of consumer DNA databases for high profile cases [4][5][6]. Although the consumer DNA database potentially allows the police to search, indirectly through shared DNA segments, against a wider pool of genetic data than that of traditional criminal databases [2][7] the legality and policy implications of this highlight the challenges with consumer products being used for investigative means. To safeguard forensic access to consumer DNA databases, attitudes of the public need to be accounted for in the construction of new structured forensic frameworks and the balance between civil liberties, privacy and security specifically considered within a forensic setting. Despite the investigative benefits that consumer DNA databases offer, understanding public acceptability is important for the success of policy decisions, especially within democratic countries [8].

Current data suggests over 30 million profiles have been uploaded and catalogued internationally on these consumer platforms [2][9] with the aim to research family history, predict biogeographical ancestry, and provide an indication of genetically inherited health conditions [1][2][3]. Unknown to many consumers, there are few legal protections for their

DNA once uploaded [10]. This has resulted in ethical, political, and academic questions over whether the current legal frameworks and policies concerning these databases are appropriate for their potential use beyond what was originally intended [10].

Specifically, the frameworks and policies associated with different jurisdictional investigative laws, consumer privacy and informed consent are particularly relevant and need to be assessed thoroughly before effective policy regarding the products' usage can be designed. The key issues that challenge effective policy design centre around complexities of DNA ownership, given its familial linkage [3], and public understandings/opinions on when, or if, DNA uploaded to consumer products should be accessible to law enforcement.

Retributive punishment and justice theory (presented below) has a valuable place in the discussion over the acceptability of police to use DNA in investigations, specifically in highlighting the public's expectations of how consumer DNA is to be used within criminal investigations. Although the literature mainly agrees that there is value in apprehending and punishing those involved in criminal activity [11][12] attitudes towards how police use DNA to apprehend those individuals was impacted by crime type [11][12] and knowledge of how DNA is collected and used [1][13][14]. Due to this, the public push for retributive punishment and justice can have consequences over the frequency, accuracy, and value that DNA can have in investigations and as such needs to be evaluated in considering public attitudes towards how the police use DNA in investigations.

1.1 Retributive punishment and justice theory

In retributive punishment and justice theory it is proposed that all crime has a moral obligation to be punished in proportional intentional severity of the crime itself [15]. Under this theory there is a belief that this form of retribution is necessary to promote justice and lower recidivism rates [16]. It is suggested that retributive theory may hold a strong empirical relationship between people's attitudes and their moral alignment regarding punishment and law. Specifically, to this study, using theory of retributive punishment will provide the

framework to explore the relationship between public punishment sentiments and the acceptability of police to have access to consumer DNA databases to investigate crime. This is an important aspect to formalising forensic access to consumer DNA databases, particularly in the design of new structured forensic frameworks and balancing the need for forensic investigations at the expense of individual privacy.

Key studies conducted into beliefs about crime and punishment alignment [17][18] found that those who believe that people commit crime out of a conscious choice were more likely to align with punishment orientations such as retribution. Further, Weiner's [19] 'life as a courtroom' theory connected the attributional theory of motivation towards punishment. In this, punishment alignment could be predicted based on several motivating factors such as emotional input, causation belief and whether punishment would balance the social scales of the crime committed [19][20].

Studies from Maryland in the United States (US) and New Zealand have shown that police use of DNA in investigation has strong public support [11][12]. This support is influenced by the severity of the crime committed and has even demonstrated a relationship with support for capital punishment [11][12]. This is particularly interesting for, despite some socio-political similarities, the two nations have fundamental differences in their approaches to law and punishment [21]. However, concerns over privacy were raised by over half of the 100 randomly selected New Zealanders who stated that they were concerned about privacy if asked by police to give a DNA sample [12]. In contrast to these two studies, a 2020 Pew Research Center study of 9,895 randomly selected US adults found 48% of the sample supported police use of consumer DNA databases consistently across all age brackets [22]. This contrasts with the strong public support from the earlier studies and may reflect changes in trust that US citizens have with law, courts, and police services.

The debate around access to consumer DNA databases extends into the forensic field. The Biometrics and Forensics Ethics Group, based in the United Kingdom (UK), expressed

concern that the forensic process used by US law enforcement to capture the Golden State Killer in 2018 may have been unethical [23]. US law enforcement uploaded crime scene DNA into a consumer DNA database and triangulated the DNA relative match results to narrow the suspect pool [23]. The Biometrics and Forensics Ethics Group has argued that not only did this violate the consumer DNA database's terms it may also have been unnecessary, as the Golden State Killer had a brother who was a convicted felon and potentially should have been on The Combined DNA Index System database (CODIS). This could have permitted close familial matching capabilities to be used, without the need to access consumer databases.

The Biometrics and Forensics Ethics Group further argues that the UK has one of the most efficient DNA databases in the world and that using primarily US based datasets would not add any real value to forensic investigations [23]. Examining other professional opinions of qualitative interviews of 14 criminal justice professionals and policymakers in the UK in 2006 saw some concern over 'no conviction, no retention' on the National DNA Database (NDNAD) expansion program [24][25]. However, this push for police and policy makers to pursue convictions is thought to be at the expense of thorough investigative work [7]. This indicates that there may be international differences in the need to access the larger DNA datasets within consumer DNA products. The fact that consumer DNA databases extend beyond national borders calls for an international approach to the development of policy surrounding consumer DNA database access within forensic settings [26].

What this means for the future of the forensic sciences requires more exploration [6][4]. Although the benefits of access to a larger pool of familial DNA have been well documented, the potential for civil liberty violations that may occur through forensic access to consumer DNA databases requires ongoing careful consideration and oversight. Should consumer DNA databases be used more frequently in investigations or used in a way the public find disagreeable, the longevity of availability of these consumer products for forensic purposes may be negatively impacted.

1.2 Aims and Hypotheses of the Current Study

As the use of consumer DNA databases is a recent investigative tool, less research exists into its ethical, political, and civil implications [6][4]. Although the debate about police using familial DNA, or DNA in general, has been developing, steady technological advancement has meant that such research is required for effective criminal justice policy to be designed and implemented [6][27][28]. This study addresses this gap and contributes to sound policy decisions. This study explores public attitudes towards the use of consumer DNA in police investigations and how moral frameworks can influence the level of public acceptability. Using the psychological moral framework of retributive punishment and justice theory it was expected that, regardless of different cultures, the alignment of individuals towards this moral framework theory would predict their position in the debate. This study utilised a quantitative approach through the administration of a questionnaire based on existing and newly developed scales. As the use of consumer DNA databases is a new component in the debate of police use of DNA, new questions had to be developed to measure the specific topic being investigated.

1.2.1 *Aim one: overall attitudes and crime types*

With the limited research available a baseline of attitudes towards the acceptability of police use of consumer DNA databases in investigations, based on crime type, was necessary before any further analysis could take place.

Hypothesis one predicted that: in-line with Dundes' [11] and Curtis' [12] research, *there would be higher public acceptability for police usage of these databases for serious violent crime types, such as homicide and sexual assault*.

1.2.2 *Aim two: the relationship between moral alignment and personal attitudes*

In-line with existing literature on retributive punishment and justice theory, there was an expected relationship between individuals' moral alignment positions and their attitudes towards police use of consumer DNA databases in investigations.

Hypothesis two predicted that: *people high in retributive punishment and justice moral alignment and those who scored highly in positive attitudes towards law, courts and police would be high in measures of support and acceptability to the police use of consumer DNA databases.*

1.2.3 *Aim three: defining group distinctions*

It was expected that this research would establish group differences in attitudes towards the police use of consumer DNA databases within investigations based on demographic factors or moral alignment groupings. The exploratory nature of this aim has meant that no formal hypothesis could be defined, however, it was expected that any differences in group attitudes would impact the degree of acceptability based on differing crime types. This research asked whether such group correlations could be made and if they determined the acceptability levels based on crime type once moral scales had been controlled.

2 Material and methods

2.1 Study Participants and Recruitment Method

The participants were 438 adults over aged 18: 103 men (24%), 250 women (57%) and 85 people (19%) did not report gender. Most of the sample, 405 adults (93%) were members of the public, with 33 being university undergraduate students (7%). The undergraduate student sample were offered a small (5% mark) course credit for participation, whereas the public sample did not receive any incentives or rewards. Demographic data for the study participants was collected and is reported below in section 3.1.

Ethics approval was granted by the Human Research Ethics Committee of the University of Canberra (number HREC 45-49). Consent was obtained through completion of a consent form and participation was voluntary and anonymous. Participants were also able to voluntarily provide an email or postal address to receive a summary of the findings.

The public sample was recruited via social media (e.g., Facebook), online groups supporting research, and resulting from a local radio interview with the first author where a

link to the survey was mentioned. The undergraduate sample were recruited through an advertisement given in a course offering at the University of Canberra, a mid-size Australian university.

2.2 Two-part Survey Questionnaire

Participants completed a two-part questionnaire. Part 1 asked demographic questions of gender, age, employment status, political preference, nationality, and country of residence. Part 2 presented three questionnaires. Two were previously validated questionnaires measuring attitudes to law, courts and police (refer section *2.2.1)*, the other measured attitudes towards retributive punishment to achieve justice (refer section *2.2.3)*. A third questionnaire comprised a set of five crime scenarios developed specifically for this study to measure the publics attitudes towards the police using consumer DNA databases to further their investigations (refer section *2.2.2)*.

The survey was presented in two formats: an online format using Qualtrics software (2016), and a very small subset of paper and pencil questionnaires. The paper and pencil version was a print-out of the online questionnaire, enabling participants without access to a computer to participate (of note, no differences were observed in the data with the average scores being similar and not significantly different between the online/offline collection method).

2.2.1 Measure of Attitudes Towards the Law, Courts, Police

Attitudes Towards the Law, Courts, Police (*LCP)* is a 25-item subscale from the Criminal Sentiments Scale [29] and measures attitudes to the operation of law, the role of police and court decisions. Analysis of this measure showed high internal reliability with all items measuring a single construct. This is evidenced through the statistical measure of Cronbach's alpha, where an alpha above >.07 is a very accurate measure of attitudes; the measure has a reported alpha of .90 [30]. Attitudes are measured on a five-point Likert score range, with participants asked to rate how strongly they agreed or disagreed with a set of

short statements on the function of the law and courts and the role of police. Questions are positively and negatively worded and included statements such as 'It is our duty to obey all laws' and 'You can't get justice in court'.

2.2.2 Crime Type Scenarios and Police use of Consumer DNA Attitudes

Five crime scenarios were specifically written for this study describing police investigations for differing crime types. Three scenarios were within current terms and conditions for consumer DNA databases presently available (as 21st January 2022) to law enforcement, being sexual assault, homicide, and identification of unidentified remains (crime type 1)[1]. Two further scenarios are outside of current conditions of use, being illicit drug use and robbery (crime type 2). Examples of the crime type scenarios used in this research can be obtained by emailing the corresponding author. In each scenario, participants are asked the same three questions and asked to rate whether they agreed or disagreed with the police using privately owned consumer DNA databases for each crime. Approval was measured on a five-point Likert scale. To ensure all participants had the same knowledge, prior to completing the crime type scenarios, information was provided on what a consumer DNA database is and how the police use them during investigations.

2.2.3 Retributive Punishment and Justice scale

For this study we used the 13-item Retributive Punishment and Justice scale (RPJ) subscale from Yamamoto's Punishment Scale [31]. A high Cronbach's alpha of .89 was reported indicating a very high accurate measure of RPJ attitudes [31]. Participants are asked to rate how highly they agreed or disagreed with statements relating to the morality of state punishment and to achieve retribution and justice for crime. RPJ uses a five-point Likert scale and asks questions such as 'Criminals are in prison because they deserve to be there' and 'Crimes that receive a great deal of publicity should be punished severely, even if the crime

[1] For example, as outlined in the GEDmatch, Terms of Service and Privacy Policy (refer https://www.gedmatch.com/terms-of-service-privacy-policy) and FamilyTreeDNA, Law Enforcement Matching – Frequently Asked Questions (refer https://learn.familytreedna.com/ftdna/law-enforcement-faq/)

was not severe, so that society knows there is a strong response'.

2.3 Statistical Analysis

The quantitative analyses were carried out using IBM SPSS 26 (IBM Corp, 2019). To test Aim 1, we carried out a frequency report of proportions and response categories to determine the level of public support for police use of consumer DNA databases in investigations. This was followed by a Friedman Test and Wilcoxon signed-ranks post-hoc analysis, to assess whether public support differed between the five crime types (illicit drug use, robbery, sexual assault, homicide, and unidentified human remains). To assess Aim 2, we carried out a hierarchical multiple linear regression to explore whether more positive attitudes towards the law, courts and police (LCP), and lower retributive punishment attitudes (RPJ) predicted higher support for police usage of consumer DNA databases in investigations. Finally, in Aim 3, we used a Pearson's correlation matrix to assess the relationships between the demographic variables of age and gender, against that of the LCP and RPJ scales and crime types. In our analyses, results were considered significant when $p < .01$.

2.4 Limitations of the sampling method used in this research

A limitation to the sampling methods used could impact the generalisability of findings. First, the sample only had a small international subsample of 24 % spanning over 12 countries. While some countries had somewhat representative numbers, others had very low sample representations and thus the generalisability of micro nationality data is limited. Second, the sample had a strong bias towards females (57 %) and left leaning (37 %) participants. Although only 20% of the sample selected student as their primary employment status, a large number of participants reported a higher education level and therefore the results may reflect the views from educational attainment rather than that of all the general public. These factors are important as research has indicated that demographic subpopulations not only have influence over attitude and punishment orientations, but also

levels of user experience and understanding of DNA [1][13][14]. Limitations in sampling, especially gender imbalances, as noted above, are common in most survey research carried out [32]. Despite being common, the results presented below cannot be assumed to be able to apply to all nations, or to men and women equally, and our results are tentative and require replication to confirm any differences by gender, political orientation and country or nationality.

3. Results

3.1 Study Participant Demographics

The participants demographics for the sample are as follows. Age of participants ranged from 18 to 87 years (M = 37.2 years, SD = 15.5). The employment status of the sample was: 47% (n = 206) were employed full or part-time, 34% (n = 151) were a student or retired, with 19% (n = 81) not reporting their status. Multiple nationalities and current countries of residences were reported (please refer Table 1). Information about political orientation was collected; 163 participants (37%) usually vote for left leaning parties; 75 (17%) usually vote for right leaning parties; 20 (5%) said they were swing voters; 8 (2%) classified as other or independent voters; and 172 participants reported that they did not/had not voted in their country.

Insert Table 1 about here

3.2 Preliminary Data Screening

Prior to analysis the survey questionnaire was scored to form total scores. Descriptive statistics (means and standard deviations) and histograms were assessed and showed normal distributions for the crime type and RPJ data. However, for the LCP data, a slight positive skew in the histogram was observed. This was minor and was expected as this data is used to access attitudes towards the criminal justice system and in part to assess antisocial thinking [29, 33]. Due to the number of statistical tests to be performed, an alpha level of .01 was set

for the hypothesis testing to reduce the risk of Type I error (i.e., a false positive where a significant relationship is accepted where in reality the variables are not related) [34].

3.3 Aim One

This research aimed to gain a baseline level of public support for police use of consumer DNA databases in investigations and to also explore if there were any significant differences in acceptability between the crime types. A frequency report of proportions was conducted based on answers to the five crime type scenarios. Response categories were combined to output proportions based on whether the participant agreed, disagreed or neither agreed nor disagreed, with the three questions asked for each scenario. The results of this analysis found that support for police use of consumer DNA databases did increase with the more serious types of crime (83.5% sexual assault and 83.2% homicide) as well as for identifying previously unidentified remains (85.2%) compared to that of illicit drugs (58.9%) and robbery (62.8%). Additionally, the data showed consistent support for police only using consumer DNA databases with informed consent from the database users across all crime types (58.8% for illicit drugs, 57.4% for robbery, 52.5% for sexual assault, 51.9% homicide and 52.1% for unidentified human remains). The final question asked if, in each crime type did participants consider that access to consumer DNA databases should only occur if all other investigative and forensic methods had been exhausted. For each crime type there was an even divide between those that agreed or disagreed to the final question. Further detail can be seen in Table 2.

Insert Table 2 about here

A Friedman test was then used to assess aim one, where differences in public support for police use of consumer DNA databases between the five different crime types (illicit drug use, robbery, sexual assault, homicide and unidentified human remains) was assessed. The results showed a significant difference in support between the five types, $\chi 2(2) = 283.01$, p

< .001. The effect size was calculated using Kendall's W, which showed a small effect size using Cohen's conventions for the significant result (W = .228) [35]. Post hoc analyses were then carried out using pairwise Wilcoxon signed-rank tests to locate in which crime type the significant difference in acceptability lay following the recommendations of Hollander, Wolfe and Chicken [36]. A Bonferroni correction was applied to the Wilcoxon tests which adjusted the significance level set for each test at $p < 0.005$ [34]. The post hoc results found statistically significant differences by crime type groupings. The participants reported significantly higher acceptability for police using consumer DNA databases for the crime types in located in crime type 1 (sexual assault, homicide and identifying unidentified remains) than for crime type 2 (illicit drugs and burglary). The results also showed no significant differences between homicide, sexual assault and unidentified human remains in acceptability scores. Further, there were no significant difference between robbery and illicit drug crimes. A summary of the findings by crime type is shown in Tables 2 and 3 while a summary of mean comparisons can be found in Table 4.

Aim One was supported in that significant differences were observed in public acceptance of the police usage of consumer DNA databases based on the type of crime. These results showed that our participants were more supportive of police accessing consumer DNA databases to help investigate sexual assault, homicide and unidentified human remains cases, than they were to help investigate illicit drugs and robbery cases. As such, these findings aligned with the research findings of Dundes [11] and Curtis [12] who found greater support for crime types like sexual assault and homicide.

Insert Tables 3 and 4 about here

3.4 Aim Two

A hierarchical multiple linear regression was used to test the hypothesis in aim two. This is a statistical technique used to look at the relationships between a set of variables and

to see if these variables combined can predict an outcome. In aim two we explored whether people with more positive attitudes towards the law, courts and police (LCP), and lower retributive punishment attitudes (RPJ) could predict higher acceptability for police usage of consumer DNA databases in investigations. All valid answers from the survey data were included in the analysis. Descriptive statistics and intercorrelations between LCP, RPJ and acceptability scores are presented in Table 5.

Insert Table 5 about here

The results showed that 20.3 % of variance was explained by the final set of results created by the analysis (adjusted $r^2 = .191$, $r^2 = .203$). The variables of age and gender were put into the regression first. The results showed that age was significant ($F(2, 279) = 9.13$, $p < .001$), however no differences were found between men and women ($F(2, 279) = 9.13$, $p = .03$), together this first step of the analysis explained a significant 6.1 % of the variance. At step two, the LCP scores were significant and explained an additional 6.8 % of variance, ($F(1, 278) = 13.76$, $p < .001$). The remaining RPJ scale entered at step three, significantly accounted for 6.8 % of the variance ($F(1, 277) = 17.64$, $p < .001$). All outputs had small effect sizes (Cohen, 1992), however as per the output, the RPJ scale had the largest of those effect sizes in comparison to the other scales. A summary of the regression model is presented in Table 6.

Insert Table 6 about here

The results from the regression show that the more positive people's attitudes are towards the law, courts and police services, the higher their support overall for police to use consumer DNA databases in investigations. This support uniquely explained 6.76% of the variance $t(282) = 4.65$, $p < .001$, however when rounded, the difference was minimal with

RPJ scores also uniquely explaining 6.76% of the variance, $t(282) = 4.83$, $p < .001$. Age was the next most significant predictor, explaining 4.24% of the variance, $t(282) = 3.55$, $p = .001$, and finally, gender explained 1.61% of the variance, $t(282) = 2.18$, $p = .030$.

Overall, these results suggest that the more positive your attitudes towards LCP and the stronger your moral alignment towards RPJ the more likely you are to support police usage of consumer DNA databases in investigations.

3.5 Exploratory Aim Three

Based on the findings of aim two, a Pearson's correlation analysis was conducted to assess the relationships between the demographic variables of age and gender, against that of the LCP and RPJ scales and crime types. Preliminary analyses were performed to ensure there were no violations of the assumptions of normality, linearity and homoscedasticity. Correlations are presented in Table 7.

Age was significant at the $p = .05$ level for all variables except gender, however the correlation was small (see Table 6). Gender on the other hand showed no significant relationship with either the scales, crime types or age. The LCP scale correlated positively with all variables except gender, with the strongest correlation being that of the illicit drug use crime type which had a medium strength relationship [35] and a coefficient of determination of .105, accounting for 10 % of variance ($r = .324$, $n = 318$, $p < .001$). The RPJ scale showed stronger correlations for crime types with medium strength relationships for drugs ($r = .421$, $n = 309$, $p < .001$), robbery ($r = .357$, $n = 307$, $p < .001$) and sexual assault ($r = .315$, $n = 307$, $p < .001$). Small relationships also showed statistical significance for homicide ($r = .241$, $n = 308$, $p < .001$) and identifying human remains ($r = .291$, $n = 307$, $p < .001$). Together, these correlations accounted for 54.5 % of variance (illicit drug use 17.7 %, robbery 12.7 %, sexual assault 9.9 %, homicide 5.8 % and unidentified human remains 8.4 %).

The crime types themselves showed strong positive correlations with each other with the strongest relationship occurring between the crime type of drugs and robbery (r = .821, n = 316, p < .001) followed by sexual assault and unidentified human remains (r = .813, n = 314, p < .001). The lowest correlation between crime types was for homicide and drugs (r = .616, n = 315, p < .001).

Together these findings indicate that whilst age does have some significance in explaining variations within scores, it is primarily attitude and moral alignments that explain the variance in scores. Specifically, punishment orientation was a stronger predictor of acceptability scores than that of attitudes, however the two were correlated. Interestingly although, in all correlations for acceptability scores, homicide showed the weakest relationship although it was still positively correlated and statistically significant.

Insert Table 7 about here

4. Discussion

The three aims of the current study explored how moral alignment and crime type influenced levels of acceptability towards police use of consumer DNA databases. This research addressed a gap in balancing the benefits of using new technology for forensic investigations against potential privacy or civil liberty concerns. Measuring how public opinions may differ from current law and enforcement practices in regard to using consumer DNA data, this research is able to help guide policy makers into creating strong and efficient guidelines for access to and use of consumer DNA databases, concerns around user consent, and law and police usage. This can then safeguard the protection of the public and define the parameters of using consumer products for forensic purposes.

The first aim established a crime type acceptability baseline building upon the prior work of Dundes' [11] and Curtis' [12]. The second aim used the theory of retributive punishment to assess whether there was a relationship between moral alignment and punishment

orientations, and the levels of total acceptability. Lastly, aim three used the findings from aim two to establish correlations between attitude and moral alignment scales and levels of crime type acceptability.

The first analysis indicated that participants did hold different levels of support for police accessing consumer DNA based on the type of crime. The crime types of sexual assault and homicide showed the highest levels of support, alongside that of unidentified human remains. Lower levels of support were given for access to consumer DNA in illicit drug use and robbery investigations. We did not find any differences in levels of support between sexual assault, homicide and unidentified human remains, meaning that support for using consumer DNA was similar for these types of cases. This was also true when comparing illicit drug use and robbery. These results indicated that although respondents felt that police use of consumer DNA databases was supported in all cases it was most justified for crime type 1, especially that of homicide. Although unidentified human remains did score a lower correlation with acceptability (M = 3.27) than that of sexual assault (M = 3.43) and homicide (M = 3.46), all mean scores only indicated a moderate level of acceptability overall. The crime types of illicit drugs (M = 2.42) and robbery (M = 2.42) had lower support then sexual assault, homicide and unidentified remains but still showed moderate support overall. The mean differences between all five crime types were only small.

Further to the key aim of these analyses, the proportional report did suggest that while support waivered based on crime type, there was consistent support for police to gain informed consent from the database users before using consumer DNA databases in investigations across all crime types. However, when in the investigative process would be acceptable for police to use consumer DNA databases remains indecisive with an almost equal division amongst people who think it only appropriate if all other investigative and forensic tools have been used, and people who disagree with these conditions.

Aim one was fully supported and our results were in line with Dundes' [11] and Curtis' [12] research, in that differences in the level of acceptability did change based on crime type. Where the research indicated higher support for more police interventions occurred the more serious the crime, even if this may intrude on civil liberties, [11][12], this study supported this claim.

During the data collection phase, two large socio-political factors may have influenced the responses obtained. The first included the international coverage of the sentencing of DeAngelo, the Golden State Killer [37], and the second being, near the end of the collection phase, Australian media covered police use of consumer DNA databases to address unidentified remains cases [38]. As 64.2 % of the sample resided within Australia, the influence of both socio-political factors cannot be ignored. With regard to policy, this aim established that although people may support DNA usage by police and law services, the level of acceptability does vary based on the severity of crime committed. Therefore, policy design may need to consider if a 'one size fits all' approach to consumer privacy and consent is socially and politically reflective of users and consumers interests. This is important for the field of forensic science as it highlights that although consumer data may provide extra capability to identify persons of interest or human remains, the public may only see the reduction of civil protections ethically valid under parameters that may change over time. These results also tentatively suggest that clearer guidelines on how consumer DNA can be used are required by both police services and consumer DNA companies.

The second aim assessed the ability of predictor variables (LCP attitudes and RPJ beliefs) to account for variance in the level of total acceptability when demographic variables of age and gender were accounted for. Results indicated that a total of 20.4% of variance was explained by the model (adjusted $r^2 = 18.9$, $r^2 = .204$) with demographic variables explaining a total of 6.1% of the variance; age and gender ($F(2, 279) = 9.13$, $p < .001$). Of the scales

themselves the LCP ($F(1, 278) = 13.75$, $p < .001$) and RPJ ($F(1, 276) = 14.12$, $p < .001$) scales were significant, explaining an additional 6.8% and 6.8% of variance respectively.

Aim two was also supported, as was predicted from Yamamoto [31] and Carlsmith & Darley [15], that respondents who were high in positive attitudes towards law, courts and the police would also be high in retributive punishment and justice orientation and thus have higher acceptability scores. The findings of this study aligned with the strong body of literature indicating that attitudes and punishment orientation were correlated [31][15][17]. Although research has indicated that emotions can influence the strength of respondent attitudes and orientations [39] this was accounted for in the survey by establishing the attitudinal beliefs from the LCP scale before the arguably more emotive crime type scenarios.

Our findings showed a correlation between attitudes and punishment orientation in line with the findings of Yamamoto [31] and Carlsmith & Darley [15]. As such, the combination of these factors appears to influence the level of acceptability towards database usage by the police. This remained supported even when differences in demographic variables were taken into account. The results indicated that when designing and implementing policy around police usage of consumer DNA databases, social support may vary based on socio-political factors. This could influence how supportive people are of police, justice, and law generally which will then correlate with how strong their retributive punishment values are. These results may be helpful in guiding policy makers regarding possible implications for political agendas around public opinion and sentiment when designing and implementing policy. These findings suggest that the trust communities have in police services will reflect how open they are to the use of forensic processes that involve the use of consumer DNA. This could suggest that building positive relationships between the public and police, especially in the times of social media, could positively enhance public acceptance of forensic processes that use consumer DNA products.

The third aim explored the validity of correlations between demographic variables (age and gender), the significant LCP and RPJ scales from aim two, and the acceptability scores for the five crime types. As very little research has been conducted no formal hypotheses were set.

A Pearson's product moment correlation analysis was conducted with findings showing a variety of positive correlations between the variables. Specifically, gender was non-significantly correlated against all variables and age showed small correlations with the remaining variables.

The LCP scale accounted for 8.0% of variance and showed significant small to moderate correlations with all the significant variables. Overall, the RPJ scale's relationship with all crime types and the LCP scale showed significant relationships. Within this, the highest correlation was moderate with the acceptability scores for drug use, followed by robbery, sexual assault, unidentified human remains, and homicide.

These findings indicate that while there is some variance that is explained by attitudes towards justice services, the main contributing factors towards acceptability scores are that of retributive punishment orientation and crime types. Although this research is in its infancy, the overall findings do match up with what could be expected wherein higher retributive scores are correlated with higher acceptance of police usage of various investigative techniques such as use of consumer DNA databases [11][12][22]. The correlation between higher acceptance levels and the crime types of homicide and sexual assault matched the findings of Dundes' [11] and Curtis' [12] research. Likewise, the correlations between less serious crimes, such as robbery and drug related crime, appears logically supported.

Collectively, this research indicates that policy makers need to consider multiple influences when aiming to design user and consumer policy around police use of consumer DNA databases. Specifically, when trying to gain public support the influence of people's emotions towards crime, and police, law and justice services will correlate with their attitudes

towards retributive punishment and their level of acceptability for police to use this service. For policy to gain public support, positive attitudes towards police, justice and law will correlate with higher retributive punishment views especially with that of more serious crime types. This could mean that the more emotive the public are towards crime resolution, the less likely they are to be concerned with aspects of privacy and consent issues in solving those cases. This also indicates that public attitudes are likely to change based on current socio-political influences and policy may need to be re-evaluated in-line with these changing attitudes.

For the forensic sciences, these findings indicate that although consumer DNA data provides a larger dataset for person of interest identification, the acceptability of using this data source appears to be directly linked to public attitudes. What this means for the future of forensic use of consumer DNA products is subject to factors that extend beyond that of the forensic sciences. To ensure access to this data continues, this research suggests that public consultation remains a key factor in not only building positive relationships between the police and communities, but also in defining under what circumstance consumer data can be used for forensic purposes.

4.1 Strengths and future directions

While this is an evolving area, this research broadens the study of the relationship between consumer products and investigative tools, and how attitudes affect democratic multi-disciplinary policy design [15]. With one of the first comprehensive analyses of these factors, this study could provide the foundations for future research into, not just the use of consumer DNA databases in investigations, but the role social science has within democratic policy more broadly. Further, this study was able to identify punishment alignment and attitude factors that correlate with acceptance over controversial investigative techniques and crime types. How this aligns and deviates from previous research shows the importance of continuing study in this field.

This research indicated that punishment orientations, and attitudes and beliefs, do have influence over how people feel about police investigative powers evolving into consumer, or public, products. Those who have stronger orientations towards beliefs in retribution and value in justice services are more likely to be less concerned over privacy or civil rights than those who are lower in retributive and justice service scores. In this study, acceptability did vary based on the type of crime, indicating that people's attitudes may also be more nuanced than was first thought. Understanding the factors that influence acceptability or criticism of police use of consumer products could allow more effective policy design that does not trade consumer protections for security. This is particularly important as online services, like consumer DNA databases, become more common.

The creation and order of the crime type scenarios could be revisited in a replication. The use of scenarios provides a consistent understanding of the purported facts, which is helpful for this type of comparative study. Even though the scenarios were based on the findings of Dundes [11] and Curtis [12], it is still possible the content of our scenarios could influence our results. Future replication of this research would be beneficial using altered scenarios to confirm the current findings.

6. Conclusion

This study aimed to investigate the public acceptance of the police using consumer DNA databases for investigative purposes. A sample of international adults responded to scales measuring attitudes towards police, courts and justice, and the theory of retributive punishment and justice. They also answered questions based on scenarios whereby consumer DNA databases were used within differing crime types. Results indicated that, while attitudes and beliefs do impact the level of acceptability, there was variance based on crime types and moral attitudes. More favourable attitudes to retributive punishment and justice (RPJ) and law, courts and police (LCP), however, not only showed positive correlations with each other but also with higher acceptability of police use of consumer DNA databases for

investigations, controlling for age and gender. Further, investigative analysis into variations of attitudes and crime types found moderate correlations between higher acceptability scores and serious crimes. However, the mean score differences for these factors remained small.

This study provided novel insight into the way attitudes and beliefs impact the civil liberties versus security debate in a small international sample and was able to establish the key areas required for future research. This highlights the need for attitude and belief factors to be considered when designing and implementing controversial investigative policy design, to provide a balance between appropriate levels of police powers and security against that of individual civil liberties and freedoms.

References

[1] Graf. N, Mail-in DNA tests results bring surprises about family history for many Users, PEW Research Center, https://www.pewresearch.org/facttank/2019/08/06/mail-in-dna-test-results-bring-surprises-about-family-history-for-many-users/ (2019) accessed April 25, 2020.

[2] Kassis. H, & Ferguson. D. A, Ancestry DNA testing and Privacy, AMWA Journal, 34(2) (2019), 62-65.

[3] Amankwaa, A. O. (2018), Forensic DNA retention: Public perspective studies in the United Kingdom and around the world, Journal of Science and Justice, 58 (2018) 455-464.

[4] Guerrini. C. J, Robinson. J. O, Petersen. D, & McGuire. A. L, Should police have access to genetic genealogy databases? Capturing the Golden State Killer and other criminals using a controversial new forensic technique, Public Library of Science Biology Journal. https.//doi.org/10.1371.journal.pbio.2006906 (2018).

[5] Kopec. M, A new use of 'race': The evidence and ethics of forensic DNA ancestry profiling, Journal of Applied Philosophy, 31(3) (2014) 237-253.

[6] Scudder. N, Robertson. J, Kelty. S. F, Walsh. S. J, & McNevin. D, Crowdsourced and crowdfunded: The future of forensic DNA, Australian Journal of Forensic Sciences, 52(2), (2018) 235-241. https://doi.org/10.1080/00450618.2018.1486456.

[7] Balding. D. J, & Nichols. R. A, DNA profile match probability calculation: How to allow for population stratification, relatedness, database selection and single bands, Forensic Science International, 64, (1994) 125-140.

[8] Daly. M, Governance and Social Policy, Journal of Social Policy, 32, (2003) 113-128, doi: hhtps:// 10.1017/S0047279402006840.

[9] Angers, A., Drabek, J., Fabbri, M., Petrillo, M. and Querci, M., Whole Genome Sequencing and forensics genomics, EUR 30766 EN, Publications Office of the European Union, Luxembourg,2021, ISBN 978-92-76-40265-7, doi:10.2760/864087, JRC125734

[10] Ram. N, Guerrini. C. J, & McGuire. A, Genealogy databases and the future of criminal investigation, American Association for the Advancement of Science, 360(6393), (2018), 1078-1079.

[11] Dundes. L, Is the American public ready to embrace DNA as a crime fighting tool? A survey assessing support for DNA databases, Bulletin of Science, Technology and Society, 21(5), (2001), 369-375.

[12] Curtis. C, Public perceptions and expectations of the forensic use of DNA: Results of a preliminary study, Bulletin of Science, Technology and Society, 29(4), (2009), 313-324.

[13] Gamero. J. J, Romero. J. L, Peralta. J. L, & Vide. M. C, Spanish study of public awareness regarding DNA databases in forensic genetics, *International Congress Series, 1239*, (2003), 773-776.

[14] Gamero. J. J, Romero. J. L, Peralta. J. L, Corte-Real. F, Guillen. M, & Anjos. M. J, A study of Spanish attitudes regarding the custody and use of forensic DNA Databases, Forensic Science International: Genetics, 2(2), (2008), 138-149.

[15] Carlsmith. K. M, & Darley. J. M, Psychological aspects of retributive justice, Advances in Experimental Social Psychology, 40, (2008) 193-236. https://doi.org/10.1016/S0065-2601(07)00004-4.

[16] Wenzel, M, Okimoto, T. G, Retributive justice. In: Sabbagh C, Schmitt M. (eds) *Handbook of Social Justice Theory and Research*. (2016), Springer, New York, NY.

[17] Cullen. F. T, Clark. G. A, Cullen. J. B, & Mathers. R. A, (1985). Attribution, salience, and **a**ttitudes toward criminal sanctioning, Criminal Justice and Behavior, 12(3), (1985), 305-331. https://doi.org/10.1177/0093854885012003003.

[18] Carroll. J. S, Perkowitz. W. T, Lurigio. A. J, & Weaver. F. M, Sentencing goals and causal attributions, ideology, and personality, Journal of Personality and Social Psychology, 52(1), (1987), 107-118.

[19] Weiner. B, An attributional theory of achievement motivation and emotion, Psychological Review, 92(4), (1985), 548-573.

[20] Weiner. B, Graham. S, & Reyna. C, An attributional examination of retributive versus utilitarian philosophies of punishment, Social Justice Research, 10(4), (1997), 431-452.

[21] Green. A, An insight into the US criminal justice system, Department of Justice, New Zealand, (2009).

[22] Perrin. A, (2020). About half of Americans are OK with DNA testing companies sharing user data with law enforcement, PEW Research Center, (2020), accessed April 25, 2020, https://pewinternet.tumblr.com/post/190762708664/about-half-of-americans-are-ok-with-DNA-testing.

[23] The Biometrics and Forensics Ethics Group, Should we be making use of genetic genealogy to assist in solving crime? A report on the feasibility of such methods in the UK, September 2020, 4 - 13

[24] McCartney. C, The DNA expansion programme and criminal investigation, The British Journal of Criminology, 46(2), (2006a), 175-192.

[25] McCartney. C, Forensic identification and criminal justice: Forensic Science, Justice and Risk, Willian Publishing, (2006b).

[26] de Groot NF, van Beers BC, Meynen G, Commercial DNA tests and police investigations: A broad bioethical perspective, Journal of Medical Ethics, Published Online First: 11 September 2021. doi: 10.1136/medethics-2021-107568

[27] Scudder. N, Robertson. J, Kelty. S. F, Walsh. S. J, & McNevin. D, An international consideration of a standards-based approach to forensic genetic genealogy, Forensic Science International: Genetic Supplement Series, https://10.1016/j.fsigss.2019.10.071 (2019).

[28] Kennett. D, Using genetic genealogy databases in missing persons cases and to develop suspect leads in violent crimes, Forensic Science International, 301, (2019), 107-117. https://doi.org/10.1016/j.forsciint.2019.05.016.

[29] Andrews. D. A, & Wormith. J. S, A summary of normative, reliability & validity statistics on the criminal sentiments scale, Ottawa, Canada: Ministry of Correctional Services, (1990).

[30] Witte. T, Placido. C, Gu. D, & Wong. S, An Investigation of the Validity and Reliability of the Criminal Sentiments Scale in a Sample of Treated Sex Offenders, Sexual Abuse: A Journal of Research and Treatment, 18, (2006), 249-258. https://10.1007/s11194-006-9017-0.

[31] Yamamoto. S, The reasons we punish: Creating and validating a measure of utilitarian and retributive punishment orientation, Carleton University, Canada (2014).

[32] Whitley. B. E, & Kite, M. E, Principles of Research in Behavioral Science, 4th Ed. 2018, Routledge, Abingdon, Oxon, UK.

[33] Wolff. N, Morgan. R. D, & Shi. J, Comparative analysis of attitudes and emotions among inmates: Does mental illness matter? Criminal Justice & Behaviour, 40(10), (2013), 1092-1108, https://doi.org/10.1177/0093854813488760.

[34] Howell. D. C, Statistical methods for psychology (8th ed.), Belmont, California: Wasworth, Cengage Learning (2013).

[35] Cohen. J, Statistical Power Analysis for the Behavioral Sciences, New York, NY: Routledge Academic (1988).

[36] Hollander. M, Wolfe. D. A, & Chicken. E, Nonparametric statistical methods. 3rd Ed. 2013, New York, NY: John Wiley & Sons (2013).

[37] Levenson. M, & Murphy. H, Golden State Killer Suspect Offers to Plead Guilty, New York Times, March 4, 2020, accessed September 10, 2020 [https://www.nytimes.com/2020/03/04/us/golden-state-killer-trial.html].

[38] McKnight. A, Australia's first DNA program to solve cases of missing people

launched: Remains are found all the time, Canberra Times (2020), August 12, 2020, accessed September 10, 2020 [https://www.canberratimes.com.au/story/6874512/using-dna-to-solve-the-mysteryof-unidentified-human-remains/?cs=14231].

[39] Millar. M. G, & Tesser. A, Effects of affective and cognitive focus on the attitude behaviour relation, Journal of Personality and Social Psychology, 51(2), (1987), 270-276. https://dx.doi.org/10.1037/0022-3514.51.2.270.