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Impact of in-depth information and multimedia presentation on mock jurors' comprehension of mitochondrial DNA evidence

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ABSTRACT

In the courtroom, jurors are often faced with the task of evaluating complex scientific evidence. However, research suggests that jurors' understanding of complex scientific evidence and its reliability can be prone to error. Therefore, it is important to explore how jurors' comprehension of such evidence can be improved. The present study examined mock jurors' ($N = 162$) understanding of mitochondrial DNA (mtDNA) and its reliability using a 3 (evidence presentation: basic information vs. in-depth information vs. multimedia information) x 2 (evidence strength: stronger vs. weaker) factorial design. The basic information condition was kept short and served as a baseline measure of participants' knowledge on the subject. Participants read an expert witness testimony about mtDNA evidence in a robbery case and then answered 18 true/false questions to assess their understanding of the mtDNA evidence and its reliability. The strength of evidence did not have a statistically significant effect on jurors' understanding of the evidence or its reliability, and no interaction effects were observed. For the presentation of evidence, by contrast, providing in-depth information on mtDNA evidence significantly improved mock jurors' understanding of both the mtDNA evidence and its reliability. Additional illustrations presented together with the in-depth information did not further improve jurors' scores, although exploratory post-hoc analyses suggested that the multimedia information may have facilitated jurors' understanding of some aspects of the mtDNA evidence. Theoretical and practical implications of the findings are discussed.

1. nDNA and mtDNA

Jurors are often presented with complex forensic evidence in court, which makes their task even more demanding (Bromby, 2011; Heuer & Penrod, 1994). Errors in jurors' assessment of evidence, such as over-rating the reliability of forensic evidence, incorrect evaluation of the quality of a piece of evidence, and having a limited understanding of processes and potential problems associated with obtaining and analysing evidence, could contribute to miscarriages of justice. For instance, mock jurors' comprehension of nuclear DNA (nDNA) evidence has been found to be associated with their proneness to convict a defendant in a case with weak circumstantial evidence (Goodman-Delahunty & Hewson, 2010). It is therefore important to develop a more thorough understanding of jurors' comprehension of complex evidence, such as mitochondrial DNA (mtDNA), and to explore methods to further increase their comprehension.

When lay people talk about DNA evidence, they usually refer to nDNA, which is located in the nucleus of a cell. In recent decades, however, a different type of DNA, known as mtDNA, has increasingly been used in legal cases (see e.g., Shelton, 2009). MtDNA contains much less information than nDNA but is far more abundant within each cell (hundreds or thousands of mitochondria compared to only one nucleus per cell). Moreover, because of its structure and location in the cell, mtDNA is more stable than nDNA (Cheng, 2005; Nic Daeid et al., 2017). For these reasons, mtDNA can be extracted from samples that would not allow for the extraction of an nDNA profile, including bones fragments and hair shafts with no roots attached. However, the two types of DNA evidence differ in their probative value, a difference that is particularly important for jurors to understand. While nDNA is inherited half from the mother and half from the father, mtDNA is passed from mother to

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child with no paternal contribution (Nic Daeid et al., 2017). Thus, except for identical twins, nDNA can be considered unique to each human and a "match" is highly probative of identity. MtDNA, by contrast, is shared by individuals from the same maternal lineage, which means that maternal relatives have the same mtDNA profile. Hence, an mtDNA match is not an exact identification of a person and less individualizing than nDNA (Cheng, 2005; Nic Daeid et al., 2017).[2] Nonetheless, mtDNA can be a useful piece of evidence when considered in the context of other evidence (Forensic Science Services, 2004).

2. mtDNA evidence in jury decision-making

Only few studies on jury decision-making have specifically focused on mtDNA evidence so far. Hans and colleagues (see e.g., Dann et al., 2007, and Hans et al., 2005, 2007, 2011) conducted a large study with 60 mock juries of eight individuals each. Participants watched a videotaped mock trial, which was based on the State vs Pappas case, and then deliberated. Although some mock jurors made errors in defining mtDNA or in making inferences about its relevance, they overall "showed moderately good command of the biological facts relating to mtDNA evidence" (Hans et al., 2007, p. 2). A better understanding of mtDNA evidence was associated with more formal years of education (Hans et al., 2005), having an educational and science background, and positive science-related attitudes (Hans et al., 2011). Similar findings were reported more recently by McCowan et al. (2021) regarding several measures related to scientific and cognitive reasoning, although the authors could not replicate the effect of positive science-related attitudes. Understanding was also higher after jury deliberation (Hans et al., 2011). Encouragingly, participants were more critical in their assessment of the reliability of the mtDNA evidence used in the specific case compared to their assessment of the reliability of DNA evidence in general before the trial: While 95% of participants identified DNA as very or extremely reliable in a pre-trial questionnaire, only 35% asserted the mtDNA evidence offered at the trial was very or extremely reliable (Hans et al., 2011).

Hans and colleagues also examined the benefit of so-called *trial innovations* on mock jurors' understanding of mtDNA evidence. Jurors' comprehension of mtDNA evidence was significantly higher when they were allowed to use a notebook, which included materials such as copies of expert witnesses' slides and an mtDNA evidence checklist designed to guide jurors through complex evidence by asking a series of questions in a flowchart design, but also when they were just using the checklist on its own compared to when they were not allowed to use these innovations (Dann et al., 2007). By contrast, according to preliminary findings from a different research group who used the same case material, additional visual decision aids in the form of pictorial presentations did not significantly improve jurors' ability to differentiate between high and low quality mtDNA evidence (McCowan et al., 2021). The visual decision aid did, however, result in a lower average evidence strength rating independently of evidence quality, although it was only a small effect.

In addition to the comprehension of mtDNA evidence per se, it is also important for jurors to develop an understanding of possible factors that may lead to errors or biases in the analysis or interpretation of the evidence. People usually have high trust in DNA evidence (for a discussion, see e.g. Daftary-Kapur et al., 2010, pp. 141–142) and may even exaggerate the reliability of evidence to fit other case information (Smith et al., 2011). Yet, there are various reasons why the result of an (mt)DNA analysis may be inaccurate. Errors can be introduced at every stage of the process, ranging from errors when collecting the sample at the crime scene or processing the sample in the lab (e.g. contamination), to

erroneous or biased interpretation of the results through the expert (see e.g. Borenstein, 2006; Dror & Hampikian, 2011). Also, the passage of time, changes in temperature or exposure to sunlight and chemical contaminants can result in evidence being corrupted (Borenstein, 2006), which is particularly problematic considering that, according to one study, 81% of US labs surveyed had a backlog of DNA sample processing (Steadman, 2002). Finally, an issue specific to mtDNA is the potential for heteroplasmy (see Footnote 1). It is important to further our understanding of the extent to which people are aware of and can be educated on such issues that may negatively affect the reliability of (mt)DNA evidence.

Finally, while increasing the ecological validity of jury decision-making research has been an important element in recent years (see e. g. Penrod et al., 2011), the complicated nature of scientific evidence is an area that has often been neglected. The probative value of mtDNA evidence is not always straightforward. A recent study by McCowan et al. (2021; but see Line et al., 2019) found some support that people can distinguish high from low quality mtDNA evidence, albeit they underestimated the difference. One piece of information usually presented with mtDNA is the percentage of the relevant population (e.g. Caucasian males) that can be excluded as the source of the mtDNA profile. A question of interest is whether being able to exclude a smaller vs. larger percentage of the population as the source of a profile elicits different assumptions in jurors regarding, for example, the probative value of a piece of mtDNA evidence. Such assumptions may be appropriate if mtDNA evidence is perceived as being of lower value in a case in which fewer people can be excluded, but it could also result in an overestimation of the probative value if a very high percentage of the population can be excluded as the source of the profile.

3. Multimedia evidence

Educational research has shown that people learn better if information is presented using both text and illustrations compared to text only (cf. multimedia effect; Mayer, 2003, 2009), though this research has mostly focused on traditional learning settings and materials (Evans, 2013). Supplementing verbal information with illustrations to create a multimedia message and support multimedia learning (Niegemann & Heidig, 2012) is more effective in certain situations, such as for people with more visual learning styles (e.g. Dunn, 2000; Hewson & Goodman-Delahunty, 2008) or for people with lower prior knowledge on a topic (see Carney & Levin, 2002; Lenzner et al., 2013).

Research has also started to explore the extent to which juror understanding can be enhanced if relevant information is presented visually as well as verbally (e.g. Goodman-Delahunty & Hewson, 2010). One easy-to-implement option for creating multimedia information is PowerPoint®. At the time of designing the present study, we were aware of only one published study that had investigated the use of PowerPoint® in a mock jury trial to accompany the presentation of evidence. Park and Feigenson (2013) found that using PowerPoint® slides to present statistical evidence in a civil case increased mock jurors' recall of the presenting party's evidence. Since illustrations have higher benefits for people with lower prior knowledge, presenting illustrations in addition to the textual information could be particularly useful for expert witness testimony on complex evidence.

4. The present study

In the State v. Pappas (2001) case, the Supreme Court of Connecticut indicated that in assessing the validity of a scientific methodology, courts may consider – amongst other things – "whether a testifying expert can present and explain the data and methodology underlying his or her scientific testimony in such a manner that the fact finder can reasonably and realistically draw its own conclusions therefrom". This study aimed to add to the existing, yet limited knowledge on jurors' comprehension of complex evidence such as mtDNA evidence and its

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[2] A phenomenon called *heteroplasmy*, which describes changes in the mtDNA sequences observed within one individual, can further complicate the interpretation of mtDNA profiles (see e.g. Adams, 2005).

reliability. We were interested in examining the extent to which people's comprehension of a piece of mtDNA evidence and its reliability would improve beyond their baseline knowledge when they read an expert witness statement providing in-depth information on the evidence (with or without additional illustrations; RQ1). Moreover, we intended to test whether jurors' understanding could be further enhanced by adding visualisations that illustrate the in-depth written information (multi-media presentation using PowerPoint®) compared to the written information only (RQ2). Finally, we were interested in whether differences in the strength of evidence would have an impact on mock jurors' responses, especially their assessment of the evidence's probative value (RQ3).

5. Method

5.1. Participants

A G*Power analysis (α = 0.05, power (1 – β) = 0.80, medium effect size) suggested a minimum sample size of 158 participants. A total of 162 jury-eligible participants (*n* = 27 per condition) were recruited from a UK University and the wider community through social media. The average age was 24.53 years (*SD* = 10.87, *Mdn* = 20.00, range 18–69), 82% were female, and the most common occupation was full-time student (68%). To partake, participants had to be eligible for UK jury duty and have no prior in-depth knowledge of complex DNA evidence through their work or field of study.[3] Undergraduate psychology students received course credits in return for their participation; all other participants received no reward. This study was granted ethical approval from the University's Psychology Department Research Ethics Committee.

5.2. Design

This study used a 3 (evidence presentation: basic information vs. in-depth information vs. multimedia information) x 2 (evidence strength: weaker vs. stronger) between-subjects design. The dependent variables were participants' understanding of (1) complex mtDNA evidence – divided into a technical comprehension score and a probative value comprehension score – and (2) potential factors that could affect the reliability of mtDNA evidence.

5.3. Materials

5.3.1. Case summary
Participants read a short summary of a robbery case which contained complex mtDNA evidence. The scenario was based on the case State v. Pappas (2001): When searching the crime scene and its surroundings immediately after a man had robbed a bank, the police recovered a sweatshirt with two human hairs in its hood. The mtDNA from the hairs was found to match the defendant's mtDNA and was used as evidence at trial. Parts of the introduction from the appeals trial were used to provide participants with a summary of the case (State v. Pappas, 2001; the full materials are available in the supplemental materials online).

5.3.2. Expert witness statement
In State v. Pappas (2001), the expert witness provided a detailed explanation, using simplified language and explaining technical terms. The information from the appeals case formed the basis of the in-depth information expert witness statement used in the present study. The in-depth information statement additionally elaborated on potential reliability issues beyond the information provided by the expert witness,

as we were also interested in the extent to which participants both already had and could develop an understanding of such issues. For the basic information condition, explanations of technical terms and detailed explanations of the evidence were removed. For the multimedia information condition, visualisations were added that illustrate the processes or information under discussion. For an example of the kind of information provided across the three conditions, see Table A1.

To manipulate evidence strength, the information provided on the outcome of the mtDNA analysis was varied by changing the population frequency of the observed profile. In the stronger evidence condition, the vast majority of the Caucasian population could be excluded as the source of the mtDNA in the sample (99.75%), whereas in the weaker evidence condition, the proportion that could be excluded was much lower (83%).

5.3.3. Questionnaire
Participants' understanding of the evidence and of potential reliability issues was assessed using an 18-items questionnaire. Ten true-false questions assessed participants' comprehension of the evidence, eight assessed their understanding of potential reliability issues. Parts of the questions were adopted from Hans et al. (2011) and Goodman-Delahunty and Hewson (2010), others were self-developed based on sources such as the review report on DNA evidence (National Research Council, 1996) (for more details and the full questionnaire, see Table B1). We calculated two evidence comprehension scores of five items each (score range 0–5), a *technical comprehension score* (e.g. "A match is the same mtDNA sequence in two samples") and a *probative value comprehension score* (e.g. "mtDNA and nDNA have the same ability to prove identity"), and a *reliability comprehension score* (e.g., "Samples processed in batches are more susceptible to contamination"; score range 0–8).

5.4. Procedure

After reading an information sheet on the study, providing consent to participate, and completing a demographics form to collect information on age, gender, and occupation, participants were randomly allocated to one of the six conditions. All participants read the same case summary. Thereafter, depending on the group they were allocated to, they read one of six versions of the expert witness statement. Participants then completed the comprehension and reliability questionnaire. Once completed, participants were thanked for their time and debriefed.

6. Results

SPSS 28.0 and R Studio version 1.3 with the WRS2 package version 1.1–3 were used to analyse the data. A Bonferroni correction was applied to account for the three separate ANOVAs, which resulted in a critical alpha level of 0.017, and all tests are reported two-tailed. The assumption of normality, assessed by inspecting skew, kurtosis, and P–P plots, was violated in various instances, and the assumption of homogeneity was violated for the reliability comprehension score. Because of these issues, all results were double-checked by running robust 2-way ANOVAs using the WRS2 package with trim set at default (0.20; as suggested by Field, 2018). Only in one case was there a difference between the results of the robust and the parametric ANOVA (see below). As an effect size measure, partial eta squared is reported, with small, medium, and large effect sizes corresponding to a value of 0.01, 0.06, and 0.14, respectively (Cohen, 1988).

6.1. Technical comprehension score

For the technical comprehension score, a 2-way between-subjects ANOVA showed no statistically significant interaction effect, $F(2,156) = 2.80$, $p = .064$, $\eta_p^2 = 0.04$, and no statistically significant main effect of evidence strength, $F(1,156) = 0.20$, $p = .656$, $\eta_p^2 < 0.01$. However, a

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[3] This criterion was considered necessary to avoid an overrepresentation of this group when recruiting through social media platforms because of the recruiting author's personal environment.

statistically significant main effect of evidence presentation was observed, $F(2,156) = 9.55$, $p < .001$, $\eta_p^2 = 0.11$, which corresponds to a medium to large effect size. The technical comprehension score in the basic information condition was statistically significantly lower than the one in both the in-depth information condition and the multimedia information condition, whereas no difference was observed between the latter two conditions (see Fig. 1A). The 2-way robust ANOVA yielded a p-value of .019 (0.001 with a 0.10 trim), which is a trend result. The difference between the basic information condition and the multimedia information condition was no longer significant in this case, $p. = 0.058$ (0.007 with a 0.10 trim). Overall, the findings lend tentative support to RQ1 but do not support RQ2.

6.2. Probative value comprehension score

The 2-way between-subjects ANOVA with the probative value comprehension score showed neither a statistically significant interaction effect, $F(2,156) = 0.39$, $p = .389$, $\eta_p^2 = 0.01$, nor a main effect of evidence strength, $F(1,156) = 0.61$, $p = .613$, $\eta_p^2 < 0.01$. By contrast, a large main effect of evidence presentation was observed, $F(2,156) = 22.63$, $p < .001$, $\eta_p^2 = 0.23$. Participants in both the in-depth information condition and in the multimedia information condition achieved statistically significantly higher scores than participants in the basic information condition (see Fig. 1B). Post-hoc tests did not show a statistically significant difference between the two conditions with in-depth information. Thus, the findings lend support to RQ1 but not to
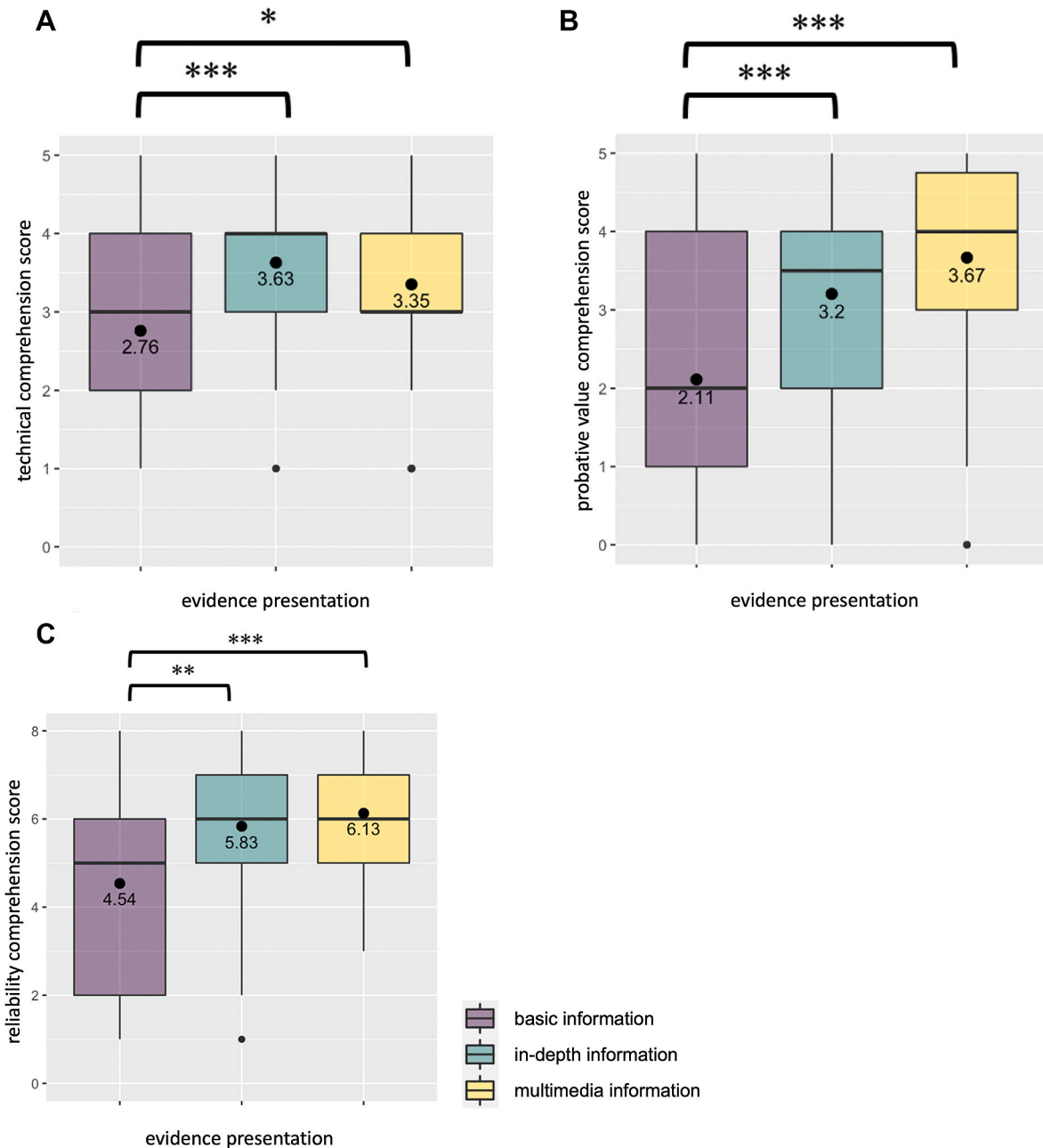
Note. *** = $p < .001$, ** $p < .01$, * $p < .017$.

Fig. 1. Box Plots with Mean Value for the Three Comprehension Scores by Condition.
Note. *** = $p < .001$, **$p < .01$, *$p < .017$.

RQ2 and RQ3.

At a descriptive level, the probative value comprehension score was higher in the multimedia information than in the in-depth information condition. We conducted post-hoc analyses of the responses to the individual items within that score to explore whether the descriptive difference was similar across all items; this is of particular interest as the probative value score includes several aspects that are important for a juror to understand when evaluating mtDNA evidence. An overview of these findings can be seen from Table 1. For the top three items in Table 1, which concern the difference between mtDNA and nDNA and the fact that mtDNA is not an exact identification of a person but still is of some evidentiary value, the percentage of correct answers was higher in the multimedia information condition by 14.8%–22.3% compared to the in-depth explanation condition. By contrast, there was little difference between the two groups in terms of understanding that mtDNA was only passed down by the mother and that it would be shared by any person from the same maternal lineage. The rather low percentage of correct answers in the basic information condition for these two questions suggests that mtDNA is not very well known or understood in the general population. Yet, even after having read a detailed explanation of this type of evidence, more than a third of participants did not answer the questions about these two crucial mtDNA facts correctly. Another interesting observation was that there was little difference in the extent to which participants agreed to the statement "The mtDNA evidence is completely irrelevant because a substantial number of other people could also be the source of the hairs" between the weaker evidence condition (44.4%) and the stronger evidence condition (51.9%).

6.3. Reliability comprehension score

A 2-way between-subjects ANOVA with the reliability comprehension score as the dependent variable found no statistically significant interaction effect, $F(2,156) = 0.37$, $p = .690$, $\eta_p^2 = 0.01$, and no statistically significant main effect of evidence strength, $F(1,156) = 0.05$, $p = .833$, $\eta_p^2 < 0.01$. By contrast, a large main effect of evidence presentation was observed, $F(2,156) = 11.23$, $p < .001$, $\eta_p^2 = 0.13$. The reliability comprehension score in the basic information condition was statistically significantly lower than the one in both the in-depth information and the multimedia information condition, whereas no difference was observed between the latter two conditions (see Fig. 1C). Thus, again the results lend support to RQ1 but not to RQ2.

Table 1

Percentage of correct responses to individual items from the probative value comprehension score.

Item	basic information	in-depth information	multimedia information
MtDNA and nDNA have the same ability to prove identity.	48.2%	66.7%	81.5%
MtDNA is an exact identification of a person.	38.9%	74.1%	90.7%
The mtDNA evidence is completely irrelevant because a substantial number of other people could also be the source of the hairs.	44.4%	44.4%	66.7%
A person's mtDNA comes from both the mother and the father.	16.8%	61.1%	57.4%
The mtDNA evidence in this case could have come from the defendant's brother, if the two had the same mother but different fathers.	31.5%	63.0%	57.4%

7. Discussion

The present study aimed to investigate the extent to which a detailed expert witness testimony would increase mock jurors' comprehension of mtDNA evidence compared to a brief testimony containing only basic information without further explanations (i.e. their baseline knowledge) (RQ1), and whether comprehension would further improve if illustrations were provided in addition to the in-depth information (multimedia information) (RQ2). Moreover, we were interested in whether evidence strength would impact comprehension scores, particularly mock jurors' comprehension of the probative value (RQ3). Overall, our findings lend support to RQ1; providing in-depth information on mtDNA evidence resulted in a considerably improved comprehension of the evidence and its reliability (large effect sizes), although results for the technical comprehension score were by trend only when running a robust ANOVA. By contrast, providing mock jurors with additional visual aids did not result in statistically significantly higher scores on any of the scales.

The findings indicate that lay people's general knowledge on mtDNA evidence and its reliability is limited, but that their understanding does improve considerably after being provided with a detailed expert witness testimony. The illustrations used in the multimedia information condition visualised, for instance, the difference between nDNA and mtDNA in terms of how they are passed on to the next generation (see Table A1), which we expected to further increase the probative value comprehension score. Interestingly, however, scores did not statistically significantly improve when illustrations were presented in addition to the in-depth information. Post-hoc exploratory analyses suggested that visualisations may be useful to understand other important aspects related to the probative value of mtDNA evidence, but not the fact that mtDNA is inherited maternally. This last point seemed difficult to grasp; even after receiving detailed information (with or without additional illustrations), over one third of participants did not correctly answer the questions on this aspect of mtDNA. The results from Hans et al. (2011) suggest that in a setting more similar of an actual trial, where case information is provided in even more depth and a deliberation takes place, a higher percentage of correct responses may be achieved (84–90%), but even then, one in ten mock jurors were unable to fully understand this vital point.

Even though mock jurors had limited knowledge on the subject, which is a condition in which multimedia information has been found to be of particular use (see e.g. Carney & Levin, 2002), participants did not seem to benefit from the additional visual aids in the present study. However, this study is not the first that failed to find an additional benefit of multimedia presentation over detailed verbal information. Goodman-Delahunty and Hewson (2010), who used a 20-min video on (n)DNA evidence and compared participants' comprehension to a condition in which this information was provided orally by an expert witness, did not observe an incremental value either. The authors argued that images may not add substantial value if the verbal information is presented in a well-structured way. Similar findings were also reported by Rempel et al. (2019), who found no difference in comprehension scores of (n)DNA evidence for participants who received written information versus information presented using PowerPoint®. Interestingly, however, the authors did find a higher likelihood of a guilty verdict in the PowerPoint® condition. Thus, while mock jurors in the PowerPoint® condition did not have a better understanding of the evidence, they were more convinced by its incriminating power. Rempel et al. reasoned that using multimedia such as PowerPoint® might lead to jurors engaging more strongly in peripheral rather than central processing. In other word, jurors relied more on heuristic cues, such as credibility, to assess the value of a message rather than the actual quality of the message's content (cf. elaboration likelihood model of persuasion; Petty & Cacioppo, 1986). Thereby, jurors neglected the evidentiary criteria provided by the expert witness against which the evidence should be assessed. By contrast, Goodman-Delahunty and Hewson

(2010) did not find such an effect of their multimedia presentation. Rather, multimedia presentation, in addition to the oral explanations, seemed to be particularly useful to those who had the least prior knowledge about nDNA. Whether and under what circumstances the use of PowerPoint® or other multimedia sources in a trial might bias jurors' verdict (rather than or in addition to improving their comprehension) is a vital question that needs to be addressed in future studies (see also Feigenson, 2010). Moreover, the conditions that need to be met for multimedia information to be of additional value when explaining complex evidence also need further testing. For instance, explicit references to the illustrations in the text or instructions to the jurors on how to engage with the illustrations (visual literacy) might increase their use (see e.g. Peeck, 1994; Schnotz et al., 2014).

Lastly, we did not observe a statistically significant effect of strength of evidence (RQ3). In other words, we could not find support for an impact of different population frequencies on mock jurors' comprehension scores, including their probative value score. It remains unclear, however, whether the frequencies might have had an impact on mock jurors' verdict – a question that should be investigated by future research. In the present study, evidence strength did not have an impact on the extent to which jurors agreed the evidence was "completely irrelevant because a substantial number of other people could also be the source of the hairs". While this could be due to the fact that both the question and the response options were not suitable to capture more subtle differences in people's assessments, it is also possible that people's sensitivity to such aspects may be limited (Line et al., 2019; but also see; McCowan et al., 2021) and may vary depending on whether the information is presented in isolation or in the context of a criminal case (Smith et al., 2011).

7.1. Limitations

The present study focused on a specific aspect, the content of the expert witness testimony, within a much more complex process, a common approach in jury decision-making research (see e.g. Bornstein, 1999). This approach increases internal validity, enabling the investigation of a specific measure's impact in isolation and facilitating drawing causal conclusions (see e.g. Wiener et al., 2011). On the downside, such simplifications limit the extent to which a study mirrors real-life conditions (ecological validity) and, thus, question the generalisability of the findings (Penrod et al., 2011); in an actual trial, many additional factors come into play that may affect the effects of interest. For instance, mtDNA evidence comprehension has been found to be better after jury deliberation (Hans et al., 2005), although in the same study the authors also found some positive – albeit modest – effects of certain trial innovations (see e.g. Dann et al., 2007; Hans et al., 2005). As it is more difficult to isolate the impact of a specific effect in studies that simulate a real trial more closely, both types of studies are important. Diamond (1997; see also Wiener et al., 2011) recommended to start with "Stage One" research, in which easier methods are used such as brief written trials, which are then replicated in "Stage Two" research, in which ecologically more valid scenarios are implemented. Thus, further research is necessary to gain a more comprehensive understanding of the use (or lack thereof) of specific measures to further improve juror comprehension under more realistic conditions.

Another point to consider is that the present study was sufficiently powered to detect effects of a medium size or larger only. It is conceivable that visual aids might result in a small increase in jurors' comprehension scores that would be detected in a study with a larger sample. However, the question arises to what extent small effects would persist in ecologically more valid studies (see above) and, if so, whether such small effects would have a practical impact large enough for policy makers to consider introducing such a measure.

Although recruitment through social media in addition to the research scheme at the university resulted in a sample consisting of both university students and community members, the sample was not representative of the UK population. The sample was younger (median age in the UK general population was 40.4 years in 2020; Office for National Statistics, 2021), more educated (in 2017, 42% of the people in the UK labour market were graduates, compared to 68% of participants stating they were full-time students in the present sample; Office for National Statistics, 2017), and women were overrepresented. While not all of these aspects necessarily affect the results, a potentially relevant difference is the possible overrepresentation of participants with more years of education and a stronger educational and science background since these factors have been found to be associated with a better understanding of mtDNA in the past (Hans et al., 2005, 2011). Thus, even though Bornstein (1999) concluded that little differences between different mock juror samples have been observed in jury decision-making research, we cannot rule out that the comprehension scores in this sample might overestimate comprehension in the general population and that additional measures such as a multimedia presentation could have a positive effect in a different sample.

Finally, the present study did not assess reading time or include a quality-control question in the questionnaire. While there is no reason to suspect systematic differences in terms of how carefully participants read the text or responded to the questions, including such assessments in future studies would improve data quality.

7.2. Practical implications and conclusion

Lay people seem to have some, but limited comprehension of mtDNA evidence and moderate knowledge of factors that may affect its reliability. Providing in-depth information on relevant processes considerably improved their understanding, whereas multimedia information with additional illustrations may be helpful to foster people's understanding of some aspects but not others. The use of multimedia information requires further research, however, as there are mixed findings from other studies regarding their use and as to whether the use of multimedia elements might bias jurors and result in more guilty verdicts. The fact that mtDNA is passed down the maternal lineage seems an aspect that is particularly difficult to grasp for lay people. Accordingly, expert witnesses are well advised to spend sufficient time on explaining that crucial difference between mtDNA and nDNA in court.

Declaration of competing interest

Appendix C. Supplementary data

Appendix A

Table A1
Example of information provided in the three evidence information conditions.

Condition	Information provided
Basic information	Mark Wilson an expert in forensic evidence is called.*
In-depth information	Mark Wilson an expert in forensic evidence is called. Wilson explains that mitochondrial DNA (mtDNA) is found in the mitochondria of cells which are outside of the nucleus. MtDNA is only inherited from the maternal line meaning that any maternal family will have identical mtDNA. MtDNA is not an exact identification of a person meaning that nuclear DNA (nDNA) is more effective.
Multimedia information	

What is mtDNA?

Mark Wilson an expert in forensic evidence is called. Wilson explains that mitochondrial DNA (mtDNA) is found in the mitochondria of cells which are outside of the nucleus. MtDNA is only inherited from the maternal line meaning that any maternal family will have identical mtDNA. MtDNA is not an exact identification of a person meaning that nuclear DNA (nDNA) is more effective.
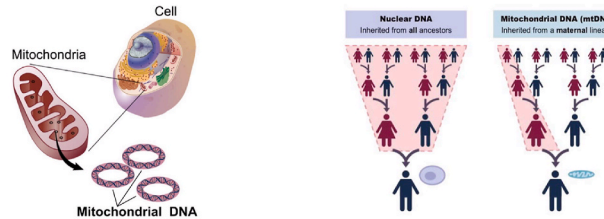
Note. * No further information on the nature of mtDNA was provided to assess participants' baseline knowledge. The next piece of information (provided in all conditions) concerned the microscopic hair analysis preceding the mtDNA analysis. The full materials are available online.

Appendix B

Table B1
Comprehension Questionnaire.

Scale	Item	Source
TC	Mitochondria are found inside the nucleus of every cell.	Hans et al. (2011)
TC	A match is the same mtDNA sequence in two samples.	Hans et al. (2011)
TC	When mtDNA evidence is analysed, about 600 base pairs are compared.	Hans et al. (2011)
TC	Polymerase Chain Reaction is used to double the amount of mtDNA present.	Adapted from Goodman-Delahunty and Hewson (2010)
TC	Microscopic analysis checks for similarities before doing more advanced procedures.	Self-developed
PVC	MtDNA and nDNA have the same ability to prove identity.	Adapted from Hans et al. (2011)
PVC	MtDNA is an exact identification of a person.	Self-developed
PVC	The mtDNA evidence is completely irrelevant because a substantial number of other people could also be the source of the hairs.	Hans et al. (2011)
PVC	A person's mtDNA comes from both the mother and the father.	Hans et al. (2011)
PVC	The mtDNA evidence in this case could have come from the defendant's brother, if the two had the same mother but different fathers.	Hans et al. (2011)
RC	Prior knowledge of the case can affect the lab experts' interpretation of the evidence.	Self-developed
RC	In mtDNA, a difference at one base pair in a sequence from samples of the same individual occurs in between 10 and 20 percent of all people.	Self-developed
RC	Someone's DNA can be present at a crime scene even if they have never been there.	Self-developed
RC	Samples processed in batches are more susceptible to contamination.	Adapted from Goodman-Delahunty and Hewson (2010)
RC	Prior knowledge of a case will not affect how the expert presents findings in court.	Self-developed
RC	The risk of contamination is greater at the scene than in the lab.	Self-developed
RC	Contamination can occur if products from previous sequencing are carried over in the amplification process.	Adapted from Goodman-Delahunty and Hewson (2010)
RC	DNA can be transferred from one person to another by a handshake and then to an object like a knife.	Self-developed

Note. TC = technical comprehension, PVC = probative value comprehension, RC = reliability comprehension.

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