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Pathways to Persuasion: How Neuroscience Can Inform the Study and Practice of Law†

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Under what conditions can lawyers persuade jurors? During criminal and civil trials, lawyers seek to persuade jurors that their interpretation of the facts is the ‘correct’ one and that jurors should, therefore, reach a verdict that favours their client. Although lawyers have many persuasive tools at their disposal (e.g. rhetorical skill, detailed knowledge of the facts, colourful exhibits), one of the biggest challenges they face is convincing uninformed jurors to trust their statements, as opposed to those of opposing counsel. To succeed, lawyers must often determine how to present information and witnesses in the most persuasive way possible. Conversely, the challenge for jurors is to determine the truthfulness of the information that lawyers and witnesses present and reach a just verdict even when they are not fully informed. Indeed, because jurors do not witness for themselves the events surrounding particular crimes or disputes, they must rely upon the statements of lawyers and witnesses whom they do not personally know when making their decisions.¹ Further, because jurors typically lack scientific and mathematical

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expertise, they are often unable to evaluate for themselves the quality of the expert testimony and evidence they receive.

Given that lawyers seek to persuade jurors and that jurors often lack the ability to evaluate critically lawyers’ and witnesses’ statements, it is important to understand the conditions under which lawyers can persuade uninformed jurors to trust and base their decisions upon the statements they make during a trial. In an effort to identify these conditions, Lupia and McCubbins, as well as Crawford and Sobel, developed game theoretic models that yield the following predictions about when a knowledgeable speaker (be it a lawyer or an expert witness) will be able to successfully persuade jurors: 1) common interests between a knowledgeable speaker and jurors should induce jurors to trust the speaker’s statements and base their choices upon them; 2) conflicting interests between a knowledgeable speaker and jurors should induce jurors to ignore the speaker’s statements and make their decisions on their own; 3) institutions that are common in legal settings should sometimes induce jurors to trust a speaker’s statements, even when the speaker’s interests conflict with those of jurors. For example, a sufficiently large penalty for lying (which in legal settings may be a penalty for perjury or a loss of reputation) can remove a speaker’s incentive to lie, and therefore lead jurors to trust and base their decisions on the speaker’s statements.

Lupia and McCubbins tested these predictions about persuasion in a series of behavioural experiments. Consistent with their predictions, they found that subjects’ decisions to trust an unknown individual’s statements depended upon the perceived trustworthiness of that other individual (dubbed ‘the reporter’ in their experiments and throughout this paper). For example, Lupia and McCubbins showed that subjects who perceived that the reporter shared common interests with them were significantly more likely to trust and base their decisions upon the reporter’s statements than were subjects who perceived that the reporter’s interests conflicted with their own. When the reporter had conflicting interests with subjects, but was made trustworthy by an institution (such as a penalty for lying that was large enough to ensure that the reporter had a dominant strategy to tell the

6 Note 4, above.
truth), subjects trusted the reporter’s statements at a rate that was similar to the rate at which they trusted the reporter’s statements when they knew that the reporter shared common interests with them. From these results, Lupia and McCubbins concluded that institutions can substitute for common interests because they, too, induced subjects to trust and base their decisions upon the reporter’s statements.

Although Lupia and McCubbins’s\(^7\) theory and experiments help clarify the conditions for successful persuasion, they leave open the following question: do measures of brain activity and reaction time also indicate that subjects view in the same way information from a trustworthy individual (i.e. one who shares common interests with them) versus an individual who is otherwise untrustworthy (i.e. has conflicting interests with them), but is made trustworthy by an external institution? This question is an important one, since it has implications for both the study and practice of law. Indeed, if subjects’ brain activity is different when they receive information from these two types of trustworthy individuals (even though their decisions and reaction times are similar), then this suggests that legal scholars and practitioners who seek to understand persuasion may not necessarily get the whole story if they only observe subjects’ behaviour. More broadly, such a finding would also have implications for lawyers and witnesses, since it would indicate that the manner in which a speaker is made trustworthy (and not just trustworthiness itself) affects how jurors process information from that speaker. On the other hand, if subjects’ decisions, reaction times, and brain activity are similar when they receive information from these two types of trustworthy individuals, then this indicates that institutions induce not only the same behaviour as common interests, but also the same cognitive processing of information.

To address this open question and illustrate how neuroscience can inform the study and practice of law, we describe our previous study that replicated Lupia and McCubbins’s\(^8\) experiments with electroencephalograph (EEG) and timed-response technology.\(^9\) Although our behavioural results were consistent with Lupia and McCubbins’s conclusion that institutions can substitute for common interests, our EEG results revealed something about trust and persuasion that we did not learn from observing subjects’ decisions and reaction times. That is, they demonstrated that even though the reporter was, theoretically and behaviourally, equally trustworthy in the Common Interests and Penalty for Lying conditions, subjects processed information differently when it came from a reporter who was trustworthy by virtue of sharing common interests with them versus a reporter who was made trustworthy by an external institution. Indeed, across a range of cognitive responses, subjects’ brain activity was different in the Common Interests condition, relative to both the Penalty for Lying and Conflicting Interests conditions. Interestingly, this processing difference existed even though subjects were equally likely

\(^7\) Note 4, above.

\(^8\) Ibid.

to base their decisions upon the reporters’ statements in the Common Interests and Penalty for Lying conditions and even though they took the same amount of time to make their decisions in these conditions. Given this difference between subjects’ behaviour and brain activity, it appears that recording subjects’ brain activity adds a new dimension to our understanding of jurors’ decisions to trust and base their decisions on the statements of others.

This paper proceeds as follows. We begin with a brief overview of the EEG experiments that we used to study the behavioural and neural correlates of persuasion. We then describe our hypotheses, as well as the data and methods that we used to test them. Next, we summarize our experimental results on subjects’ decisions, reaction times, and brain activity. We conclude with a discussion of the substantive and methodological implications that our research has for debates about persuasion in courtroom settings. Indeed, we summarize our previous research to illustrate the ways that neuroscience can contribute to our understanding of legal phenomena, such as persuasion and trust. Specifically, we emphasize that our experiments show the value of tying together both behavioural results and brain data in analyses of persuasion and trust. Although our study represents only a first step in this endeavour, we emphasize that future research on persuasion (and other topics of interest to legal scholars) can potentially benefit from simultaneously assessing behaviour and brain activity.

20.1 Using Neuroscience to Study Persuasion

In order to analyse the conditions under which a lawyer can successfully persuade a juror, we conducted laboratory experiments at two large public universities. When recruiting subjects, we posted flyers at various locations on campus, and we also sent out campus-wide emails to advertise the experiments. A total of fifty-nine healthy adults from these two university communities (thirty-seven men), aged eighteen to twenty-eight, participated in our experiments. We recorded behavioural responses and reaction times from all fifty-nine subjects, and we recorded the EEGs of twelve of these subjects.10

During the experiment, we asked subjects to predict the outcomes of coin tosses that they did not observe. We told subjects that they would earn 50 cents for each correct prediction that they made, and nothing when they made an incorrect prediction or failed to make a prediction. We also informed subjects that another subject in another room (dubbed ‘the reporter’) would observe each coin toss outcome and then send a report to them via computer about whether the coin landed on heads or tails. Importantly, we told subjects that the reporter could either lie about the coin toss outcome or tell the truth. Thus, before subjects made a prediction about each coin toss, they observed the reporter’s report of whether the coin landed on heads or tails, but they did not know whether the report was

10 Note 9, above.
truthful. As in Lupia and McCubbins’s study, the key factor that we manipulated was the perceived trustworthiness of the reporter, and we did this by varying the financial interests of the reporter, as well as the institutional context in which the reporter sent his or her report.

Specifically, we began the experiment by reading the instructions for the Common Interests condition to subjects. That is, we asked subjects to predict the outcome of an unseen coin toss after receiving a message from the reporter. We informed subjects that, in this condition, both they and the reporter earned 50 cents every time they, the subjects, correctly predicted the coin toss outcome, and nothing if they predicted incorrectly or failed to respond before the onset of the next coin toss. We reminded subjects that it was entirely the reporter’s decision as to whether he or she sent a true or a false report via the computer. To ensure that subjects fully understood the instructions for the Common Interests condition, we gave them a quiz that asked them to say how much money the reporter earned under various circumstances. To motivate performance on the quiz, we paid subjects 25 cents for each quiz question they answered correctly. When we were sure that subjects understood how the reporter earned money in the Common Interests condition, ten experimental trials began.

Following the initial Common Interests trials, we read the instructions for the Conflicting Interests condition to subjects. Specifically, we told subjects that their task was the same as in the previous condition—to predict the outcome of an unseen coin toss after receiving a message from the reporter. We told subjects that while they themselves still earned 50 cents for each correctly predicted coin toss and nothing for incorrect predictions, the reporter now earned 50 cents for each incorrect prediction that subjects made. We then gave subjects a brief quiz on how much money the reporter earned under various circumstances, and we paid them 25 cents for each correctly answered quiz question. When we were sure that subjects understood how the reporter earned money in this condition, ten Conflicting Interests trials began.

Following the initial Conflicting Interests trials, we read the instructions for the Penalty for Lying condition to subjects. We told subjects that as in the previous (Conflicting Interests) condition, the reporter earned 50 cents for each of the subject’s incorrect predictions, while the subject earned 50 cents for each correct prediction. We also told subjects that every time the reporter sent a false report, we deducted $1 from the reporter’s experimental earnings. We then gave subjects a brief quiz on how much money the reporter earned under various circumstances, and we paid them 25 cents for each correctly answered quiz question. Because we quizzed subjects on how the reporter earned money and corrected their quizzes in front of them, they knew that the $1 penalty was large enough to ensure that the reporter always had an incentive to tell the truth about the coin toss outcome. When we were sure that subjects understood how the reporter earned money in this condition, ten Penalty for Lying trials began.

11 Note 4, above.
Once subjects completed ten trials for all three conditions, we collected data for additional coin tosses in each of our three conditions. In order to control for learning and arousal effects, half of the subjects completed the second block of trials in order 1 (Common Interests, Conflicting Interests, Penalty for Lying), while the other half completed the second block of trials in order 2 (Penalty for Lying, Conflicting Interests, and Common Interests). On each coin toss, we recorded the amount of time that elapsed between the presentation of the reporter's report and subjects' predictions. We did not tell subjects that their predictions were being timed, and we did not give them any feedback until the end of the experiment. We also told subjects that the reporter did not observe their predictions about the coin toss outcomes.

20.2 Predictions

Lupia and McCubbins's\textsuperscript{12} theory and experiments suggest that particular institutions (such as a sufficiently large penalty for lying) can substitute for common interests. Based on their results, we predicted that subjects would be equally likely to trust the reporter's statements (and, thus, base their predictions upon them) when the reporter shared common interests with them and when the reporter was made trustworthy by a penalty for lying. Following Lupia and McCubbins, we also predicted that when the reporter's interests conflicted with those of subjects, subjects would not trust the reporter's statements and, thus, not base their predictions upon them.

As for subjects' reaction times and brain activity in the three conditions, Lupia and McCubbins\textsuperscript{13} do not offer predictions for these other measures. That said, based on their theoretical and experimental results suggesting that institutions can substitute for common interests, we expected to observe similar reaction times in the Common Interests and Penalty for Lying conditions, as well as similar brain activity in these two conditions. We also expected subjects' reaction times and brain activity to be different in the Conflicting Interests condition (relative to the Common Interests and Penalty for Lying conditions), as this was the one condition where the reporter was not trustworthy.

If our results supported these expectations, then our study would suggest several substantive and methodological conclusions. First, it would suggest that particular institutions substitute for common interests; that is, they induce not only the same decisions, but also the same reaction times and cognitive processing of information. Second, it would suggest that observing subjects' brain activity does not add much to our understanding of subjects' decisions to trust and base their decisions on the statements of others. Indeed, if subjects' brain activity simply mirrored their behaviour, then one might question whether there is any value added to using this technology. Stated differently, one might ask why legal scholars should record

\textsuperscript{12} Ibid.
\textsuperscript{13} Ibid.
and interpret subjects' brain activity if it simply tells us the same thing that subjects' decisions and reaction times tell us.

Alternatively, if subjects' brain activity differed from their behaviour, then this would indicate that legal scholars and practitioners who seek to understand persuasion and trust may not necessarily get the whole story if they only observe subjects' decisions and reaction times. For example, it was possible that subjects in our experiments would process information differently when it came from a reporter who was trustworthy by virtue of sharing common interests with them versus a reporter who was made trustworthy by an external institution. This difference in the way that subjects process information from these two types of trustworthy reporters could exist even if they were equally likely to base their decisions upon these reporters' reports and even if they took the same amount of time to make their decisions with both reporters. Indeed, research in cognitive neuroscience shows that similar behavioural outcomes can be subserved by different neural mechanisms.¹⁴

20.3 Measuring Persuasion

To assess whether subjects were persuaded by the reporter’s reports, we first examined the extent to which their predictions were the same as what the reporter reported in each experimental condition (i.e. how likely were subjects to predict ‘heads’ when the reporter reported ‘heads’ and predict ‘tails’ when the reporter reported ‘tails’ in each condition). Specifically, we analysed whether subjects’ predictions matched what the reporter reported more than 50 per cent of the time. We used a 50 per cent baseline because we tossed a fair coin; thus, if subjects were simply choosing heads or tails randomly, then we would expect their predictions to match the reporter’s reports 50 per cent of the time. If subjects were persuaded by the reporter’s reports, then we should observe their predictions matching the reporter’s reports more than 50 per cent of the time. We also recorded the amount of time that elapsed between each presentation of the reporter’s report and subjects’ predictions.

We recorded subjects’ brain activity from twenty-nine tin electrodes that were arranged in an expanded version of the 10–20 system atop subjects’ scalps.¹⁵ In a nutshell, these electrodes recorded electrical activity in the brain due to postsynaptic potentials (i.e. graded voltage changes in the cell membrane of neurons) occurring in the cortex. Because electrical activity in response to a particular


event (i.e. stimulus) is quite small, the signal must be enhanced by averaging over a large number of trials. Specifically, for each subject in an EEG experiment, it is necessary to: 1) repeat the event of interest (which in our experiment is the reporter's report) many times in each experimental condition; and 2) time-lock segments of the EEG to that event so that those segments can be averaged together for each experimental condition. This averaging process reveals the subset of each subject's brain's electrical response that is temporally correlated with the onset of the event, and is known as an event-related potential (ERP). Once this averaging process is completed for each subject, all subjects' ERPs are averaged together to produce what is known as a grand average ERP. It is this grand average ERP that is used in statistical analyses.16

In our study, we time-locked subjects' EEGs to the onset of the reporter's report in each experimental condition. We assessed subjects' ERPs by measuring the mean amplitude of the waveform in intervals that captured various cognitive components of interest. Specifically, we analysed the mean amplitudes that we observed in each experimental condition by using three sorts of repeated measures ANOVAs: 1) midline analyses involving measurements taken from channels FPz, FCz, Cz, CPz, Pz, and Oz; 2) medial analyses involving measurements taken from channels FP1, F3, FC3, C3, CP3, P3, O1, and their left hemisphere counterparts; and 3) lateral analyses involving measurements from channels F7, FT7, TP7, T5, and their left hemisphere counterparts.

20.4 Results

20.4.1 Subjects' decisions

When subjects knew that the reporter shared common interests with them, they were significantly more likely to predict 'heads' when the reporter reported 'heads' and predict 'tails' when the reporter reported 'tails' than they would by chance. Specifically, when the reporter reported 'heads' in the Common Interests condition, there was a 94 per cent chance that subjects predicted 'heads' — a figure that was significantly greater than our 50 per cent baseline. Similarly, when the reporter reported 'tails' in the Common Interests condition, there was a 94 per cent chance that subjects predicted 'tails,' which was also significantly greater than our 50 per cent baseline. In the Penalty for Lying condition, subjects' predictions were also significantly more likely to match the reporter's reports than they would by chance. That is, when the reporter reported 'heads' in the Penalty for Lying condition, there was a 94 per cent chance that subjects predicted 'heads.' When the reporter reported 'tails' in the Penalty for Lying condition, there was a 94 per cent chance that subjects predicted 'tails.' These figures were both significantly greater than 50 per cent and were the same as in the Common Interests condition.

16 Steven J. Luck, An Introduction to the Event-Related Potential Technique (Cambridge, MIT, 2005).
In the Conflicting Interests condition, however, subjects' predictions matched what the reporter reported only 50 per cent of the time. That is, regardless of whether the reporter reported 'heads' or 'tails', subjects were equally likely to predict 'heads' versus 'tails'. Taken together, these results were consistent with those of Lupia and McCubbins\(^{17}\) and indicated that subjects were equally likely to trust the statements of a reporter who shared common interests with them and a reporter who was made trustworthy by a penalty for lying. They also demonstrated that subjects' behaviour in both the Common Interests and Penalty for Lying conditions was significantly different from their behaviour in the Conflicting Interests condition, where subjects did not trust the reporter's statements.

20.4.2 Reaction times

Our reaction time results showed a similar pattern. That is, subjects in the Common Interests and Penalty for Lying conditions took similar amounts of time to make their predictions after receiving the reporter's reports. Further, subjects in the Conflicting Interests condition were slower to make their predictions than were subjects in the other two conditions. Specifically, subjects in the Common Interests condition took, on average, 1,191 milliseconds to make their predictions of 'heads' or 'tails', while subjects in the Penalty for Lying condition took, on average, 1,157 milliseconds to make their predictions. This difference was not statistically significant. Subjects in the Conflicting Interests condition, however, took, on average, 1,318 milliseconds to make their predictions, which was significantly slower than subjects in Penalty for Lying and Common Interests conditions.

20.4.3 ERP results

Unlike our behavioural results, our ERP results demonstrated that subjects' brain activity was different when they received information from a reporter who shared common interests with them versus a reporter who was made trustworthy by a penalty for lying. Indeed, across a range of cognitive responses to the reporter's reports, we consistently found that subjects' brain activity was more similar in the Penalty for Lying and Conflicting Interests conditions than it was in the Penalty for Lying and Common Interests conditions. Specifically, prominent portions of the waveform included a negativity peaking approximately 100 ms after the onset of the reporter's report (the AN1), a positivity peaking approximately 200 ms after the onset of the reporter's report (the P2), a more broadly distributed positivity peaking at approximately 500 ms (the P3), a negative-going peak at 600 ms (the medial negativity), and subsequent slow wave activity we refer to as the late positive complex (LPC). With only one exception (i.e. the medial negativity\(^{18}\)), each of

\(^{17}\) Note 4, above.

\(^{18}\) This is the only ERP component that showed a similar response in the Common Interests and Penalty for Lying conditions.
these cognitive responses indicated that subjects' brain activity was different in the Common Interests condition, relative to both the Penalty for Lying and Conflicting Interests conditions. Our results for the P3 and the LPC also demonstrated that there was not a significant difference in subjects' brain activity in the Conflicting Interests and Penalty for Lying conditions.

At a minimum, our ERP results indicate that subjects processed information differently when it came from an individual who shared common interests with them, relative to when it came from an individual whose interests conflicted with their own, but who was made trustworthy by an external institution. More broadly, these results may suggest that subjects' brains treated reports as more informative when the reporter shared common interests with them.\(^{19}\) Further, that we observed differences in subjects' brain activity across these three conditions is remarkable because the visually presented stimuli were identical in each condition. It is also interesting that subjects' brain activity was different in the Common Interests and Penalty for Lying conditions even though both reporters were trustworthy (albeit for different reasons) in these two conditions.

### 20.5 Conclusion

In this paper, we provided an overview of our previous EEG experiments\(^ {20}\) to illustrate the potential that neuroscience has to inform the study and practice of law. Specifically, in our experiments, we analysed subjects' behaviour and brain activity in response to information from reporters whose trustworthiness stemmed from either the reporter's interests (vis-à-vis the subjects) or from an institution, such as a penalty for lying. We did so by recording the decisions, reaction times, and EEGs of subjects who guessed the outcome of an unseen coin toss after they received information from an anonymous reporter who knew the outcome of the coin toss, but was under no obligation to communicate it truthfully. Based upon Lupia and McCubbins's\(^ {21}\) theory and experiments, we predicted that subjects would be equally likely to base their decisions upon the statements of a reporter who was trustworthy by virtue of sharing common interests with them and a reporter whose interests conflicted with their own, but who was made trustworthy by a penalty for lying. Because Lupia and McCubbins's theory does not make predictions about subjects' reaction times and brain activity when receiving information from reporters in the Common Interests, Conflicting Interests, and Penalty for Lying conditions, we asked whether these two other measures would also yield results that are consistent with their conclusion that institutions can substitute for common interests.

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\(^{20}\) Note 9 above.

\(^{21}\) Note 4 above.
Our results indicated that although subjects behaved as if reporters in the Common Interests and Penalty for Lying conditions were equally trustworthy, their brain activity suggested that they processed information differently in the Common Interests and Penalty for Lying conditions. Subjects in both the Common Interests and Penalty for Lying conditions almost always based their predictions on the reporter's reports, while subjects apparently ignored the reporter's reports in the Conflicting Interests condition. Further, subjects' reaction times were similar in the Common Interests and Penalty for Lying conditions and were significantly faster than subjects' reaction times in the Conflicting Interests condition. Based on these behavioural responses, it appeared that subjects were equally likely to be persuaded by a reporter who shared common interests with them and a reporter who was made trustworthy by an institution, namely a penalty for lying.

In contrast, subjects' brain activity in response to the reporter's reports in the Common Interests condition tended to differ significantly from both the Conflicting Interests condition (as expected) and from the Penalty for Lying condition (contrary to our predictions). Thus, even though the reporter was, theoretically and behaviourally, equally trustworthy in the Common Interests and Penalty for Lying conditions, subjects processed information differently when it came from a reporter who was trustworthy by virtue of sharing common interests with them versus a reporter who was made trustworthy by an external institution. In this way, our results suggest that even though institutions can substitute for common interests in a behavioural sense, they do not necessarily induce the same cognitive processing of information.

As for the implications of our results, they indicate, at a minimum, that legal scholars who seek to understand persuasion and trust may not get the whole story if they only observe subjects' decisions and reaction times. Specifically, in our experiments, subjects processed information differently when it came from reporters who were trustworthy for different reasons, and this processing difference existed even though subjects were equally likely to base their decisions upon these reporters' reports and even though they took the same amount of time to make their decisions with both reporters. Given this difference between subjects' behaviour and brain activity, it is clear that recording subjects' brain activity adds a new dimension to our understanding of subjects' decisions to trust and base their decisions on the statements of others.

More broadly, our results have implications for lawyers who seek to present arguments, evidence, and witnesses in the most persuasive way possible during trials. Specifically, our results suggest that the manner in which a speaker is made trustworthy (and not just trustworthiness itself) affects how jurors process information from that speaker. Thus, lawyers who seek to persuade jurors should not necessarily assume that all perceptions of trustworthiness are created equal. Specifically, if the broader interpretations of our EEG results are correct (i.e. that subjects' brains treat reports as more informative in the Common Interests condition, relative to the Penalty for Lying condition), then lawyers (and witnesses) who seek to persuade jurors may benefit from conveying that they share common interests with jurors, as opposed to emphasizing their trustworthiness by appealing
to institutional constraints. Of course, the question of whether and when the cognitive differences that we observed lead to changes in jurors’ behaviour is an empirical question that we will explore in future research.

Finally, we emphasize an important methodological conclusion: namely, that EEG technology has much to offer legal scholars who seek to understand how jurors process information. First, because electricity travels at nearly the speed of light, the voltages that scalp electrodes record reflect the brain’s activity at the same point in time; thus, EEG has excellent temporal resolution (approximately 1 millisecond) and provides a continuous measure of the online cognitive processing of information. Given the many behavioural studies of the online processing model and other theories of cognition, it is clear that the direct real-time processing measure that EEG provides would be beneficial to many scholars. Indeed, in their study of the ‘hot cognition’ hypothesis that underlies the online processing model, Morris, Squires, Taber, and Lodge take advantage of EEG technology to test this hypothesis, arguing that EEG allows for a better understanding of sensory and cognitive processing, as well as the activation of implicit attitudes. We could not agree more.

Second, EEG directly reflects the activity of neurons that are involved in the processing of information; therefore, EEG provides a direct measure of brain activity, in contrast to other neuroimaging techniques, such as fMRI, that provide more indirect measures that are based on blood oxygenation levels or blood flow. Further, unlike other neuroimaging techniques, EEG is much less expensive (the supplies needed to test each subject cost between $1 and $3) and much less invasive (i.e. subjects simply wear a cap atop their heads that contains small electrodes). Thus, EEG provides legal scholars with a unique, practical way of simultaneously observing decision-making and the cognitive processing of information. Further, given the differences that we observed between subjects’ behaviour and brain activity in our study, it appears that recording subjects’ brain activity via EEG can potentially add a new dimension to our understanding of persuasion, trust and other legal phenomena—a dimension that we cannot necessarily tap if we only record behavioural responses.

22 Note 16 above.
24 Note 16 above.