The Brain **Stands Trial**

How important is brain research in the context of ethics and law? Modern analytical processes such as positron emission tomography and functional magnetic resonance imaging have made it possible for the first time to establish the connection between modes of behavior and certain brain activities. Even if we are still very far from being able to read minds, we must still ask ourselves whether the new insights gained in brain research should or, indeed, must be incorporated into legal processes, and precisely which processes should avail of them.

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The increasingly accurate methods and technologies used in the neurosciences have led to the discovery, particularly over the past decade or two, of very direct links between the brain and behavior. Nonetheless, the search for connections between brain activity and behavior can be traced back to the early days of neurological practice, when it also had implications for the assessment of criminal liability and the responsibility of an individual for his or her actions. Cesare Lombroso, a doctor whose theories caused a stir both in forensic-psychiatric and legal circles, is still quoted today.

A large tumor triggered pedophile tendencies

Since the beginning of the present century, the number of case descriptions illustrating these links increased enormously. For example, the story of a father who suddenly started to display pedophilic behavior and was subsequently convicted for it was described by Burns and Swerdlow in the journal Archives of Neurology in 2003. Having complained about constant headaches in prison, he was examined and a large tumor was discovered in his right frontal lobe. Once the tumor was removed, his pedophilic tendencies disappeared completely and he was later able to return to his family. A case of this nature clearly illustrates how changes in the brain can trigger changes in behavior.

The availability of modern imaging technologies such as positron emission tomography (PET) and static and functional magnetic resonance imaging (fMRT) led to an explosive increase in studies on the correlations between behavioral deviations, such as pedophilia and psychopathy, and changes in brain morphology and brain metabolism. Both technologies, PET and fMRT, are now used for very wide-ranging purposes, from lie detection to the mapping of malfunctioning brain areas. In a case involving a murder trial, it was possible to show, using functional brain imaging, that a young woman was a credible witness because she activated the same areas of the brain as those activated by other people when remembering personally experienced events.

Companies already exist in the US that offer lie detection services to the courts. Researchers refer to a series of studies on the differentiation between in-

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vented or fabricated material and authentic memories; other scientists stress the ethical implications of this application-related research. In what was probably the first study carried out on this topic, we discovered that the fabrication of "memories" was followed by the activation of the medial posterior cortex in particular, while the recollection of true memories triggered activity in a region composed of both prefrontal and anterior temporal lobes.

There can be no talk of "mind reading" for the foreseeable future

Whether or not differences in brain activity can reveal that someone believes that he or she is telling the truth while actually providing false information is a particularly interesting question. Numerous studies have already been carried out on this topic from a behavioral perspective and relate above all to the research carried out by the American psychologist Elizabeth Loftus.

We investigated the question regarding the cerebral representation of false memories in a study in which we showed two short and simple movies to students and asked them to watch attentively, as we would later ask them questions about details from the movies. We placed the test subjects in a magnetic resonance scanner and showed them individual images from the two films on a monitor along with other images that were not featured in the movie or were not featured in the same form. To our surprise, the average total number of errors was almost 45 percent. Moreover, it emerged that correctly and incorrectly remembered images activated different regions of the brain: the medial prefrontal cortex was activated primarily in the case of correctly remembered images, while the activation of the visual association cortex in both brain hemispheres was observed mainly in the case of incorrectly remembered images.

A solid collection of methods and technologies and the knowledge based on them has since been established in the natural sciences, enabling us to make a large number of intellectual activities quantifiable. Based on everything that brain research discovers, and as indicated by personality changes following brain damage or external manipulation (brainwashing), it is very difficult to deny that we are controlled by our genes, our environment and the processes that unfold in the brain (and in the rest of the body).

We would now like to consider the question of how these findings and developments should be assessed from the specific perspective of the law and its underlying principles. This includes the question of the nature of the legal proceedings in which the new insights and possibilities provided by brain research can, should or even must be availed of, and the way in which this should be carried out where appropriate. We will limit our considerations to the perspective of criminal law and its legal-ethical principles.

The neuroscientific findings will not and must not prompt the abandonment of a criminal law concept of guilt that is understood as reasonable. They do, however, force us to reconsider its preconditions and scope, and possibly also to reformulate some of its elements. We outlined above (approximately) how the data obtained with the help of complicated calculations enable the recording of neural activity in the brains of test subjects while they undertake certain tasks of a cognitive nature. The corresponding mental processes can thus be associated with some neural correlates – albeit with some uncertainties – whose activity can be observed *in vivo* and (almost) "in real time" in defined areas of the brain and in the network of their complex interactions.

As we have seen, this opens up the basic possibility of "reading" these mental states and performances from the recorded neural data as current processes – admittedly, however, only in the form of highly abstract typifications of the process with which the relevant subject is currently mentally occupied, and not in the form of the concrete content of his or her thoughts. There can be no talk of real "mind reading" in the sense of the decoding of differentiated semantic content in the foreseeable future. However, even if it is presently possible only within the narrow confines of simplistically constructed experiments, functional imaging processes can be used to determine, with a reasonable degree of reliability, whether certain expressions of thought are true (and this does not exclude the possibility of their incorrectness being a matter of error) or fabricated.

In the context of the questions raised here, it makes sense to differentiate between two basic perspectives: first, the question as to the basic legitimacy of the use of neuroimaging in criminal proceedings, and second, its corresponding suitability. Multiple uncertainties, which, based on the current

status of research in the field, obscure all insights into the inner life of a subject through neuroimaging, may render it unsuitable for use in such a significant and, indeed, often vitally important process as a criminal trial.

A criminal trial is not a homogeneous process carried out with a view to fulfilling an unchanging legal objective and characterized by constant interests on the part of the participants, the public and the state. Rather, it consists of clearly separated sections with which the legal order associates different objectives, and in which the roles of the participants and the observing public assume different forms. The fact that the holders of these roles also pursue entirely different and, in part, clashing interests is, of course, obvious. All of these differences influence the significance that the results of the insights into the internal mental life of a person involved in a court case, obtained using neurotechnological means, could have for the individual himself or herself, and for the other participants at the different stages of the criminal proceedings.

As is generally known, under criminal law, the onus is not on the defendant to prove his or her innocence, but on the prosecution and, ultimately, the court that hears the case. As far as the latter is concerned, in cases of doubt, the presumption of innocence, which is guaranteed under constitutional and human rights law and is traditionally formulated in the constitutional state principle of *"in dubio pro reo,"* works in favor of the defendant. The latter may, therefore, also be interested in using evidence that (still) appears to be unreliable in scientific terms and whose circumstantial evidence value is, at best, low – even the weakest suggestion of his or her innocence may be welcome. Although it may not be very convincing in itself, such evidence could cast a shadow of doubt on the court's opposing view, and this could prove crucial for the outcome of the court case.

If the defendant actually committed the crime of which he or she stands accused, then he or she will also want to avoid the presentation of the slightest incriminating circumstantial evidence. In this instance, the use of neuroimaging, which is difficult to calculate in advance and may provide just such circumstantial evidence, would be highly undesirable. In terms of the opposite purpose, that is, providing proof of the defendant's guilt, neuroimaging does not provide suitable evidence for any of the participants involved in criminal proceedings.

Based on the current, and probably also immediately foreseeable, state of their development, the deficits displayed by all imaging procedures in terms of validity and reliability are far too extensive for this. An application made by the prosecution on this basis could thus be rejected outright by the court on the grounds of unsuitability of the evidence (section 244, subsection 3, sentence 2 of the German Code of Criminal Procedure [StPO]).

The question regarding the reliability of neuroimaging is, however, seen in a different light when it is requested by the defendant or his or her lawyer. For

A low circumstantial evidence value is enough if it can establish doubts about the defendant's guilt

the purposes of the defense, as already suggested above, the scientific limits of the validity of the neuroimaging process do not, in any way, give rise to its "complete unsuitability" for use as evidence. If it can establish or reinforce doubts regarding the defendant's guilt, a low circumstantial evidence value is sufficient to justify its suitability for defense purposes. And it can't be denied that the results produced by the various neuroimaging processes today provide this kind of weak circumstantial evidence.

This observation must, however, withstand the arguments that prompted the First Criminal Division in 1998 and, five years later, the Sixth Criminal Division of the German Federal Court of Justice to reject the traditional polygraph process of "lie detection" as "completely unsuitable" for use in both criminal and civil proceedings. In their abstract form, these arguments would appear to fully support a corresponding verdict against today's neuroimaging processes. However, two things should be noted here. First, in certain respects that can be precisely defined, the neuroimaging processes available today exceed the reliability of the traditional polygraph process of "lie detection" and will do so even more clearly in the future.

Second, the validity criteria formulated in the resolution of the Federal Court of Justice of 1998 are already excessive in relation to the polygraph method. This fact was correctly criticized by the relevant ex-

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perts in the debate following their adoption. If the requirements proposed for the polygraph by the Federal Court of Justice were also to be applied to the other psychological and psychiatric diagnostic processes that have been used in criminal proceedings since time immemorial, hardly any of them would be found to be in compliance.

Based on this, the following prediction may be made: it is very unlikely that the use of neuroimaging processes to establish the veracity of statements will be excluded from evidence gathering for criminal proceedings in the future with reference to their lack of suitability. Admittedly, this observation necessitates an important limitation and a no less important caveat: on the one hand, the use of imaging tests can be possible only for trial participants who, following adequate instruction on the forms, risks, possibilities and limits of the proposed process, agree to the test without any form of coercion or pressure.

The limits of the different forms of neuroimaging must be considered in detail

And on the other hand: despite the astonishing progress made in recent years in terms of the development, reliability, understanding and possible applications of the different forms of neuroimaging, their suitability for determining the truth in criminal proceedings is currently still subject to obvious limitations. Even if the process is to be used at the request and in the interest of the cooperating defendant, its limits must be considered in detail. This is the only way that serious misinterpretation of their results can be avoided and a suitable assessment be made as to the significance of the circumstantial evidence they provide. Here are the most important of these limits:

(1) It is likely that both the lay persons and judges involved in a criminal trial will perceive the colored computer images in which the results of brain-imaging studies are documented as a kind of photographic snapshot of the brain of a subject while he or she carried out the test task in question. This is incorrect in several respects. First, these images merely present computer-generated statistical mean values from many thousands of recordings. Second, in most of the studies conducted to date, the data on which the statistics are based are drawn from numerous personal sources: they represent mean statistical values based on larger groups of subjects rather than individuals. Third, and finally, these images are not direct photographs of the neural activity of thinking brains. Instead, they are generated from certain biological markers: in the case of functional magnetic resonance imaging, the markers involved are the metabolic correlates of brain activity. Conclusions about the underlying neural activity can be drawn from minute differences (or, to be more precise, from thousands of results from such minute differences) in the accumulation of oxygen observed in certain cerebral areas during the tests.

(2) The number of cortical areas identified, in studies carried out to date, as very likely to be involved when someone tells a lie is considerable. Moreover, the consistent mapping of these areas as involved in deception is significantly hampered by the fact that they are involved in numerous other mental activities and not just deception. The brain does not have a specific "lying area." Furthermore, the complex interaction between the areas involved is far from sufficiently understood.

(3) The subjects involved in the tests carried out to date regularly display considerably greater homogeneity – in most cases they were healthy young university students – than may be found among the defendants involved in criminal proceedings. Whether and to what extent the information gained in this way may be generalized, irrespective of the considerable differences in age and social status of those tested, remains unclear.

(4) At present, the potentially most serious problem is posed by the stylized artificiality of the diversionary maneuvers assigned to the test subjects in the studies conducted thus far. They usually have to "lie" about very simple things, such as the symbol or suit of a playing card shown to them. Such (desired!) untruths are not associated with any risk whatsoever, and thus involve little or no stress for the test subjects involved in such studies. Precisely what, then, do the neuroimaging results of such studies have to say about real life situations in which the incredibility of a false statement may be associated with serious risks, and the psychological pressure on the person telling the lie is correspondingly high? Or, more simply: Does the false denial of a murderous deed on the witness stand involve the same areas of the brain as the denial of the perception of a certain card to the

leader of a research project? And does the denial of a murderous crime involve the same brain activity as the refutation of an insult or the forging of a document? We still do not have any definitive answers to these questions.

Against this background, we believe that three conditions must be fulfilled in order for neuroimaging methods to be deemed fundamentally suitable for determining the truth in criminal proceedings: first, it must be clarified that the results of these processes have merely a highly relative circumstantial evidence value that can make no claim to superiority over other circumstantial evidence. Second, both lay assessors and professional judges must be clearly instructed on this point so that they can avoid succumbing to any false suggestion that may be based on the concise clarity of the visual representations. This may lead lay persons to the false assumption that the clarity of the images reflects a corresponding clarity of the facts that have been certified by the certainty of a scientific evidence-collecting process. Third, and finally, the tasks of implementing the desired tests and instructing the court in relation to their possibilities and limits must be assigned solely to scientific experts with specific qualifications in this area.

> The brain does not have a specific "lying area"

When and to what extent such factors can contribute to the mitigation of the guilt or even exoneration of a defendant and to the assessment of the continuing danger represented by a prisoner is, at present, anything but clear. It may, however, safely be predicted that this question will become one of the most prominent elements of criminal law development in the 21st century. It is important that its clarification become the object of intensive cooperation between lawyers, neuroscientists, neuropsychiatrists and legal philosophers. The corresponding debate at the international level has already begun. Even considering all of the unresolved controversies that have yet to be played out, in particular regarding the relationship between the normative and empirical elements of the concept of guilt, it promises to herald a major boost for the creation of an enlightened criminal law for the future. ◀

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THE BOOK

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