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Dilemmas and Solutions in the Judgment of Criminal Intent Against the Background of Brain-Computer Interface Technology

Yujia Rong

Law School, Nankai University, Tianjin, China
AuroraVickys@outlook.com

Abstract. The application of Brain-Machine Interface (BMI/BCI) technology poses a fundamental challenge to the identification of criminal intent in traditional criminal law. This paper systematically analyzes how this technology impacts the two core elements of "knowledge" and "freedom of will" in criminal intent from the perspectives of cognition and will, and further reveals the multiple dilemmas faced in judicial practice. To address these challenges, this paper advocates the construction of a multi-level adaptive system and the establishment of corresponding supporting mechanisms to enhance the operability of judicial practice, so as to safeguard the impartiality of criminal law while ensuring technological development.

Keywords: Brain-Computer Interface, criminal intent, subjective structure, cross-analysis, system construction

1. Introduction

Brain-Machine Interface (BMI) or Brain-Computer Interface (BCI) refers to the direct connection established between the brain of humans or animals and external devices to realize information exchange between the brain and devices. As a revolutionary human-computer interaction technology, brain-computer interface technology bypasses peripheral nerves and muscles to directly build a brand-new communication and control channel between the brain and external devices. It captures brain signals and converts them into electrical signals to realize information transmission and control. With the development of brain science, artificial intelligence and materials science, brain-computer interface technology has been advancing continuously. It not only plays an important role in improving patients' quality of life and promoting personalized and precise medical treatment, but also changes the way of social interaction. These changes have exerted a significant impact on the field of criminal law, and issues such as criminal subjects, criminal acts and consequences of acts remain to be resolved. Among them, the judgment of criminal intent, as a type of subjective state of mind, also faces dilemmas due to the development of brain-computer interface technology. In judicial practice, problems such as alienated behavioral patterns, complicated liability attribution, and admissibility of new types of evidence have become practical obstacles to the judgment of criminal intent. To cope with the complex challenges in judicial practice, it is

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imperative to study the alienation of the subjective structure of criminal intent and its judgment dilemmas.

2. Analysis of the impact of Brain-Computer Interface technology on the subjective structure of criminal intent

Brain-computer interface technology, through the new form of "human-machine integration", has a structural impact on the traditional identification system of criminal intent. Under the influence of brain-computer interface, the cognition and will of the actor may face alienation. Therefore, analyzing the specific impact of brain-computer interface technology on the subjective structure of criminal intent will provide an indispensable theoretical premise for responding to subsequent judicial challenges.

2.1. Alienation in the cognitive dimension

Within the framework of traditional criminal law theory, the element of "knowledge" in criminal intent has always been based on the actor's normal cognitive ability, and the cognitive content is mostly limited to the connection between physical acts and direct harmful consequences. However, the emergence of brain-computer interface technology has broken this traditional identification framework of the "knowledge" element, and further reshaped the identification standard of criminal intent.

Firstly, the enhancement or weakening of cognitive ability by brain-computer interface has a significant impact on the identification of intent.

First, in the scenario of enhanced cognitive ability, the cognitive level improved by technology will affect the identification standard of "knowledge" in criminal intent. Invasive brain-computer interfaces optimize synaptic plasticity through connection with neurons, realizing rapid memory extraction and improved cognitive accuracy [1]. For example, the invasive brain-computer interface chip developed by Neuralink, a company owned by Musk, has such a function—the chip is implanted into the cerebral cortex to directly establish connections with neurons, realizing rapid memory and precise extraction of specific knowledge, and greatly reducing the time cost and difficulty threshold of cognitive learning [2]. With the assistance of such cognition-enhancing technology, the actor's cognitive degree of the connection between "act-harmful consequence" far exceeds the level achievable through self-learning. Therefore, the requirement for "knowledge" of such actors should be correspondingly broadened, and indirect factors such as "learning cycle" and "knowledge background" no longer need to be considered. In addition, some views in practice hold that this "cognitive increase" is passively accepted by the actor. In fact, the current mainstream cognition-enhancing brain-computer interfaces are not simply "information storage tools", but intelligent systems with "auxiliary functions for knowledge understanding and application" [3], which means that the actor's cognition of harmful consequences has transformed from "passive memory" to "active understanding". Thus, the actor should not use this as a defense for "knowledge".

Second, in the scenario of weakened cognition, technological intervention may blur the boundary between "knowledge" and negligence. Some brain-computer interfaces may interfere with the neural activities of cognitive-related brain regions such as the prefrontal cortex, breaking the normal cognitive regulation mechanism, reducing the subject's ability to identify and evaluate act risks, and further leading to dilemmas in the identification of knowledge and negligence of criminal intent. In this regard, the "actor's foreseeability of cognitive weakening" can be taken as a key consideration

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factor, combined with "avoidance ability" for judgment. When the actor has no way to know the impact of the brain-computer interface device on cognition, that is, cannot foresee it, it shall be identified as negligence or an accident; when the actor is aware of the potential risks through product warnings or other means, and has the ability to avoid them by refusing to operate, but still indulges or desires their occurrence, it shall be identified as indirect intent.

Secondly, brain-computer interface expands the extension of the actor's cognitive content, and also extends its cognitive boundary from the biological brain to the "brain-technology" hybrid.

First, the expansion of knowledge related to brain-computer interface requires the application of the "knowledge" presumption rule to technical subjects. On the one hand, professional knowledge related to brain-computer interface is included in the actor's cognitive category. On the other hand, with the participation of brain-computer interface devices, the way of confirming cognitive content has changed from the traditional model relying on the internal processing of the brain to a new model relying on "chip storage + algorithm operation" [4]. Under this model, the technicality and professionalism of brain-computer interface create space for actors who actually master technical knowledge to deny criminal intent. Therefore, to prevent such subjects from denying criminal intent on the grounds of "unaware that the technology may cause harmful consequences", the "knowledge" presumption rule can be tentatively applied. Under this rule, actors with professional knowledge of brain-computer interface are presumed to have cognitive content including harmful consequences caused by technical vulnerabilities or functions, unless the actor can provide sufficient rebuttal evidence. On the one hand, it helps to break the dilemma of identifying criminal intent faced by judicial organs due to technical barriers. On the other hand, reversing the burden of proof helps to balance the duty of care and right protection of such actors, and protects their right of defense while urging them to improve their duty of care.

Second, risk cognition is upgraded. The application of brain-computer interface technology also expands the "risk cognition" in criminal intent from the traditional "physical injury risk" to "mental privacy invasion risk" and "data abuse risk". This upgrade of risk cognition requires the synchronous expansion of the content identified by "knowledge". From the perspective of legal attributes, according to the definition of "sensitive personal information" in the Personal Information Protection Law, electroencephalogram data, as "once leaked or illegally used, it is easy to cause infringement on the personal dignity of natural persons or harm to personal and property safety", belongs to "ultra-sensitive personal information", and its legal protection intensity should be higher than that of ordinary personal information [5]. From the perspective of criminal intent cognition, "the risk of electroencephalogram data leakage" has the same legal value as the "physical injury risk" in traditional crimes, both of which may cause serious infringement on the legitimate rights and interests of obligees. Therefore, "cognition of the risk of electroencephalogram data leakage" should be included in the content category of "knowledge" of criminal intent, and apply the same identification standard as "physical risk cognition".

2.2. Structural impact on freedom of will

Brain-computer interface technology realizes the reverse regulation of neural signals through "machine-brain connection" and "brain-brain connection", dividing free will from a complete and independent state into three forms: "complete manipulation", "partial interference" and "independent exercise", each of which has a differentiated impact on the identification of criminal intent.

First, in the form of complete manipulation, the actor completely loses freedom of will, and criminal intent is directly excluded. Brain-computer interface can deeply intervene in neural signal transmission through algorithms to realize complete manipulation of the actor. For example, a

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"machine-brain connection" type brain-computer interface can transmit control instructions to the brain from an external device, and forcibly drive muscle movement by simulating a specific electroencephalogram pattern, reducing the actor to a "biological puppet"; "brain-brain connection" technology can realize consciousness hijacking and transfer the right of act domination to the manipulator [6]. At this time, the actor's acts are completely controlled by external instructions, and his subjective will is forcibly replaced by the manipulator's will through technical means. In this state, the actor's acts are disconnected from his own cognition and emotions, he has neither the ability to recognize the harm of the act nor the possibility to dominate the act, which does not meet the core element of "domination by freedom of will" in criminal intent, and the establishment of intent can be directly excluded.

Second, in the form of partial interference, the degree of will distortion determines whether intent is established. Partial interference is reflected in the selective intervention of brain-computer interface on free will. Unlawful actors may use neural technology to force users to change their self-cognition without their knowledge and make users act against their original will [1]. For example, transcranial direct current stimulation (tDCS) is used to strengthen aggressive impulses or weaken risk judgment ability, and subconscious manipulation is used to affect decision-making autonomy [7]; passive brain-computer interfaces can monitor users' brain activities (such as fatigue and emotions) that are not voluntarily regulated, which may lead to "illusion of control" and make users mistake machine intervention for independent decision-making [8]. In this state, the actor still retains part of his cognitive and control abilities, but his will tendency is directionally distorted by technical means, leading to a possible deviation in his attitude towards harmful consequences. From the analysis of the will element of criminal intent, partial interference may make the actor form a wrong conviction about the judgment of "act necessity" (such as mistaking an aggressive act for "legitimate defense") or blind optimism about "possibility of avoiding consequences". In this case, although the actor's freedom of will is not complete, he can still make certain choices within the scope of technical interference, and his attitude of "indulgence" or "overconfidence to avoid" harmful consequences may still make him meet the establishment conditions of intent or negligence.

Third, in the form of independent exercise, the brain-computer interface is only a tool, and the traditional intent identification standard is followed. The "brain-to-machine" type brain-computer interface expresses the user's intention in the form of a machine. If the system operates normally, the validity of its expression of intention should be recognized, and the user has the obligation to foresee the risks of technical tools [9]. That is to say, when the brain-computer interface only serves as a "brain-machine connection" type tool (such as mind-controlled prosthetics) and does not intervene in the will formation process, the actor expands the scope of action through technology, but makes completely independent decisions, and freedom of will is not substantially intervened at this time. In this state, the actor foresees the risks of technical tools and has a clear cognition of the connection between "act-harmful consequence", and his will domination state is no different from that of traditional crimes, so the traditional intent identification standard can be directly applied.

3. Practical challenges in the identification of criminal intent

The theoretical impact analysis reveals the variation of the subjective structure of criminal intent, and placing these changes in practice will expose more intractable practical problems. The conflict between technology and law is not only reflected in abstract theoretical models, but also permeates every judicial link, constituting practical challenges that must be faced in the identification of criminal intent.

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3.1. Dilemmas at the technical level

Firstly, the pattern of criminal acts has been alienated, and there are identification differences between electroencephalogram acts and traditional physical acts. In criminal law theory, criminal act is one of the prerequisites for the establishment of a crime. If an actor does not commit an act, he cannot constitute a crime [10]. In traditional criminal law, criminal acts are centered on physicality and externality, which are physical movements and stillness dominated by human free will. At this time, subjective intent can be identified through multiple objective elements such as the way and result of the act. However, the "electroencephalogram act" in the scenario of brain-computer interface technology has completely broken the traditional logic of identifying criminal acts. Under the new form of "human-machine integration" of brain-computer interface, criminal acts have transformed from traditional external physical actions to internal neural activities. The profound change in the nature of acts has also brought major challenges to the identification of intent in criminal law theory.

First, the immaterialization of criminal acts leads to the lack of external manifestation of intent. Under brain-computer interface technology, acts are gradually separated from material carriers and directly related to the actor's mental activities [11]. This non-physical characteristic enables acts to be directly triggered by neural signals, and the lack of observable direct external manifestations such as "waiting in advance" and "carrying out the act" makes it difficult for judicial organs to presume whether the actor intended or negligently committed the act through act traces. At this time, the identification of subjective intent can only rely on the interpretation of neural signals. However, in practice, the technology for corresponding identification between subjective intent and neural signals is not mature. Relevant studies in cognitive neuroscience show that there is "ambiguity" between electroencephalogram signals and the actor's psychological state, and it is difficult to establish a one-to-one specific relationship between them [12].

Second, the black-boxing of the act process leads to the break of intent connection. The operation of brain-computer interface follows the complete chain of "electroencephalogram signal collection-information analysis and processing-external device control-information feedback closed loop" [13]. Among them, the "information analysis and processing" link mainly relies on artificial intelligence algorithms with strong professionalism and concealment, so electroencephalogram acts are inevitably under the "algorithm black box". Ordinary people have no access to the logic and mechanism of algorithm operation. After a criminal act is committed, it is difficult to distinguish whether the act is intentionally manipulated by the actor, caused by equipment misjudgment due to algorithm failure, or caused by the equipment being maliciously tampered with or invaded by a third party. If the actor defends the reason for committing the criminal act, and the judicial organ cannot prove the corresponding connection between neural signals and subjective intent, the identification of subjective intent is likely to fall into the dilemma of "no basis to rely on".

Third, the blurring of act boundaries leads to difficulty in determining the scope of intent. Unlike traditional physical acts, electroencephalogram acts do not have clear act boundaries, and often break through the limitations of physical space due to their non-physical characteristics. As a result, the identification of subjective intent falls into a dilemma. Imagine if an actor uses a brain-computer interface to control multiple devices at the same time to infringe on multiple objects. At this time, is his intent directed at specific objects or unspecified majority? Is it specific intent or general intent? The traditional intent identification standard has applicable loopholes for this "one-to-many" act pattern, resulting in the lack of clear judgment on the definition scope of subjective intent in the brain-computer interface scenario.

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Moreover, under the complex subject liability chain, intent attribution is difficult. Criminal acts of brain-computer interface are the result of the interweaving of multiple factors, which may involve multiple subjects such as users, manipulators, equipment manufacturers, operation and maintenance parties, and data service providers. The interweaving of multiple subjects makes the identification of intent attribution under the traditional legal framework extremely complicated. The perpetrator of a criminal act has changed from a single subject or multiple accomplices to a complex form involving multiple subjects, and the subjective intent state of each subject may be different, leading to difficulties in intent attribution.

First, there may be conflicts in intent attribution between users and manipulators. In the form of "complete manipulation" or "partial interference", users will be interfered by manipulators to varying degrees. At this time, we need to distinguish the criminal intent of the two: if the act committed by the user is completely controlled by the manipulator externally and has no subjective criminal intent, the intent should naturally be attributed to the manipulator, who shall be identified as an indirect principal; but if the user is only partially interfered by the manipulator, has indirect intent of desiring or indulging, and takes the initiative to cooperate with the manipulator to commit a criminal act without taking avoidance measures, the intent may be attributed to both at the same time, that is, joint intent is established. In practice, it is extremely difficult to accurately identify the "dominant intent" of the manipulator and the "cooperative intent" of the user. Manipulators and users may also defend on the grounds of "technical testing, unintentional crime" and "being coerced, not intentional", making it difficult to identify intent attribution.

Second, the identification of intent of equipment manufacturers is also difficult. The controversy mainly focuses on whether the manufacturer has indirect intent of "knowing that the equipment may have risks but indulging them". If it is an "illegal equipment manufacturer" (that is, a manufacturer specializing in the illegal production of invasive brain-computer interface equipment for manipulating others), the identification of its subjective intent is naturally relatively easy. Of course, the other party may defend on the grounds of "scientific research experiment, unintentional crime"; however, in practice, most are "legal equipment manufacturers" (that is, manufacturers legally producing medical brain-computer interface equipment and other equipment), and the identification of subjective intent is more complicated at this time. If someone finds a design vulnerability in the equipment and then maliciously uses it to commit a crime, how to identify the subjective state of the equipment manufacturer? Does it have negligent negligence, overconfident negligence or even indulgent indirect intent? For example, if the equipment manufacturer fails to set necessary safety protection procedures for the equipment, leading others to find vulnerabilities and then manipulate users to commit crimes, how should we judge whether it knows that the vulnerability may cause criminal risks?

Third, the causal relationship of intent may break. According to the objective imputation theory, "attribution" belongs to factual judgment, and "imputation" belongs to normative evaluation [14]. However, in the brain-computer interface scenario, the intervention of complex technologies and numerous subjects makes the factual causal relationship non-linear, and it is difficult to complete the "one-to-one" attribution identification. On the one hand, as mentioned above, the operation of brain-computer interface technology goes through a complex process chain, and errors in each link may affect the final result. At this time, the causal chain between the actor's will and the committed act may break. The judgment of "whether the act belongs to the actor's domination field" in the objective imputation theory faces challenges [12]; on the other hand, there are too many subjects involved in criminal acts. When multiple subjects intervene in a crime successively, it is difficult to

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determine the exact causal relationship between the intent of each subject and the harmful consequence. At this time, the causal chain faces a break crisis again.

3.2. Operational obstacles in judicial practice

Firstly, the legal status identification and admissibility problems of new types of evidence (such as electroencephalogram signals) in intent proof remain to be solved. As the core new type of evidence to prove criminal intent, electroencephalogram signals, due to their own particularity and the lag of current evidence rules, often fail to fully play their probative role in judicial practice:

First, there is no clear standard for evidence qualification identification. The Criminal Procedure Law stipulates that evidence is divided into physical evidence, documentary evidence, witness testimony, electronic data and other categories. The legal attribute of new types of data such as electroencephalogram signals is fundamentally controversial. This new type of evidence is different from the subjective statement characteristics of traditional verbal evidence, nor is it completely equivalent to the objective data generated by machines. They have the dual attributes of biological characteristics and electronic characteristics, and are not clearly included in the statutory evidence categories, making judicial practitioners often face difficulties in evidence identification. All evidence must meet the tripartite review of "authenticity, legality and relevance". If identified as electronic data, the fact that electroencephalogram signals and other data are easily changed by many factors such as emotions and physical conditions cannot be ignored, and their authenticity is difficult to guarantee; if identified as biometric evidence, the current law lacks procedural provisions for their search and collection, and their legality is difficult to determine.

Second, it is difficult to prove the relevance of evidence. The core of criminal intent is the actor's "subjective psychological state", while data such as electroencephalogram signals more reflect the actor's neural activities, and it is difficult to establish a direct and effective connection between the two. Studies in cognitive neuroscience show that there is a "one-to-many" or "many-to-one" fuzzy correspondence between electroencephalogram signals and psychological states. The same electroencephalogram signal may correspond to different psychological states, and the same psychological state may also produce different electroencephalogram signals. For example, the electroencephalogram signal representing "excitement" may be a reflection of the intentional psychology when the actor commits a crime, or just a normal emotional reaction. At present, judicial organs lack technical means and judgment standards for accurate identification, so it is difficult to admit such new types of data.

Third, the technical threshold for evidence admissibility is too high. Due to the high technicality and professionalism of new types of evidence such as electroencephalogram signals, their interpretation and identification can often only rely on relevant professional institutions. However, the research and identification standards for brain-computer interface evidence are still being improved, so it is difficult for judicial organs to accurately judge the reliability and scientificity of expert opinions. In such a scenario, the prosecution and defense have no way to effectively cross-examine the professional expert opinions, which also affects the fairness of intent identification.

Secondly, there are connection difficulties and practical deviations between technical causal relationship and legal intent judgment. The intervention of brain-computer interface technology has transformed the causal relationship of criminal acts from the traditional "physical causal relationship" to "technical causal relationship", and there is inevitably a connection fault between the complexity of technical causal relationship and the normativity of legal intent judgment, leading to deviations in intent identification in practice.

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In terms of connection difficulties, on the one hand, the multiplicity of technical causal relationships leads to the ambiguity of the premise of legal intent judgment. The operation of brain-computer interface technology goes through a complex process chain and has a complex technical causal relationship. Each layer of relationship may have the situation of multiple causes leading to one effect or one cause leading to multiple effects, which greatly hinders the judicial organs from proving the actor's intentional psychology in each link; on the other hand, the legal intent judgment is insufficiently adaptable to technical causal relationships. Limited by technological development, the current laws and regulations have not yet formed a unified standard for the identification of technical causal relationships with high technicality and professionalism.

In terms of practical deviations, there may be a risk of "inferring intent from results". The complexity of technical causal relationships may make judicial organs tend to infer the actor's subjective intent from harmful consequences in the absence of direct evidence to identify intent. But this is obviously incorrect. A series of external factors such as third-party intervention and technical failure may affect the operation of brain-computer interface equipment. Therefore, in judicial practice, even if it is difficult to identify subjective intent due to technical problems, we must adhere to the criminal law principle of "unity of subjectivity and objectivity", implement the idea of "presumption of innocence", and try to avoid unjust, false and wrong cases.

4. Constructing an identification system of criminal intent adapted to the era of brain-computer interface

Faced with the dual theoretical and practical dilemmas in the identification of criminal intent under brain-computer interface, passive case-by-case response is no longer sufficient to support the stable operation of the judicial system. At this time, a systematic response becomes inevitable. We need to continuously promote the improvement of criminal law theory and system on the premise of respecting the basic principles of criminal law, and construct a new identification system of criminal intent with forward-looking, adaptability and operability, so as to ensure the orderly development of brain-computer interface technology within the legal track.

4.1. Theoretical innovation and framework reconstruction

Firstly, it is necessary to actively explore a theoretical model of the subjective structure of criminal intent that conforms to the characteristics of brain-computer interface. Brain-computer interface technology has a great impact on users' cognitive ability and freedom of will, so it is urgent to establish a subjective structure model of criminal intent adapted to its characteristics. The model can be designed hierarchically from the two dimensions of cognition and will:

First, the cognitive design can be carried out from three aspects: enhanced cognitive ability, weakened cognitive ability, and expanded cognitive content. In the scenario of enhanced cognitive ability, indirect evidence such as "knowledge background" in traditional criminal identification will no longer apply. When the cognitive ability enhanced by the brain-computer interface is sufficient to recognize the connection between the act and the consequence, the actor shall be identified as knowing; in the scenario of weakened cognitive ability, attention should be paid to distinguishing the subjective psychological state for the "weakening". If the weakening is truly unforeseeable and unavoidable, the act committed by the actor will exclude the establishment of intent due to the lack of cognitive possibility. However, if the actor indulges in the foreseeable and avoidable weakening of cognitive ability, his subjective state will constitute indirect intent; in the scenario of expanded cognitive content, stricter identification standards should be applied to subjects with more

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professional knowledge of brain-computer interface, so as to regulate them from using the expanded cognitive content to commit crimes through technical vulnerabilities and evade legal accountability.

Second, the will design can be carried out from three aspects: complete manipulation form, partial interference form, and independent exercise form. In the form of complete manipulation, the actor completely loses freedom of will, and criminal intent can be directly excluded, with criminal liability borne by the manipulator; in the form of partial interference, it is necessary to determine the degree to which the actor is affected by the brain-computer interface equipment through accurate calculations such as technical judgment. If it only interferes with the decision-making tendency, but the actor still recognizes the harmful consequence and chooses to commit the act, it will not affect the identification of criminal intent. If the brain-computer interface interferes with the actor's decision-making freedom, that is, he cannot resist its influence, intent shall be excluded and identified as an accident or other circumstances; in the form of independent exercise, the brain-computer interface is only a tool. Since the actor has completely independent freedom of will, the traditional intent identification standard in criminal law can be directly applied.

Secondly, it is necessary to provide scientific and reasonable theoretical basis for judicial application. The premise of the application of the above theoretical model in judicial practice is that it is scientific and reasonable, that is, it can provide a solid legitimate basis for judicial application.

First, it conforms to the basic principle of unity of subjectivity and objectivity. Taking the degree of intervention of brain-computer interface on users' cognition and will as the core standard, the model is divided into hierarchical processing. It not only considers the intervention of technology, but also does not deviate from the actor's own subjective cognitive possibility and freedom of will, avoids wrong tendencies such as result-only theory, and follows the basic criminal law principle of unity of subjectivity and objectivity.

Second, it follows the methodology of criminal law interpretation and application. This model is not a complete overthrow of the traditional theory of identifying criminal intent, but a new theoretical framework with creativity and transformation formed on the basis of traditional theory through standardized and refined interpretation of key concepts such as "knowledge" and "freedom of will".

Third, it has cross-theoretical support of brain science and law. The division of cognitive and consistent standards in the model draws on the division standards in neuroscience, transforms technical standards into intent identification standards, and realizes the effective connection between brain science achievements and legal application. The interdisciplinary and professional theoretical foundation also adds credibility to judicial application and provides a scientific basis for judicial adjudication.

4.2. Improvement of legal system and guidance of judicial norms

Firstly, it is necessary to formulate special laws and regulations, improve the criminal law system, and fill the legal gaps in the identification of criminal intent related to brain-computer interface.

First, clarify the evidence status and evidence collection rules of brain-computer interface data. In terms of evidence status, a category of "biological electronic data" can be added according to technological development, and new types of evidence represented by data generated by brain-computer interface with the development of technology, such as electroencephalogram signals and neural activity data, can be included in it, clarify their dual attributes of biological characteristics and electronic characteristics, and unify the evidence qualification identification standards. At the same time, clarify the procedural provisions for the collection of relevant evidence, such as formulating special procedural provisions for the search, collection and fixation of biological

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electronic data to ensure the legality of evidence. On the one hand, it is necessary to clarify the approval authority and operation process for investigative organs to collect brain-computer interface data, requiring that it must be carried out by professional personnel with compliant equipment to ensure the legality of evidence collection. On the other hand, in view of the fact that electroencephalogram signals are easily affected by many factors such as emotions and physical conditions, an authenticity verification rule can be established, requiring that the background information such as the actor's emotions and physical conditions be recorded synchronously during evidence collection for later proofreading and elimination of invalid data; in terms of evidence collection rules, legislation can be used to force brain-computer interface enterprises to achieve "transparent operation". Enterprises are required to disclose the operating principles and logic to regulatory authorities, and store brain data generated by users due to brain-computer interface in neutral third-party institutions to ensure that investigative and judicial organs can obtain relevant original data in a timely, accurate and comprehensive manner. Prevent enterprises from privately modifying data and destroying evidence to ensure the authenticity of evidence. Optimize the application rules of new types of evidence to promote the identification of criminal intent;

Second, optimize the burden of proof rules, and refer to product liability to reverse the burden of proof. When a criminal act is related to the use of brain-computer interface equipment, the equipment manufacturer shall first bear the burden of proof. It is required to prove that its products meet national safety standards, have no design vulnerabilities or algorithm defects, and at the same time prove that the harmful consequence is caused by its own no-fault reasons such as the user's independent intent or third-party illegal invasion; for manipulators with professional knowledge, they are required to prove that there is no causal relationship between their acts and harmful consequences to break their defense on the ground of "technical professionalism"; for ordinary users, the general rule of "he who claims must prove" is still applied, and the prosecution proves the establishment of their subjective intent to balance the burden of proof capacity of all parties and reduce the difficulty of proof for judicial organs. Reversing the burden of proof in a timely manner can efficiently investigate defenses such as technical failures and reduce the difficulty for judicial organs to identify criminal intent in a multi-subject liability chain [11].

Secondly, it is necessary to improve judicial interpretations and operation guidelines to standardize the intent judgment standards in judicial practice.

First, issue special judicial interpretations to refine the adjudication rules for intent identification. In view of the above-mentioned "cognition-will" two-dimensional theoretical model of the subjective structure of criminal intent, special judicial interpretations shall be issued to transform the theoretical identification rules into judicial application standards. On the one hand, it is necessary to refine the intent identification elements in different technical scenarios. On the other hand, it is also necessary to unify the intent attribution standards in the multi-subject liability chain, clarify the liability division boundaries of manipulators, users and equipment manufacturers, and solve the problem of inconsistent intent identification standards in judicial practice.

Second, formulate judicial operation guidelines to lower the technical application threshold. In view of brain-computer interface issues, China has issued the Ethical Guidelines for Brain-Computer Interface Research, but there is still a lack of more targeted and normative operation guidelines. To better respond to specific issues, specific guidelines can be formulated for issues such as criminal intent. The guidelines should be both professional and practical. On the one hand, they can sort out the core principles of brain-computer interface technology, common crime patterns and key points of evidence review to provide technical background guidance for judicial personnel; on the other hand, they can extract the intent identification process for different types of cases, such as

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for cases involving multiple subjects, clarify the progressive review steps of "first investigating the manipulator's control intent-then identifying the user's cooperative intent-finally reviewing the manufacturer's negligence or intent"; on the other hand, a "judicial-technical" cooperation mechanism can be established, listing the list of professional institutions qualified for brain-computer interface data identification, clarifying the procedures and powers and responsibilities of expert assistants participating in litigation, helping judicial personnel break through technical barriers and improve the accuracy of intent identification.

4.3. Establishment of supporting mechanisms

Constructing a complete and feasible identification system of criminal intent requires not only the innovation of theoretical framework and legal system, but also the assistance of supporting mechanisms to make the theory implementable and the law enforceable.

First, establish a special fact-finding mechanism to break through the technical black box. In the brain-computer interface scenario, the technical barrier with strong professionalism is undoubtedly a major obstacle to fact-finding and criminal intent identification in judicial practice. To better respond to this dilemma, referring to the application of the technical investigator system in fields such as intellectual property rights, a technical team composed of interdisciplinary talents such as neuroscience, computer science and law can be formed to provide explanations and consulting opinions on a series of professional issues such as equipment operating principles, algorithm deviations, and technical causal chains. This system not only helps legal workers break through technical barriers and transform complex case situations into legal facts, but also helps them make more accurate judgments on the actor's cognitive state, freedom of will and other aspects, so as to achieve more accurate identification of criminal intent.

Second, explore and establish a mandatory filing and security audit system for the application of brain-computer interface equipment. To cope with the characteristics of immaterial criminal acts and difficulty in fixing and verifying evidence in the brain-computer interface scenario, a mandatory filing system can be tentatively established, requiring relevant personnel who purchase and use brain-computer interface equipment to register the purpose of the equipment, main control instruction logs and other contents. At the same time, equipment manufacturers can be encouraged to add an unmodifiable security audit module inside the brain-computer interface equipment, so that in the face of possible legal risks, public security organs can legally obtain audit logs to obtain equipment operation data tracks, and better restore the true situation of the actor's acts and will. This traceable mechanism further improves the possibility of finding out the facts of brain-computer interface cases and the accuracy of criminal intent identification.

5. Conclusion

The rapid development and wide application of brain-computer interface are important manifestations of human technological progress, showing great development potential in medical and other fields, but also bringing many legal risks and criminal law challenges. Among them, the dilemma of identifying criminal intent deeply reflects the adaptability problem of the traditional criminal law framework in the face of technological development, and puts forward new requirements for the development of criminal law. By analyzing the impact of brain-computer interface technology on the subjective structure of criminal intent and the practical challenges faced in judicial practice, this paper advocates the construction of an identification system of criminal intent adapted to the era of brain-computer interface, in order to provide a reference for judicial

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practice. In the future, we should actively promote the in-depth integration of law with cutting-edge disciplines such as brain science and artificial intelligence, and realize the resonance of theoretical research and judicial practice. Only in this way can criminal law better become the legal guarantee for the orderly development of technology.

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