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Research on Criminal Liability for Takeover Accidents of Autonomous Vehicles

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Abstract. Autonomous vehicle takeover accidents are a new type of legal risk associated with the development of intelligent driving technology. The current judicial practice is confronted with core problems such as unclear paths of accountability, ambiguous subjects of responsibility, inappropriate application of charges and absence of obligation standards, which have led to the predicament of accountability for takeover accidents. It is clarified that the basis of criminal law evaluation is the duty of care and the allocation of accident risks. Divide the relevant entities'risks into three paths of imputation, and determine the subjects to be held accountable based on the roles of different subjects in the takeover accident. Based on this, establish the principle of determination of charges, and determine the standards of charges for different responsible parties in combination with the applicable boundaries and causal relationships of charges such as the crime of causing a traffic accident, providing precise criminal liability for autonomous driving accidents.

Keywords: Autonomous driving, Takeover accident, Human-machine collaboration, Takeover time limit

1. Introduction

The rapid development of autonomous driving technology is reshaping the transportation ecosystem in China, and the gradual commercialization of level 3 autonomous vehicles is further bringing "human-machine collaborative driving" from concept to reality. Meanwhile, takeover accidents, which occur when an autonomous driving system makes a takeover request in a scenario beyond its design range and the human driver fails to respond in time or intervene effectively, as a new type of accident, are frequently challenging the traditional criminal liability system. In recent years, there have been many takeover incidents at home and abroad, which are at the blurred boundary between "machine decision-making" and "human control", presenting an urgent problem of accountability. This article will take the current state of autonomous vehicles in China as an entry point to provide reference suggestions for constructing a criminal law framework that takes into account both technological innovation and public safety.

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2. The source of criminal liability for the subjects involved in the takeover of accidents by autonomous vehicles

2.1. The source of the takeover obligation of the relevant subjects

First, from classification standards and legal norms.In the application of autonomous driving technology, "takeover obligation" refers to the legal obligation of a human driver to intervene promptly and restore vehicle control when the system makes a request or is faced with a situation that cannot be handled. According to the "Grading of Driving Automation for Motor Vehicles" (GB/T 40429-2021) issued by the State Administration for Market Regulation of China and the Standardization Administration of the People's Republic of China: Automobile driving automation is divided into six levels from 0 to 5. Among them, Level 3 autonomous driving vehicles can continuously perform all dynamic driving tasks within the scope of their designed programs and is the core level for discussing autonomous driving takeover obligations. Conditional autonomous driving requirements at Level 3: The backup user of the dynamic driving task takes over in a timely manner upon receiving the intervention request, at which point the takeover obligation becomes the driver. Some places have made more detailed provisions, such as Article 35 of the "Regulations on Intelligent Connected Vehicles in the Shenzhen Special Economic Zone" (hereinafter referred to as the "Shenzhen Regulations") promulgated by the Standing Committee of the Shenzhen People's Congress in 2022, which also requires drivers to take over in Level 3 autonomous driving mode.

Second, from the operational logic of the technical design.In the current market of autonomous vehicles, level 3 is a watershed in the classification of autonomous driving levels. It is evident that the particularity of the design of Level 3 autonomous driving technology lies in the human-machine interactive driving operation, where the driver has a duty of care to take over the driving vehicle in a timely manner when the driving vehicle gives an alarm. The limitation of autonomous driving systems is that the system can only operate within the preset design operating conditions (ODD), such as specific roads, weather and other general situations. When it goes beyond the range, such as encountering extreme weather, complex road conditions and other special scenarios, the system will trigger a takeover request. The production of autonomous vehicles involves multiple producers such as system development companies, battery manufacturers and assemblers, all of which may be responsible in takeover accidents.

Third, from duty of care and risk Allocation.There are liability boundaries for both producers and users of self-driving cars. According to the Shenzhen Regulations, the obligations of producers of autonomous driving systems include: ensuring through technical design that the system automatically identifies unseaworthiness and avoiding shifting the responsibility of judgment to users; Provide clear instructions for use and prevent misleading publicity such as exaggerating system capabilities, etc. The user's duty of care is to remain alert to the system status and respond to obvious external stimuli when applying Level 3 autonomous driving systems; Comply with traffic rules and operating norms, such as stopping non-driving activities immediately after taking over. At the same time, in accordance with the principle of the lowest-cost avoider, producers should assume more responsibility for risk prevention due to their technological superiority; Users are only obligated within their reasonable capacity and are not required to judge complex technical issues.

2.2. Criminal law characterization of the takeover obligation

As a key component of Level 3 autonomous driving systems, the obligation to take over itself has criminal attributes, which are mainly reflected in the source of the obligation and the boundary of

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responsibility. As the source of the obligation, the driver's act of activating the autopilot function creates a potential hazard source, thus generating an obligation to prevent harmful consequences. The user agreement and operation manual of the autonomous vehicle also set out takeover responsibilities, which form the basis of contractual obligations. At the legal level, the "obligation of safe driving" stipulated in Article 22 of the Road Traffic Safety Law naturally extends to reasonable monitoring and necessary takeover of the system's status in the context of autonomous driving. The takeover obligation is essentially a "duty of action" in criminal law that requires the actor to take active actions to avoid infringement of the legal interest, and it is a concrete manifestation of the collective legal interest of ensuring road traffic safety in the era of autonomous driving. The core of the takeover obligation lies in the "duty of care" derived from it, which is one of the constitutive elements of the criminal law attribute. A violation of the duty of care resulting in an accident may constitute a negligent crime such as the crime of causing a traffic accident.

3. The path for identifying the responsible party in accidents where autonomous vehicles take over

3.1. Producer subject: technical defect risk

In judicial practice, there are certain prerequisites for holding producers accountable: the risk of the takeover accident must be caused by the production plant and be prohibited by criminal law. Manufacturing and design flaws resulting from the limitations of The Times and the level of technology, if the manufacturer has done everything possible to avoid potential defects and accidents, then accidents that the manufacturer could not have foreseen or avoided in such cases are legally tolerated risks. In response to this issue, China released the "Guidelines for the Construction of the National Internet of Vehicles Industry Standard System" in February 2021, which provides detailed regulations on the standard system for Internet of Vehicles applications and industrial development. Therefore, if a manufacturer can prove that its research and development and manufacturing activities fully comply with the relevant hard production standards, an accident caused by vehicle manufacturing defects can be excluded from criminal liability as it only meets the "risk permitted by law" [1].In contrast, there are technical defect risks that producers are capable of encountering or avoiding, but they fail to avoid them in time due to negligence, resulting in takeover accidents. This is a violation of the duty of care stipulated in the criminal law, which creates a "risk not permitted by law" for the product and is criminally illegal when it causes damage to legal interests.

In the field of current research on autonomous vehicles, some scholars believe that since autonomous driving is permitted by current law and the promotion of autonomous driving systems can minimize the risks permitted by law and the harm caused by such risks, then the law does not allow this technology but should allow it [2].In the author's opinion, this view has logical flaws. On the one hand, a low accident rate does not equal criminal liability immunity. Confusing the low accident rate of self-driving cars, that is, the safety advantage, with compliance with the constitutive elements of the crime of causing a traffic accident is a case of conceptual substitution. Because the comparison of safety is a matter of probability and statistics, while the composition of crime (such as whether the act is illegal and causes damage to legal interests) is a matter of legal evaluation. In the case of data, even if the accident rate of autonomous driving is much lower than that of human driving, if a takeover accident occurs due to system design flaws, it may still meet the requirements of the crime of causing a traffic accident, so a low accident rate cannot directly deny the illegality of a single act. On the other hand, a low accident rate does not equate to permissible risk. Claiming that

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all accidents of self-driving cars are "permissible risk" on the grounds of a lower accident rate would result in manufacturers being completely exempt from liability regardless of the cause of the accident as long as the accident rate is lower than that of human driving, which clearly violates the principle of criminal liability.

To sum up, the sole criterion for determining liability should be whether the actor violated the duty of care, rather than the overall technical benefits. In traffic accidents caused by manufacturing defects that conform to industry standards, the producer did not violate the duty of care and did not meet the constitutive elements of negligent offense and thus did not have criminal illegality; When a takeover accident is caused by a design defect, the producer directly or indirectly creates a "risk not permitted by law", criminal law should take punitive measures against it.

3.2. Driver subject: human-machine interaction risk

As mentioned above, in most traditional autonomous vehicle takeover accidents, criminal responsibility is mainly borne by the driver who has not fully exercised his duty of care due to the low level of intelligence of the autonomous driving system. As the level of intelligence of autonomous driving systems increases, manufacturers should also bear corresponding criminal responsibility in autonomous driving takeover accidents of level 3 and above. But this does not mean that in all cases of autonomous vehicle takeovers, the driver is not criminally responsible; in certain specific circumstances, the driver is still held criminally responsible.

First of all, the driver is held accountable on the premise that he has always been the ultimate bearer of legal responsibility in autopilot. Although in Level 3 autonomous driving the driver gives part of the driving rights to the autonomous driving system conditionally, his subject status remains the same, only changing from "operator" to "supervisor". Under such circumstances, the driver still has the potential to bear criminal responsibility. Secondly, human-machine interaction failure in a takeover accident is a condition for determining whether the driver has violated the takeover obligation. When the accident occurs after the autopilot gives the takeover order and before the driver takes over the vehicle, since the driver should fulfill the takeover obligation when the system gives a warning or when necessary, it is generally believed that in conditional autopilot mode, the autopilot's takeover request means a transfer of responsibility and the driver should take over the vehicle in a timely manner, If damage results from untimely or non-compliant takeover, the driver shall be held responsible. Unless there are exclusionary circumstances, for example, the driver did not have sufficient time to take over, or even if it is taken over in a timely manner or as required, it is not sufficient to prevent the accident [3].When an accident occurs after the driver takes over the vehicle in accordance with the requirements of the autopilot system or based on his personal judgment, the autopilot driver is transformed from a "supervisor" to a "manipulator" and, of course, complies with the duty of care and bears criminal responsibility as stipulated in the current Road Traffic Safety Law of the People's Republic of China. Finally, the driver is exempt from liability in certain circumstances: the system has no fault record and meets technical standards, and the driver has no operational errors. But a driver who continues to use an autonomous driving system despite knowing that it has inevitable flaws does not apply the exemption.

3.3. Multiple subjects: risk of concurrent negligence

Of course, under certain conditions, there may also be a situation where technical defect risks and human-machine interaction risks coexist, that is, a multi-subject type where producers and drivers jointly bear criminal responsibility for taking over the accident. In such cases, both parties have a

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causal relationship with the damage. Some scholars believe that the driver should not be the responsible party in such a situation. Because the accident was not caused by the driver's actions, the driving behavior of the car was completely controlled by the car itself, and the accident was caused by the driving behavior made by the car itself based on the real-time data collected, and there was no causal connection between the driver's actions and the final legal effect [4].Contrary to this view, another group of scholars, such as Professor Englander, argue that from the perspective of causality, the results of the infringement of legal interests achieved are all due to the driver's act of starting the car, and therefore should all be attributed to the driver's act of starting the self-driving car.In fact, both views have the problem of "one-size-fits-all", mechanically separating the manufacturing and usage processes of self-driving cars. This would result in the omission of a subject when holding the criminal subject responsible for taking over an accident accountable. In a multi-subject situation, both the producer and the driver have performed a dominant act over the vehicle, so there is an overlapping causal relationship and a common dominant relationship between the two and the damage result. In an overlapping causal relationship: the design defect of the producer is a necessary condition for the damage to occur, that is, a direct causal relationship; The act of the driver starting and driving the autopilot is also a necessary condition and a direct causal relationship in the accident, and together they constitute a necessary component of the competition-cooperative takeover accident.

4. Principles for determining charges in self-driving car takeover accidents

4.1. Conviction of a single criminal subject

4.1.1. Determination of the producer's charge

Based on the content of legal interests and behavioral characteristics infringed upon by the illegal and criminal acts of the parties involved in autonomous driving, the types of crimes can be divided into two major categories: "crimes committed by using autonomous driving vehicles" and "crimes in violation of the safety management obligations of autonomous driving vehicles". The former is mainly intentional crimes, while the latter is mainly negligent crimes. At present, there are many disputes in the academic circle regarding the determination of charges for producers in autonomous vehicle handover accidents. The charges mainly discussed for application include: traffic accident crime, negligent causing serious injury, negligent causing death, and the crime of producing and selling substandard products and the crime of producing and selling products that do not meet safety standards.

First, the crime of producing and selling substandard products and the crime of producing and selling products that do not meet safety standards should be excluded. Both charges may seem similar to the act of a producer causing a risk of technical defect, but both require the criminal subject to have intent subjectively, which is not in line with the subjective purpose of the producer who produces and develops defective self-driving cars.

Secondly, different scholars hold different views on whether to apply the crime of causing a traffic accident. Some scholars argue that, in theory, producers have an obligation to avoid indirect consequences of public traffic safety. In fully autonomous driving mode, the system substantially replaces human driving, and producers can be regarded as "simulated drivers". If it violates transportation regulations, such as failing to meet industry safety standards and causing a major accident, it may constitute the crime of causing a traffic accident. There are different opposing views on the inapplicability of the crime of causing a traffic accident: One view holds that for the crime of

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causing a traffic accident to be established, there must be a possibility of foreseeing and avoiding a specific act of causing a traffic accident and the consequences of causing a traffic accident, and producers cannot foresee a specific traffic accident during driving or use and cannot have the obligation to foresee and avoid it, therefore the crime cannot be established [5]; Another view holds that the key lies not in whether the perpetrator was negligent in the outcome, but in how to understand the "perpetrator" element of the crime of causing a traffic accident. Whether it is the manufacturers of self-driving cars or the designers, producers and sellers of related intelligent systems, they cannot be legally considered drivers at present and are not subjects of the crime of causing a traffic accident [6].The author believes that the current Road Traffic Safety Law of the People's Republic of China (referred to as the "Road Traffic Safety Law") does not define producers of autonomous vehicles as drivers in the legal sense. Producers should not be subject to the crime of causing a traffic accident until the law is revised and improved.

Finally, regarding whether to apply the charges of causing serious injury or death by negligence, the vast majority of scholars believe that producers should apply these two charges. In the case of using an autonomous driving system, since the driver still plays a dominant role, the developers of the autonomous driving system and the manufacturers of the vehicle are not legally regarded as drivers or transportation personnel and cannot be held criminally responsible under charges such as negligent causing serious injury or negligent causing death.

4.1.2. Determination of the driver's charge

At present, the main controversy related to the determination of the charge of the driver in an autopilot vehicle takeover accident is: when the autopilot system controls the vehicle and the driver causes a traffic accident resulting in death due to violation of duty of care, should the charge of negligent homicide or traffic accident be established? The author believes that in the case of a death caused by the driver's violation of the duty of care when the autonomous driving system is controlling the vehicle, it should be recognized as the crime of causing a traffic accident rather than the crime of causing death by negligence. From the perspective of the domain where the act occurred and the legal scope violated, the crime of causing a traffic accident is a crime endangering public safety, the core of which is that the act occurred in the field of transportation and the perpetrator violated transportation management regulations; The crime of causing death by negligence falls within the category of crimes against the personal rights of citizens. The core of the crime is the situation where the death of another person is caused by negligent acts in daily life, and the violation of the duty of care is the general rule of common social life. From the perspective of the scene of the accident, the self-driving car takeover accident occurred when the vehicle was running on a public transportation road, which belongs to the transportation field. From the perspective of the type of legal interest infringed upon by the act, when the accident occurs on a public road, it endangers the safety of life and property of an unspecified majority of people, namely public transport safety, rather than just the right to life of the specific victim in the takeover accident.Although the driver's act itself was a fault and resulted in a death result, it meets the constitutive elements of the crime of causing death by negligence. However, since the negligent act occurred in the field of transportation and directly violated the specific duty of care set by transportation management regulations, the nature of the act was an infringement upon the special legal interest of public transportation safety. Therefore, the act is covered by the crime of causing a traffic accident, which is specifically aimed at negligent crimes in the field of transportation, and is no longer subject to the crime of ordinary negligent causing death as stipulated in the crime of

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infringement of personal rights. So the driver should be held criminally responsible for the crime of causing a traffic accident when an autonomous vehicle takes over an accident.

4.2. The determination of the charge of the subject of the concurrent crime

When there is a complex type of criminal subject where the producer and the driver jointly bear criminal responsibility for the takeover accident, there is an overlap in causal relationship between both parties and the harmful result. It is difficult to identify the charge of the criminal subject at this point, which involves the application of law for the joint fault of the designer of the autonomous driving system, the producer of the autonomous vehicle and the driver. The criminal liability of the parties should be determined based on the principle of proportionality between crime, responsibility and punishment. According to China's judicial interpretation, the establishment of the crime of causing a traffic accident requires the driver to bear full responsibility, primary responsibility, or equal responsibility for the accident. When a traffic accident causes serious injury to two people and the driver is primarily responsible, the driver does not constitute the crime of causing a traffic accident. At this time, if the provider of artificial intelligence services and the producer of automobiles need to bear criminal responsibility for the crime of causing serious injury by negligence, there is obviously an imbalance between crime and punishment [7].In cases of joint negligence, the degree of criminal liability for negligence of the producer or the service provider of the autonomous driving system should be determined by analogy with the standards of crime and punishment for traffic accident.

When the technical defect of the producer and the human-machine interaction error of the driver jointly cause the accident, it is urgent to solve the problem of balancing the charge and the amount of the crime, and the "joint negligence crime" of Article 25, Paragraph 2 of the Criminal Law shall be applied, and each shall be punished separately according to the name of the crime committed. As in the 2024 Guangzhou Xpeng G9 rear-end accident, the owner was driving the XPeng G9 on Level 3 autopilot on the highway. The vehicle failed to recognize the faulty truck ahead and did not issue a request to take over, resulting in one death and two injuries. The court identified it as an algorithmic flaw, with the automaker bearing 70% of the liability for compensation and the driver bearing 30% for not taking over voluntarily. In a takeover accident caused by joint negligence, if the technical defect that the producer or the autonomous driving service provider should have foreseen but failed to foresee directly leads to infringement of the legal interests of others, criminal responsibility shall be pursued for negligent homicide or negligent serious injury; If a driver fails to perform his duty of care during the period when he has not taken control of an autonomous vehicle, and fails to perform or fails to perform his duty of taking over in a timely manner after the system gives the signal of taking over, he shall be held criminally responsible for the crime of causing a traffic accident.

5. Improvement of the takeover time limit and duty of care for autonomous vehicles

5.1. Deficiencies in the current law regarding the time limit for taking over and duty of care

The legal improvement of the takeover time limit and duty of care for autonomous vehicles plays an important role in reducing the rate of takeover accidents of autonomous vehicles. It is necessary to construct systematically from the perspective of criminal law, road traffic safety law and supporting regulations in light of the current legal framework and technological development status of China.

On the one hand, the current Criminal Law and Road Traffic Safety Law lack standards for takeover time limits and legally defined "reasonable takeover time" for different driving scenarios

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and different systems. The speed of a vehicle varies on different roads such as highways, urban areas and tunnels, and the required response and takeover time should also be different. Likewise, depending on the level of the autonomous driving system, the reaction time required by the driver in a sudden takeover accident will also vary. For example, in the 2025 Mi SU7 accident in Tongling, Anhui Province, the system failed to identify the concrete barrier on the construction section and only issued a "attention barrier" alert two seconds before the collision. One second later, the driver attempted to take over but failed to avoid the collision, resulting in three deaths. This reminds us whether 3 seconds or 10 seconds can constitute a reasonable time limit in the event of a sudden system failure?

On the other hand, the current law lags behind the driver's duty of care, and the "duty of reasonable care" for traditional vehicles is not suitable for autonomous driving scenarios. For instance, issues such as whether a driver is in violation of regulations when engaging in other activities unrelated to driving during autonomous driving and how responsibility is allocated in the event of a takeover accident need to be clearly defined by laws and regulations.

5.2. Suggestions for improving the time limit for taking over

At the criminal law level, the criminal standards for the time limit of takeover should be clearly defined. According to the level of autonomous driving and the type of scenario, set the legal minimum time limit at different levels and stipulate the lower limit of takeover time through national standards. Refer to the provisions of the German Autonomous Driving Act: The system should reserve sufficient reaction time. Introduce flexible provisions for "reasonable response time". The judicial interpretation of the criminal law should stipulate that failure to take over within the system's preset time limit should be presumed to be negligent; If an accident is not avoided within the time limit due to an emergency, technical feasibility and individual ability should be taken into account to determine exemption.

At the level of the supporting legal system, the Road Traffic Safety Law should be revised. Refer to the UK's Autonomous and Electric Vehicles Act to require drivers to maintain proper supervision. Clearly define the legal attributes of the "takeover process", define the transition period from system control of driving rights to driver control of driving rights as the "special driving phase", and prohibit drivers from engaging in distracting behaviors; Producers and drivers are required to install on-board data loggers to record data such as the time of takeover requests and the response time of driver operations as criminal evidence in the event of a takeover accident. Clarify the criminal liability boundaries of the vehicle manufacturer. If the system design defect leads to the inability to take over within a reasonable time limit, the crime of major responsibility accident of the enterprise or the crime of providing products that do not meet safety standards shall be pursued.

5.3. On the path to improving the duty of care

At the criminal law level, reconstruct the rules for determining the duty of care and stratify the driver's duty. In autonomous driving, the driver's duty of care is to remain alert and be ready to take over at any time, and the criminal liability boundary should be gross negligence, such as sleep, intoxication, etc. After the system alerts, the duty of care is to respond immediately and take over safely, and the boundary of accountability is ordinary negligence, such as operational error; In the event of an autonomous driving system failure, the driver should do his best to avoid the hazard, and if it is impossible to avoid it within a reasonable time limit, he should still bear criminal liability.

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At the level of the supporting legal system, technical standards are updated dynamically based on the current status of technological research and development. Develop "Autonomous Driving System Takeover Performance Requirements", specifying standards such as minimum warning duration and human-machine interface warning intensity for different levels of systems. Publish guiding cases to provide reference for the judicial practice of Chinese legal authorities in typical scenarios of autonomous vehicle accidents such as system failure to detect crossing pedestrians.

6. Conclusion

The research on criminal liability for takeover accidents of autonomous vehicles is essentially an exploration of the criminal responsibility path for relevant subjects in the process of technological transformation of autonomous driving. This paper holds that the core of criminal liability for autonomous vehicle takeover accidents is to clarify the boundary of human-machine liability. China's judicial authorities should clarify the principles for the division of responsible subjects and the determination of charges in autonomous vehicle takeover accidents, balance technological innovation and public safety, and provide support for the development of autonomous driving. When the law is revised in the future, the relevant provisions on the time limit and duty of care for the takeover of autonomous vehicles in the criminal law and the supporting legal system should be improved. To provide a solid legal backing for the safe use of autonomous vehicle systems by Chinese citizens.

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