An Ethical Evaluation of Tesla’s Autopilot – Nicholas Quinn (z5117408)

Tesla is an American electric vehicle manufacturing company and one of the biggest competitors in the self-driving industry, thanks to their Autopilot software. This report focuses on the current day issues of self-driving software, specifically those that arise due to full autonomy not yet being achieved, such as the **need for an attentive driver who understands the limitations of this software** to still be behind the wheel. In deciding whether to invest, I consider whether Tesla should be testing via, and distributing their Autopilot software to, the general public, specifically taking into consideration the two aforementioned issues of understanding and attentiveness.

*Background*

Before covering the ethical issues surrounding Autopilot, it is necessary to first outline what it is. According to the Tesla website, Autopilot is a generic term for their “advanced **driver assistance** system”, which is powered by 8 external cameras, a forwards-facing radar, and 12 ultrasonic sensors that all serve as inputs to an onboard computer running a deep neural network [1]. Autopilot (AP) and Full Self-Driving (FSD) are two specific types of Autopilot, each offering different features. The most relevant features to this discussion include traffic aware cruise control (AP), automatic steering (AP), and highway and city street navigation (FSD **beta**) [1]. Both packages fall under the industry standard [2] Society of Automotive Engineers level 2 classification of self-driving vehicles, which means **the driver is still required to be fully attentive, with their hands on the wheel, ready to take control at all times** (see figure 1)[3]. It is also important to note that, due to the age of the industry and the techniques used within it (i.e. deep machine learning), there are naturally going to be many bugs [4]. Nevertheless, Tesla’s technical approach to the problem is sound when it comes to capability and performance [5] [6], with even their most controversial choice of not using LiDAR [7] being backed up by researchers [8]. In fact, no self-driving company is ethically required to program bugless and fully functional code immediately, as this is impossible. The ethical responsibility is therefore more about mitigating the ramifications of these bugs, especially for Tesla as they are testing and training their software via the public [9], a choice which they have been criticized for by members of the industry [10].

*The Situation*

Driver attentiveness has been, and continues to be, a huge issue in the public deployment of level-2 driving software, including Autopilot. In fact, it is one of the main metrics used to rate such software [5] [6]. The severity of this issue is evident by the number of crashes and deaths that have occurred with Autopilot engaged, in which the driver was believed to be distracted. The first confirmed Autopilot death occurred on a Florida highway in 2016, when neither the driver nor the Autopilot were able to detect a semi-trailer crossing the road perpendicularly, resulting in collision [11]. The National Transportation Safety Board (NTSB) determined that the cause of the crash was partly due to the driver’s overreliance on the Autopilot system, stating that there was no human input to the car for 2 minutes prior to the crash, and only a mere 25 seconds of human input for the 37 minutes of Autopilot engagement [11] [12]. At the time of the incident, the only precautions put in place by Tesla to mitigate against driver distraction were warning messages, such as on the support page, which states Autopilot features are “… intended for use with a fully attentive driver, who has their hands on the wheel and is prepared to take over at any moment… [and] do not make the vehicle autonomous“ [1], as well as in Tesla car manuals, on the in-car display when it is first enabled, and subsequently whenever activated [13]. The NTSB criticised the fact that the driver was allowed to keep Autopilot engaged even though they were ignoring all warnings and weren’t detected to be paying attention [12].



Figure 1: SAE's Levels of Vehicle Autonomy - Tesla Autopilot commonly classified as level 2 [2]

In fairness, Tesla has since updated the software to frequently check whether the driver is applying torque to the steering wheel, and provides visual and audible alerts if it doesn’t detect human input, eventually slowing to a stop if driver input remains undetected [13]. The problem is that this can take up to 60 seconds to complete, in which a lot can happen, and even though Autopilot is disabled for the rest of the drive after this occurs, a new drive can be started simply by putting the vehicle into park, then back into drive, circumventing the punishment [14]. The consequence of such ineffective countermeasures is that there have since been more crashes and fatalities due to misuse. Coincidentally, a crash that was almost identical to the aforementioned 2016 semi-trailer crash occurred in 2019, in which the NTSB once again concluded that Autopilot was engaged and the driver hadn’t touched the wheel for 8 seconds prior to impact [15]. Other relevant crashes include collisions with stationary vehicles, such as police cars [16] and fire trucks, in which one of the drivers was on her phone and hadn’t touched the wheel for over a minute prior to the crash [17], a fatal crash in which the driver, who was playing a video game on his phone, hit a concrete highway lane divider after 6 seconds of hands free driving [18], and very recently, and a non-fatal but incredibly obvious crash into an overturned truck [19], the video [20] of which indicates the driver clearly wasn’t paying attention. This obvious and persistent issue has not yet been adequately addressed despite the NTSB calling for Tesla to “develop applications to more effectively sense the driver’s level of engagement and alert the driver when engagement is lacking” all the way back in 2017 [11]. This sentiment was also backed by Tesla’s own engineers, suggesting they implement eye-tracking software similar to Cadillac’s Super Cruise [36], which was ranked the highest amongst 4 level-2 self-driving systems for driver engagement, compared to Autopilot which scored the lowest [6]. This request was ignored by Tesla executives, who called eye-tracking ineffective [37] and annoying [23].

The naming and marketing of Autopilot has also proven to be a controversial topic, as it potentially causes drivers to misunderstand the capabilities of the system, place too much trust in it, and therefore not pay attention. The name Autopilot does somewhat imply it is a fully autonomous piloting software, and a survey conducted by the Insurance Institute for Highway Safety (IIHS) clearly reveals Tesla’s Autopilot naming is the worst offender amongst level 2 driving software when it comes to misleading the general public about the capabilities of the software, and what behavior is acceptable when using it (see figure 2) [21]. Furthermore, Tesla CEO Elon Musk has also repeatedly neglected his own company’s safety advice by taking his hands off the wheel whilst Autopilot was engaged in multiple televised interviews [22][23][24]. This hasn’t gone unnoticed in the industry, in fact, The Center for Auto Safety and Consumer Watchdog launched a request for investigation to the Federal Trade Commission with regards to Tesla’s Autopilot marketing [25], and a German court recently banned Tesla from using such terms [26]. Tesla questioned the relevance of the aforementioned survey, arguing that whilst the general public may be misled by the term Autopilot, Tesla owners are not [27]. A German company, puls Marktforschung, surveyed Tesla owners specifically, finding that 98% of respondents were aware they had to maintain control of the vehicle at all times and were familiar with the numerous safety warnings and agreements (results shown in figure 3) [28]. It should definitely be noted that 7% of Tesla owners still thought Autopilot meant fully autonomous, not requiring any driver supervision, which may not seem like much at first, but considering there are over 800,000 Autopilot enabled vehicles, which have together driven over 3.3 billion miles [29], that’s a lot of unsupervised Autopilot driving. Musk has defended the Autopilot name and refuses to change it [30].



Figure 2: Results of the IIHS survey depicting the percentage of people who believe certain behaviours are safe whilst a level 2 system is being used - Tesla's Autopilot shown in blue [21].



Figure 3: Results of the ‘puls Marktforschung’ survey 'Awareness and utilization of the Autopilot' [28]

The distribution of Autopilot to the public is not all bad, however. Despite the crashes, Tesla’s that are driving with Autopilot enabled are reported to only have an accident every 4.53 million miles, whereas the US average is every 479,000 miles, a rate of almost 10 times less (see figure 4) [30]. Whilst it is unlikely that this data is completely reliable from a statistical perspective, the general trend of Autopilot accidents decreasing over the past couple of years, and the difference in accident rates between Tesla’s using Autopilot compared to those which aren’t, at least reveals that it does halve accidents purely amongst Tesla’s. Furthermore, there is an abundance of video evidence showing Autopilot both predicting and avoiding accidents [31] [32], as well as reports of drunk and asleep drivers being saved by Autopilot [33] [34]. This is a huge benefit to society, especially when you consider that there are approximately 36,000 vehicle fatalities annually in the US, of which drink driving causes 1/3 (NHTSA) [35].

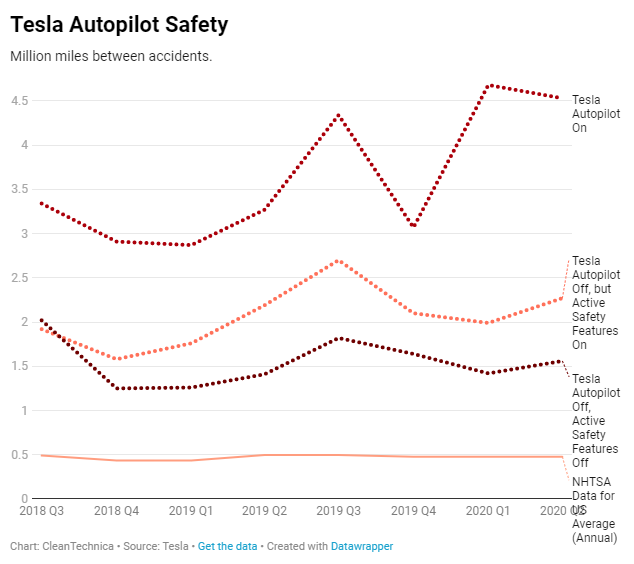


Figure 4: Tesla Autopilot Safety Statistics, by CleanTechnica [30]

*Ethical Reasoning*

Distraction:

* Tesla initially either didn’t account for humans misusing their self-driving system, which is morally negligent, or they intentionally decided to not implement better safeguards to protect and combat against driver distraction, which is morally reckless.
* These actions are a clear violation of the Association for Computing Machinery’s Code of Ethics and Professional Conduct (ACM CoE), specifically the principle of avoiding harm, the responsibility to comprehensively analyse the risks of computer systems, and the responsibility to design and implement systems that are secure even when misused [38].

Comprehension:

* Actions speak louder than words, and with the huge audiences that these mainstream outlets have, it’s morally reckless to normalise this kind of behaviour. [Hypocritical to promote the software in this way given their numerous warnings about this very behaviour, and it is a violation of the ACM CoE principle about fostering public awareness and understanding of software systems, especially their limitations [38]].
* It’s clear that this marketing and behaviour is unethical from a deontological perspective because … Deontology is very theoretical and on principle, and so it is important to evaluate the consequences of these decisions as well, because …
* From a deontological perspective, in which morality is determined by the principle of the action itself and not its consequences, it doesn’t matter whether or not Tesla owners mostly understand the limitations of Autopilot anyway, but rather that Tesla, on principle, is being deceptive. This is another clear breach of the ACM CoE, including principle 1.3, which is concerned with being honest and trustworthy, and responsibility 2.7, which entails fostering public awareness and understanding of software systems, especially their limitations [38].
* It must also be said that, from a deontological perspective, Tesla isn’t completely at fault for the issue of driver attentiveness because the drivers are breaking their promise to remain in control at all times. If we set aside this issue of driver attention, focusing solely on the software itself, then, from a consequentialist perspective, Autopilot is ethical because it is preventing accidents, and therefore injury and death.
* Talk about how the negative consequences actually stem from Tesla’s actions (or more accurately, inaction – renaming and implementing better tracking) and how Tesla therefore has the power to redress these issues, which would hopefully turn this ethical situation into a non-ethical one, where

*Conclusion*

It is likely that ethics will become even more important in the self-driving industry once software approaches the higher levels of autonomy, as issues such as automation [41] and the trolley problem [42] will inevitably emerge. For these reasons, I believe it is the morality of the actions themselves that Tesla makes that matters more than the outcomes of their software, since they are an important figure in shaping the future of the industry, and their actions now serve as an indication of their actions in the future. I therefore favour the deontological perspective and do not advise investing until Tesla redress the mentioned issues and show a clear intention of prioritising safety.

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