Introduction

App在提升驾驶行为的同时，也可能会对碳排放造成不良影响。

Literature Review

1 IT usage

(app usage/alert)

--正面影响 —side effects darkside负面影响

The continuous development of information technology (IT) has created new and immensely complex environments. The world we live in is greatly influenced by these developments and the use of information technology is gradually penetrating all aspects of life (Stolterman and Fors 2004).

However, while all these developments will bring many benefits, they also carry risks. If managed well, they have the potential to give rise to innovation that will drive growth and social impact. For example, people use IT in health care to reduce the frequency and consequences of errors (Bates et al. 2001; Bates and Gawande 2003); in the field of education, using advanced IT helps learning and add value to management education (Alavi and Gallupe 2003; Alavi et al. 1997); IT also has dramatically transformed travel and tourism (Buhalis and Law 2008; Werthner and Klein 1999); IT has been widely adopted in business not only as a supporting player within the overall strategy of the firm to, but can used to create new needs, cause new product development, and command new procedures as well (Chan 2000; Gunasekaran and Nath 1997); and, IT has a great potential to be a global greenhouse gas emission game-changer by monitoring the waste remotely (Imasiku et al. 2019; Liu et al. 2020a; Sun and Zhang 2020).

IT can definitely bring some side effects with its benefits. Aside from some common problems like the rising threat of cyberattacks, privacy issues, and the polarizing effects of technologies on labor markets could derail these benefits (Baller et al. 2016), the down-side of IT can be manifested in different areas. For instance, in education, studies show that typing could impair reading and writing. Impaired reading and writing impairs learning and memory (Spitzer 2014). IT even leads to decreased student learning because of increased distraction (Bowman et al. 2010; Fried 2008). Finally, IT can cause IT-addiction (Chen 2020; Leung and Lee 2012; OReilly 1996). Moreover, although IT could be used to promote low-carbon environmental protection, they themselves contribute to carbon emissions in their operation (Gelenbe and Caseau 2015; Zhou et al. 2019). Every click, every browse we make on the Web depends on millions of physical servers in data centers around the world. These data centers are connected to numerous cables, switches and routers, requiring a lot of energy to run, most of which comes from fossil fuels. The burning of these fuels results in significant carbon emissions.

We can find a large body of research has explored IT usage in diverse areas. Recently, IT in the Internet of Vehicles (IOV) has become an emerging topic. In this area, researchers always put stress on the connection between vehicles, vehicle and road, vehicle and cloud, vehicle and infrastructure, etc., and take note to self-driving, automotive revolution(Guo et al. 2017; Kadhim and Seno 2018; Liu et al. 2019; Liu et al. 2020b; Wu and Horng 2017). However, few studies the relationship between vehicle and driver. This paper is interested in the relationship between vehicles and drivers, and explores the effects of IT on drivers: whether they have positive impacts or bad ones, or there would be some side effects like in other areas mentioned above while positively influenced drivers.

2 Greenhouse Gas Emissions (碳排放，其实就是各种温室气体排放)

--意识到气候变暖

We have been aware of global warming since February 1979 when the first World Climate Conference (FWCC) was held in Geneva.

--刻不容缓，已经在行动

In order to prevent global warming, since the entry into force of the United Nations Framework Convention on Climate Change in 1994, the UN-led global climate governance has undergone more than 27 years of tortuous development. In November 2021, the 26th United Nations Climate Change Conference (COP26) reported that on the current trajectory, global carbon emissions are projected to increase by 16% by 2030 compared to 2010 levels -- implying global warming of at least 3°C, exceeding the 2°C red line set by the Paris Agreement. The situation has become increasingly dire, and 197 countries finally reached an agreement to sign *The Glasgow Climate Pact*.

--温室气体排放，尤其是碳排放，是最主要的原因。

Since greenhouse gas (GHG) emissions, especially CO2 emissions, are considered to be the main causes of global warming (Letcher 2019; Soytas et al. 2007), the most important measure to control global warming is to control the GHG emissions.

--而温室气体的排放主要来自于xxxx，其中xxx

As was indicated by researchers, the GHG emissions can be generated by both natural systems and human activity, while it is human activity that exerts extra pressure on what is otherwise a self-balancing Earth system (Xi-Liu and Qing-Xian 2018). And the human emissions of GHG such as CO2 mainly comes from burning fossil fuels (Ritchie and Roser 2020).

--目前的大部分措施和政策都是宏观的，但是individual角度也是很重要的.目前最主要的做法是交通上的节能减排

Most of the current measures and policies are proposed from the macro level, whereby large emitters (electric utilities and industries) will be required to reduce emissions in the aggregate over time. These did not touch individual citizens directly. However, individual actions need to be seen as a necessary complement to the policies and it is not too early to seek to fully engage citizens in the unprecedented challenge of reducing GHGs (Barkenbus 2010).

The most popularly known practice is about personal transportation: people can buy more fuel-efficient vehicles; they can purchase vehicles that utilize low-carbon fuels (e.g. electricity and renewable energy) (Saber and Venayagamoorthy 2010); they can reduce their vehicle miles travelled through such actions as carpooling and using public transportation; and, they can operate their current vehicles more efficiently (Barkenbus 2010).

Thus, when discussing the effects of IT in the context of IOV, we are meant to pay attention to its effects on greenhouse gases emissions as well.

3 Driving Behavior

--behavior会导致什么(侧重于behavior and emission联系)

GHGs emissions from road transport are of special concern, as they have been rising constantly (Gorham 2002).

Apart from transport infrastructure, vehicle technology, energy sources and management systems (Nejadkoorki et al. 2008), the driver is a major and often overlooked factor that determines vehicle performance (Huang et al. 2018). Studies show that driving style has influence on greenhouse gas emissions as well. Alessandrini et al. have shown that slamming down on the accelerator pedal leads drivers to consume and emit more (Alessandrini et al. 2009). Gao et al. analyzed fuel consumption and NOx emission characteristics over various scenarios, and provided the guidance for eco-driving to achieve cleaner travelling (Gao et al. 2021). In fact, eco-driving is a new approach to driving style developed since the mid '90s and nowadays it is a climate change initiative not to be overlooked (Alessandrini et al. 2012; Barkenbus 2010). To be more specific, in an comprehensive experiment, Huang et al. have proven that the major factors of eco-driving are acceleration/deceleration, driving speed, route choice and idling (Huang et al. 2018). Improvements in the these driving behaviors could lead to significantly higher reductions in fuel consumption and emissions than other behaviors such as better maintenance practices (Alam and McNabola 2014). Conversely, poor driving behavior can mean more fuel consumption and emissions. 主要问题在这个批注里

--什么会导致behavior变化(IT)

Behaviors could be influenced by many factors. Scholars categorize the factors into internal ones and external ones (Halepota 2005; Hull 1943). As information technology develops rapidly, people continue to open up its application scenarios, especially in public health and business, and IT has been used as external stimulation to assist in changing people's behavior (Hughes et al. 2010; Kamal et al. 2016; Short et al. 2014; Sundaram et al. 2007). According to Hebden et al., apps used on mobile devices are a novel technology that can be used to deliver behavior change interventions directly to individuals and have the potential to make a difference (Hebden et al. 2012). However, when exploring ways to improve driving behavior, few researchers have reported on the use of IT products and applications for behavior changing. Therefore, this study tests the effects of IT on drivers’ driving behaviors.

Though promising, as an external intervention, IT’s positive effects could be limited. As stated in lots of studies in the field of eco-driving, people’s behaviors can improve obviously immediately after an external training (Larue et al. 2014; Rolim et al. 2014; Rutty et al. 2013), while long-term studies showed that the training impact faded over time (af Wåhlberg 2007; Barla et al. 2017). This was because the habits developed through many years of practice were engrained and thus hard to change in short training time (Huang et al. 2018). It should be noted that many factors could influence the ‘training’ results -- behaviors. So in this paper, we consider a variety of factors relevant to drivers’ driving behaviors too.

In summary, this research explores the relationship between IT and driver behavior in the context of IOV, and examines the possible positive and negative impacts of IT, considering driver characteristics, vehicle types, and environmental influences.

↑在IOV的语境下，探究IT与驾驶员行为的关系，研究IT的正面和负面影响，并考虑驾驶员特征、汽车特征和环境影响。

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