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**Balancing the Commitment to the Common Good and the Protection of Personal Privacy:  
Consumer Adoption of Sustainable, Smart -Connected Cars**

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# **Balancing the Commitment to the Common Good and the Protection of Personal Privacy: Consumer Adoption of Sustainable, Smart Connected Cars**

## **Abstract**

Sustainable, smart connected cars (SSCCs) are one of the representative sustainable products that leverage smart technologies (e.g., the internet of things, artificial intelligence, big data). Although many studies have investigated consumers' purchase decisions regarding sustainable products, little research has addressed SSCCs and the relationship between privacy, disclosure intentions, and purchase intentions in SSCCs. These relationships are important because the use of smart technology products requires large volumes of consumers' personal information, which can lead to severe privacy issues when adopting SSCCs. Accordingly, consumers' preferences for features of sustainable products could conflict with their privacy concerns when they disclose personal information. Thus, we investigate the relationship between the several benefits of SSCCs and privacy-related decisions when purchasing SSCCs. We propose an extended privacy trade-off model based on three critical assumptions: two types of privacy trade-offs, bidirectional privacy reduction, and anchoring effects. We also investigate the effects of government subsidies for purchasing SSCCs regarding the relationship between governments, companies, and consumers. To validate our model, we test the effects of interaction between privacy concerns and the benefits of SSCCs on disclosure intentions and purchase intentions. Our repeated tests for the various benefits of SSCCs demonstrate the robustness of the model. Our results indicate that when consumers consider purchasing SSCCs, sustainability plays the role of the common good in trading for privacy concerns. In addition, government subsidies to encourage companies' sustainable products increase disclosure intentions and purchase intentions. We conclude that the status of sustainability as a common goal among governments, companies, and consumers represents an opportunity to balance the privacy tensions in the sale and purchase of SSCCs.

**Keywords:** common good, information disclosure, privacy concerns, privacy trade-offs, purchase intentions, sustainability, sustainable smart connected cars

## 1. Introduction

In this paper, we consider the privacy risks-versus-benefits trade-offs involved when consumers consider adopting sustainable, smart connected cars (SSCCs). Although the adoption of such complex sustainable products is beneficial to the sustainability efforts of governments and consumers who care about reducing carbon footprints, there are much more complex privacy risks and trade-offs with these than with other smart products. Because of the complexities and trade-offs, extant privacy models are inadequate to explain consumer adoption of SSCCs, privacy risks, and information disclosure. There is added complexity in rational and irrational consumer decisions in adopting SSCCs. We address this opportunity by proposing a novel model to address these key factors for SSCCs. We further detail the motivation as follows.

Increasingly sought after by consumers, innovative sustainable products have leveraged recent applications in smart technologies, resulting in the increased production of electric vehicles, smart solar home systems, green chips, and so on [85]. Sustainable products based on smart technologies, such as the internet of things (IoT), artificial intelligence (AI), and big data, provide multiple benefits; they protect people, preserve the environment, and improve the efficiency in the use of nonrenewable resources. However, consumers must disclose their personal information to leverage such smart technology to take advantage of the smart features [114] and benefits of sustainable products, such as efficient autonomous-vehicle technology and intelligent traffic systems. Although the sustainability revolution has attracted many consumers to sustainable products, early adopters face risks when these products are unproven. Despite the privacy drawbacks of using innovative sustainable products, governments and many corporations persuade consumers to purchase products for the common good by appealing to “the consumer’s genuine desire to benefit humankind and the planet, construed more broadly as altruism” [30, p. 644].

SSCCs are ideal innovative, sustainable products that combine sustainable technologies with other smart technologies [71]. They offer consumers several benefits: human safety, the mitigation of greenhouse-gas emissions, fuel-cost savings, and system efficiency, all of which advance the common good. For the purposes of theorization and control, we define SSCCs<sup>1</sup> as smart-connected cars powered by

electric energy that provide multiple personal benefits and contribute to the common good of sustainability based on smart technologies. SSCCs' synergistic combination of smart technology has the potential to revolutionize the consumer vehicle market in terms of sustainability [98]. Experts expect the global market value of SSCCs to reach \$556 billion by 2026 and an estimated 14 million SSCCs to be on US roadways by 2025 [63, 71].

Many governments, companies, and consumers share the goal of improving sustainability, thereby contributing to the common good. Klotz et al. [59, p. 225] emphasize the importance of linking sustainability to the common good: "If you try to ensure long-term human well-being within the limits of the natural world, then you design for sustainability." This goal is encouraged in several ways.

*First*, governments encourage using SSCCs rather than conventional cars as part of the "zero-emissions" policy for preserving the Earth and discovering economic engines for the next generation [99]. For example, the California state government has announced the goal of achieving zero emissions from "all new cars and passenger trucks sold in California" by 2035 [16, p. 1]. In addition, the US government has tried to raise its federal tax credit for electric vehicles to \$12,500 for the 2021 tax year [95].

*Second*, SSCC manufacturers have increasingly emphasized the sustainability features of their vehicles (e.g., low fatal-accident rates, low CO<sub>2</sub> emissions, low fuel costs) in response to high consumer demand for and satisfaction with sustainable products [48, 53]. Accordingly, SSCC manufacturers have found their future growth engines in smart technology that can improve sustainability. "The car will no longer be a mere means of transport because, thanks to new technologies, it will be able not only to simplify the driver's life but also to increase safety on the road" [6, p. 1].

*Third*, SSCCs are attractive to many consumers because of their multiple personal benefits and sustainability. For example, many governments' zero-emission policies and subsidies for sustainable products have encouraged consumers to purchase SSCCs rather than conventional cars [95]. Furthermore, "Electric vehicles don't require as much maintenance as gasoline-powered ones because they don't need oil changes or air-filter replacements . . . \$330 less than a gas-powered car" [112, p. 1]. Companies' green

advertisements also promote consumers to participate in the common good of sustainability by driving SSCCs.

SSCCs can contribute to sustainability and provide personal benefits in several ways. The autonomous-driving feature of SSCCs, which is based on real-time information processing, can lower the fatal-accident rate [74].<sup>2</sup> Whereas the average accident rate for SSCCs with autonomous driving engaged is one accident per 4.59 million miles, the US National Highway Traffic Safety Administration reported that on average, a conventional-car accident occurs every 0.479 million miles in the US [58]. According to a study based on 26 countries across five continents, electric vehicle growth with governmental support will mitigate carbon dioxide (CO<sub>2</sub>) emissions [84]. The European Field Operational Test<sup>3</sup> consortium has reported that SSCCs can reduce CO<sub>2</sub> emissions by 1.7 million tons and save the equivalent of 700 million liters of fuel every year [12]. Consequently, the innovative benefits provided by SSCCs are expected to attract many consumers [94]. However, to fully benefit from using SSCCs, including their sustainability features, consumers must disclose a great deal of personal information—and expose themselves to the corresponding privacy risks. This is because SSCCs heavily use smart sensors, cloud-based IoT, AI, and big data, all of which require high volumes of consumers' personal information [70].

Concerns over the smart technologies used by SSCCs stem from potentially severe risks to consumers' unique but highly private information [5, 67], and the unprecedented amount of personal data SSCCs generate and share [116]. The risks regarding personal information posed by SSCCs are much more complex than those associated with other technologies, such as mobile apps, ecommerce, and social media, because SSCC consumers must share large amounts of new types of sensitive information in real time [5, 86]. For example, public traffic systems connected to government data servers, vendors' clouds, and SSCCs' unique intelligent sensors (e.g., radar, lidar, ultrasonic sensors, internal/external cameras) communicate with one another. This imposes new risks for consumer privacy: the exposure of drivers' and passengers' personal lives by cabin cameras [96], the direction of drivers' traffic-violation history, health information [79], weight (monitored in car seats), real-time location, driving habits, and information about

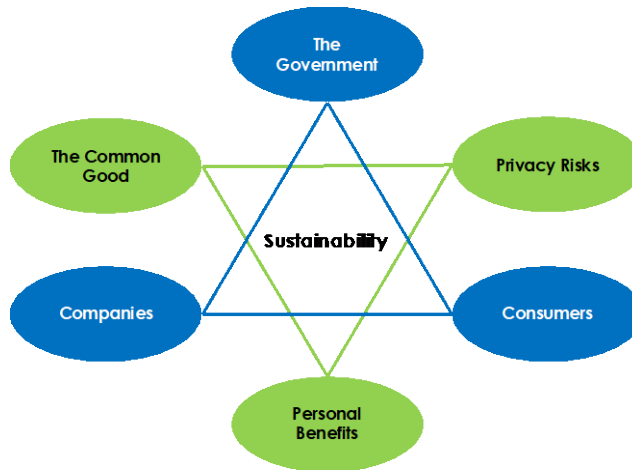
a vehicle's surroundings (other cars and the people on the street) [70, 116]. Moreover, in SSCCs, many sensors, computer systems, and apps<sup>4</sup> generate several terabytes of real-time, traceable information about drivers and passengers. A typical SSCC collects four terabytes of data per day [34, 86], which far outpaces the amount typically collected in other consumer settings, such as mobile communications and social media. For example, SSCCs' external cameras, one of the innovations by which they achieve a low fatal-accident rate and highly efficient use of traffic systems, can compromise the privacy of other drivers and pedestrians. Wireless communication systems can also transmit the large volumes of personal data collected by SSCCs, and even firmware updates for SSCC computing systems are conducted via over-the-air services, which are highly vulnerable to data breaches [78]. Thus, according to IBM studies, 56 percent of executives agree that the main differentiators in SSCC purchasing decisions are privacy-related issues [41].

Because SSCCs are associated with severe privacy vulnerabilities, policymakers are increasingly calling for solid privacy policies to protect consumers. Privacy experts have warned of the privacy vulnerabilities of various intelligent technologies embedded in SSCCs. For instance, in 2017, two US senators introduced the Security and Privacy in Your Car Study Act, known as the SPY Bill [88].<sup>5</sup> However, although companies emphasize the sustainability features of their SSCCs, they have yet to resolve SSCC privacy risks, despite their severity. Many consumers ignore or detach themselves from potential privacy risks when driving SSCCs. Despite the unresolved privacy issues of SSCCs, many governments, companies, and consumers share a commitment to improving human well-being for the long term, which can positively affect sustainability.

Given these opportunities, our study focuses on privacy tensions between governments, companies, and consumers concerning the purpose of using sustainable products, namely SSCC technologies, which require consumers to disclose high volumes of personal information (see **Figure 1**). Accordingly, we raise the following research questions:

**RQ1.** How can governments, companies, and consumers mitigate the tensions between privacy concerns, personal benefits, and the common good that arise in using SSCCs' smart technology?

**RQ2.** What role does sustainability play in purchasing SSCCs and consumers' personal information disclosure?



**Figure 1.** The Tensions in Decisions Related to SSCCs

To answer these questions, we adopt a dual approach involving (1) two types of privacy trade-offs (i.e., intuitive trade-offs and external trade-offs) leveraging the lens of the *privacy calculus model* (PCM) [60, 91]; and (2) consumers’ cognitive biases (i.e., anchoring effects on sustainability) based on *theories of bounded rationality* (TBR) [60, 90]. Combining these two approaches illuminates how SSCC consumers trade their privacy concerns for multilevel benefits. For example, researchers have suggested that the benefits of driving SSCCs include human safety [52], environmental performance as the common good [26, 30], and fuel and system efficiency as financial rewards [45].

In summary, numerous governments, companies, and people have a shared objective of enhancing sustainability for the greater social good. However, the use of complex smart and sustainability technology like SSCCs requires the disclosure of major amounts of personal information by consumers—leading to privacy threats. Thus, to better understand this ongoing phenomenon, we propose a novel model that examines the privacy tensions between governments, companies, and consumers regarding the purpose of using sustainable smart products in the context of SSCCs. We also find that the common good of sustainability plays an essential role in successfully implementing government policies (e.g., zero emissions), structuring car companies’ sustainability strategies, and satisfying consumers. Thus, our study can contribute to improving policies, practices, and laws regarding SSCCs and designing their interfaces and procedures, enabling consumers to provide better-informed consent regarding their privacy disclosures. Our study can also foster sustainability research on consumers’ privacy behaviors, particularly given the

lack of such research in the context of SSCCs [27]. Crucially, SSCC privacy considerations are not merely an extension of privacy considerations in other consumer contexts, such as app use, social networking, and ecommerce transactions. Instead, SSCC technology represents a paradigmatic shift that requires a similar change of theory, research, and practice—especially because extant research has not adequately accounted for such technology in a consumer privacy context. The privacy risks associated with SSCCs are much greater than that related to previous applications and products because SSCCs involve new types of privacy risks [116] and much more extensive data collection than previous products.

## **2. Background and Literature Review**

We consider a combination of rational and nonrational behaviors to explain the relationship between privacy and the common good. In this section, we begin by discussing information privacy and consumers' privacy concerns to outline how consumers disclose personal information and make purchasing decisions in the context of SSCCs. To understand consumers' complicated decision mechanisms, we adopt the PCM for SSCC consumers' rational privacy decision-making and cognitive biases based on TBR for nonrational privacy behaviors. Next, we explore three types of sustainability—people, planet, and profit—instead of only concentrating on environmental performance, which is the focus of most research. Considering the sustainability of SSCCs allows researchers to discuss the tensions between governments, companies, and consumers regarding privacy concerns, the common good, and personal benefits. In the next section, we explore new privacy trade-offs, multiple privacy reduction approaches, and anchoring effects in the SSCC context.

### **2.1. Information Privacy and Privacy Concerns**

Many studies have examined consumers' privacy concerns to understand their relationship to information privacy. Smith et al. [92, p. 169] suggested four dimensions of information-privacy concerns: data “collection, errors, unauthorized secondary use, improper access.” Based on the Internet users' information privacy concerns model, some studies have tested how consumers' privacy concerns impact their behavioral intentions to use ecommerce [69, 115]. Awad and Krishnan [8] suggested that in online

personalization markets, consumers with high privacy concerns place less value on personalization offerings than do consumers with low privacy concerns. In addition, Hong and Thong [44, p. 275] identified six dimensions (i.e., “collection, secondary usage, errors, improper access, control, and awareness”) of Internet privacy concerns; because several factors influence consumers’ privacy concerns, resolving them is challenging grounded in multidimensional developmental theory. Bansal and Nah [9] extended the concept of Internet privacy concerns in the surveillance context. Other researchers have found that culture, gender, perceived severity, perceived vulnerability, and self-efficacy act as antecedents of privacy concerns [65, 73].

Although concerns about information privacy in the use of information technology (IT) devices and services are well established, they have become critical due to the emergence of IoT and AI, which generate and apply big data, respectively [67]. For example, technology awareness, including an awareness of big data, affects information-privacy concerns [4] that moderate the relationship between information collection and transactional privacy concerns [22] and mediate the relationship between online privacy violations and privacy-protection behaviors [18]. The advent of SSCCs has made consumers’ privacy concerns much more severe. SSCCs process a vast amount of data, including consumers’ personal information, which is accessible to multiple stakeholders. Vendors and governmental agencies can also manipulate the degree to which consumers say they are concerned about their privacy [1]. Privacy concerns and information-disclosure behaviors should thus be intensively studied with a multifaceted approach [10, 11]. Our study provides valuable insights into how multiple stakeholders approach consumers’ privacy concerns in the context of SSCCs, and how potential privacy tensions among stakeholders can be minimized.

## **2.2. Information Disclosure and Privacy Concerns**

With conflicting results, substantial interdisciplinary research has examined the relationship between privacy concerns and information disclosure. Some scholars have argued that information-privacy concerns are negatively associated with actual disclosure behaviors via Facebook and smartphone location-based

services [56, 65], online purchasing behaviors [35], and personal-information disclosure [4]. Similarly, general privacy concerns negatively influence consumer willingness to delegate profiles to the Facebook app [21], and beliefs pertaining to privacy risks negatively affect self-disclosure [83]. Warkentin et al. [108, p. 766] have also found that smart meter invasiveness that indicates “the amount of detail that such devices can record and how much control they possess” decrease the intention of consumers to use smart metering technology.

By contrast, some studies have concluded that consumers’ actual information disclosure is not associated with privacy concerns [19, 76]. Keith et al. [56] have argued that the effect of privacy concerns on actual disclosure is statistically weakly significant despite the effect of such concerns on the intention to disclose. One of the difficulties of performing a privacy-behavior study is that consumers’ information-disclosure behaviors can vary depending on the level of perceived relevance and monetary rewards [64]. People also behave differently in shallow-disclosure and in-depth-disclosure contexts, depending on their history of breach experiences<sup>6</sup> [77]. Although privacy concerns exert a positive influence by limiting the profile visibility of social networking users, they do not constrain all acts of self-disclosure in privacy management because the interaction effect between high self-efficacy in privacy management and low privacy concerns leads to risk-taking behaviors [19]. Thus, the relationships between privacy concerns and consumer information disclosure are complicated.

To make sense of these conflicting results in an SSCC context, we first note that researchers who support rational decisions concerning privacy based on the PCM tend to claim that consumers’ decisions to disclose personal information result from an evaluation of privacy risks and benefits [29]. Second, we note that behavioral researchers typically contend that information disclosure is the outcome of heuristics and cognitive biases [60].

### **2.3. The PCM for Rational Privacy Decision-Making**

Used in the traditional, rational approach to privacy, the PCM explains consumers’ privacy decisions based on the notion of utility maximization between privacy concerns as costs and the benefits of

information disclosure. When applying the PCM, researchers consider numerous factors that vary depending on context. For instance, Li et al. [64] have shown that the calculation of benefits and privacy-protection beliefs affects information disclosure. In mobile app contexts, network size is positively correlated with calculating benefits and privacy risks [55]. In social media research, the PCM has been extended to include privacy self-efficacy and self-withdrawal behaviors (e.g., deleting Facebook posts), which are positively affected by privacy concerns [28]. Focusing on Facebook, Wang et al. [107] have suggested that perceived benefits affect the intention to disclose personal information more strongly than do privacy costs, although perceived privacy risks negatively influence the intention to disclose personal mobile information. In particular, monetary incentives play a critical role in consumers' calculation of benefits over privacy costs in ecommerce transactions [46, 64]. In the SSCC context, consumers often exchange their personal information to receive discounts on their insurance fees [38].

However, the evaluation of privacy costs and benefits can be skewed and bounded by personal dispositions, cognitive biases, and heuristic thinking [54]. For example, Pentina et al. [80] have suggested that perceived privacy concerns and perceived benefits are affected by personality and cultural differences. Thus, despite the importance of the PCM's rational decision-making approach, a behavioral approach must be introduced to shed light on consumers' decisions concerning privacy, because such decisions are made on the basis of inconsistent evaluations [49], which reflect bounded rationality and cognitive biases. Thus, we combine these two approaches to explain consumers' privacy decision in the context of SSCCs.

#### **2.4. Bounded Rationality and Cognitive Biases**

TBR explains consumers' intuitive decision-making in terms of cognitive biases and limited personal capabilities [90]. Behavioral economists and researchers largely agree that consumers do not correctly evaluate privacy risks for expected effects [54] because uncertainty, preferences, and context-dependence strongly influence consumer decisions regarding privacy [1]. Consumers have great control over their personal information; they have fewer privacy concerns and are more willing to disclose sensitive information [13]. Consumers' nonrational evaluations related to privacy issues can render privacy notices

ineffective in changing consumer privacy decisions [87]. Thus, the complexity of SSCC technology makes it difficult for consumers to fully evaluate the privacy risks posed by SSCCs. Instead, they are likely to rely on their intuition, which is prone to cognitive biases and steeped in heuristics.

Moreover, cognitive biases explained by TBR can provide insights that can explain consumers' tendency to engage in *nonrational privacy decision-making* [2, 50, 90]. To illustrate this tendency, Waldman [106] has suggested five cognitive biases, including *framing* and *anchoring effects*, that explicate the limit of privacy trading for convenience. For instance, *prospect theory*, which is grounded in TBR, posits that people tend to make instant and intuitional decisions in the same probability conditions (e.g., nonrational decisions) but within their own frames [50].<sup>7</sup> Regarding ecommerce review systems, Wolf and Muhanna [111] have demonstrated that consumers interpret reviews on Amazon and eBay as biased because they assume feedback data are incorrectly processed, which is a *judgment bias* [62]. Moreover, in online health service applications, consumers often experience a *status quo bias*, in which they “prefer to maintain their current status rather than to change it even though the new status is a better choice” [117, p. 988]. Similarly, as an anchoring effect, sustainability can play a crucial role in consumer privacy decisions, because many consumers are anchored to initial information regarding SSCCs' sustainable benefits, and governments and car companies emphasize SSCCs' sustainable benefits despite SSCCs' high privacy risks. Thus, cognitive biases with TBR can shed light on nonrational consumer behaviors that cannot be explicated with the PCM's rational decision approach. Our study examines consumers' cognitive bias with the PCM's rational-decision making approach to understand consumers' privacy decisions when adopting SSCCs.

## 2.5. Three Types of Sustainability in SSCCs

Sustainability involves a broader concern about the depletion of natural resources and is addressed in terms of the three Ps: people, planet, and profit [25, 81]. **Table 1** summarizes the 3Ps of sustainability, and we explain the three Ps as follows:

**(1) People.** The ultimate goal of sustainability is to preserve human life by achieving harmony between humans and nature. Instinctively, consumers prefer to purchase safer cars [52, 98], as exemplified by the

**Table 1.** Three Types of SSCC Sustainability

<b>Sustainability type</b>	<b>Construct name</b>	<b>Variable name</b>
Sustainability 1 (people)	Human safety	Fatal-accident rate
Sustainability 2 (planet)	Environmental performance	CO <sub>2</sub> emissions
Sustainability 3 (profit)	Fuel and system efficiency	Fuel and system efficiency

popularity of smart sensor systems and self-driving features. Smart technology converts conventional vehicles as a means of transport into SSCCs, protecting human life [6]. The low fatal accident rates of SSCCs exhibit the *human safety* aspect of SSCCs, which is one of the most important types of SSCC sustainability. Thus, in our SSCC context, we focus on human safety, which we measure by the fatal-accident rate.

**(2) Planet.** Preventing environmental destruction is the foundation of sustainability. For example, the considerable amount of CO<sub>2</sub> emissions in the atmosphere is the main culprit of the greenhouse effect. Accordingly, preliminary research indicates that *environmental performance* of electric cars may be a strong predictor of consumers' attitudes, which in turn reflects their purchase intentions<sup>8</sup> [26]. Many consumers are willing to sacrifice their extrinsic values (e.g., time, labor, money) to pursue the more intrinsic value of preserving the planet based on mere altruism [30] or more nuanced sustainability practices [15, 43, 110]. Thus, in our SSCC context, we focus on environmental performance, which we measure with CO<sub>2</sub> emissions.

**(3) Profit.** Because “no waste” is the foundational philosophy of sustainability, many people expect that sustainability requires sacrifice and financial costs; however, with careful execution, it may confer financial rewards. For instance, companies devoted to sustainability can maximize their profits by minimizing their waste. Consumers who use sustainable products may be able to benefit financially by reducing electricity or fossil fuel use. In practice, *fuel and system efficiency* [45, 98] based on new types of energy, such as electric energy and hydrogen energy, *government subsidies*, and *car insurance discounts* [38] are significant factors behind a consumer's decision to purchase an SSCC because these dramatically influence the benefits they are able to receive aside from reduced energy consumption. Consequently, in our SSCC context, we focus on fuel and system efficiency as the key benefit that provides consumers benefits.

### 3. Theory and Hypothesis Development

This section further presents consumers' actual personal information disclosure and purchase behaviors in the context of SSCCs. We propose a new model regarding the relationship between privacy concerns and the sustainability of consumers' personal information disclosure behaviors when purchasing SSCCs. Notably, our model is further contextualized and bounded by three assumptions that are derived from the PCM and TBR.

#### 3.1. Extended Privacy Trade-off Model for SSCCs

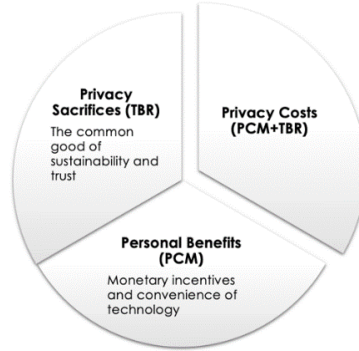
Prior research has focused mainly on consumers' self-disclosure decisions to explain rational or nonrational behaviors related to privacy decision-making. In the context of social media and ecommerce, consumers are generally aware of the content they share with service providers. However, many consumers are unaware of the privacy risks that stem from SSCCs due to the complexity of the technology and the multiple stakeholders who can access their sensitive information. Consequently, SSCC consumers' disclosure decisions are much riskier than self-disclosure or information disclosure on traditional Internet platforms, because driving SSCCs requires them to disclose a large amount of personal information despite their lack of awareness of the associated privacy risks.

To explain how consumers use both rational and behavioral approaches to evaluate the privacy costs and technological benefits of using SSCCs, we propose the *privacy–common good trade-off* (PCGT) model, which is premised on three assumptions: a *bidirectional reduction of privacy concerns* (based on PCM and TBR), *two types of privacy trade-offs* (based on PCM and TBR), and anchoring effects (based on TBR).

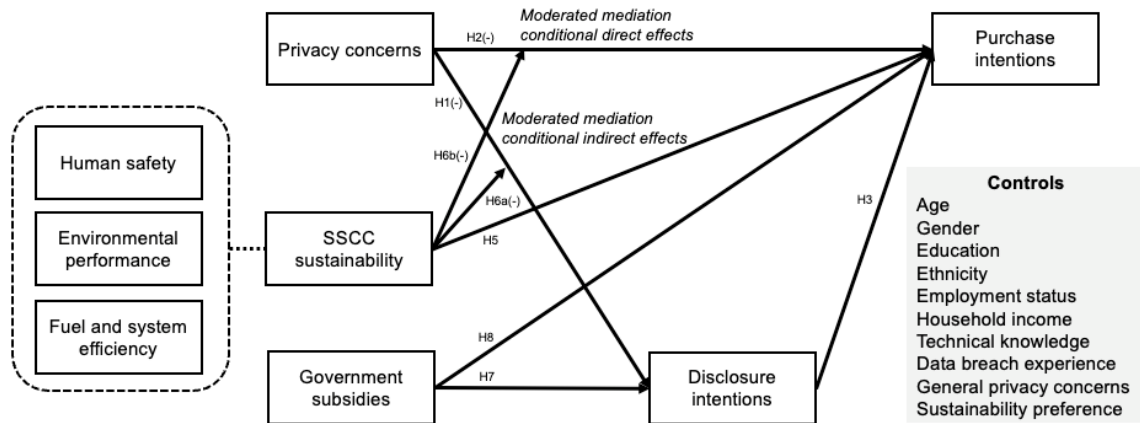
#### 3.2. Bidirectional Reduction of Privacy Concerns about SSCCs

Our first assumption is that SSCC consumers' privacy concerns can be alleviated in two ways: (1) based on PCM, by trading privacy for personal benefits (e.g., convenience, monetary incentives) and (2) based on TBR, by sacrificing privacy concerns for the common good (e.g., sustainability) (see **Figure 2**).

Our proposed PCGT model (see **Figure 3**) depicts its three assumptions: the bidirectional reduction of



**Figure 2.** Bidirectional Reduction of Privacy Concerns



**Figure 3.** Proposed Privacy–Common Good Trade-off (PCGT) Model

privacy concerns, two types of privacy trade-offs, and anchoring effects. The model also includes a combination of rational and behavioral privacy decisions based on the three types of sustainability and two SSCC applications of monetary incentives. Thus, to demonstrate how consumers disclose their personal information, specifically that for SSCCs, the PCGT model describes not just the effects of the three types of sustainability on disclosure intentions but also a mediation effect and six moderated–mediation effects. Next, we discuss the effect of each type of sustainability on SSCC consumers’ disclosure intentions and purchase intentions.

### 3.3. A Mediation Relationship between Privacy, Disclosure, and Purchase

Information disclosure acts as a mediator between privacy concerns and purchase decisions concerning SSCCs. Accordingly, we assume that privacy concerns will negatively affect information disclosure [4, 107]. In parallel, we predict that SSCC consumers’ purchase intentions will be affected more by disclosure intentions than privacy concerns because the willingness to use personal information for location-aware

marketing positively influences purchase intentions [113]. Due to the unique privacy issues raised by SSCCs—that is, the large amount of personal information disclosed and its accessibility to multiple stakeholders—we posit that privacy concerns similarly affect consumers’ disclosure intentions and purchase intentions regarding SSCCs (see **Figure 3**). Thus, we propose the following hypotheses:

- H1.** SSCC consumers’ *privacy concerns* will negatively influence their *disclosure intentions*.
- H2.** SSCC consumers’ *privacy concerns* will negatively influence their *purchase intentions*.
- H3.** SSCC consumers’ *disclosure intentions* will positively influence their *purchase intentions*.
- H4.** SSCC consumers’ *disclosure intentions* will partially mediate the relationship between *privacy concerns* and *purchase intentions*.

### 3.4. Two Types of Privacy Trade-off Concerning SSCCs

To understand why consumers share their information in response to vendors’ sustainability-related advertisements and government policies concerning SSCCs, it is important to consider their rational *and* nonrational behaviors. We explicate consumers’ privacy decisions from two perspectives, as summarized in **Table 2** and **Figure 4**: (1) from a PCM perspective, rational decisions, which involve personal benefits and monetary incentives, and (2) from a TBR perspective, behavioral decisions, which involve anchoring effects on sustainability.

**Table 2.** Two Proposed Types of Privacy Trade-off Concerning SSCCs

	<b>Intuitive privacy trade-offs</b>	<b>External privacy trade-offs</b>
<b>Theoretical background</b>	TBR explains consumers’ nonrational behaviors based on their limited processing capabilities and cognitive biases.	The PCM explains consumers’ rational behaviors based on the calculation of privacy risks and benefits.
<b>Construct</b>	SSCC sustainability	SSCC monetary incentives
<b>Interpretation approach</b>	Behavioral privacy decision-making (researchers posit that consumers cannot make fully rational decisions. Instead, consumers behave intuitively based on their limited cognition and experiences).	Rational privacy decision-making (researchers posit that consumers can make rational decisions. Thus, consumers calculate privacy risks and benefits and behave rationally).
	It is unnecessary to pay to decrease privacy concerns, because consumers sacrifice their privacy for psychological benefits.	It is necessary to pay for trade-offs to decrease privacy concerns because consumers expect monetary incentives.
	Psychological (indirect) trade-off.	Monetary (direct) trade-off.
<b>Goals of privacy behaviors</b>	Satisficing via personal preferences, heuristics, and cognitive biases	Optimization via calculations between personal/monetary benefits and privacy concerns

Note. PCM = privacy calculus model; SSCC = sustainable smart-connected cars; TBR = theories of bounded

rationality.

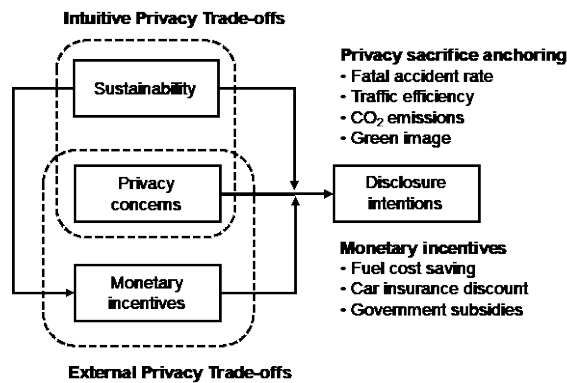


Figure 4. The Two Types of Privacy Trade-offs

### 3.5. Cognitive Biases and Privacy Concerns about SSCCs

Regarding the inconsistency in consumers' behaviors with respect to privacy concerns, Jiang et al. [49] suggested that consumers exchange privacy for social rewards. In the SSCC context, because TBR [90] explains that consumers cannot completely calculate the effect of sustainability on privacy concerns, they intuitively trade privacy for access to the technology, which in turn influences the extent of their information disclosure [56, 57]. Degirmenci and Breitner [26] have emphasized that environmental performance is an essential predictor of purchase intention, and Tu and Yang [100] have argued that environmental awareness affects the intention to behave. Thus, we posit that many SSCC consumers are willing to accept increased privacy risks in return for the opportunity to protect the environment and to send a positive sustainability signal to others.

Generally, an anchoring effect is a cognitive bias that influences consumers' decision-making under uncertain conditions. More formally, *anchoring effects* are "the disproportionate influence on decision makers to make judgments that are biased toward an initially presented value" [36, p. 35, 101]. In the context of SSCCs, consumers' personal information is highly vulnerable, but most consumers have little awareness of the privacy risks posed by SSCC technology [116]. Anchoring effects on sustainability work in tandem with the suppression of privacy concerns over the disclosure of personal information by SSCCs. For example, consumers of SSCCs can be anchored to their lower fatal-accident rates, CO<sub>2</sub> emissions, or fuel costs. SSCCs have a fatal-accident rate 3.7 times lower than that of conventional cars and a predicted

90 percent decline in the accident rate by 2050 [47, 97]. According to one study, SSCCs reduce CO<sub>2</sub> emissions by at least 60 percent (123 grams of CO<sub>2</sub> emissions per mile compared to 381 grams for gas-powered cars) [102]. The calculated reduction of 1.7 million tons of CO<sub>2</sub> emissions every year can also anchor SSCC consumers. In addition, SSCCs can reduce the average fuel cost of conventional cars—\$1,117 per year—to about \$485 per year [31]. Accordingly, consumers' purchase behaviors can be anchored to the sustainability of SSCCs.

Therefore, consumers can attempt to trade off these three types of SSCC sustainability against privacy concerns when adopting SSCCs. We posit that (see **Figure 3**):

**H5.** SSCC *sustainability* will positively influence consumers' *purchase intentions*.

**H6a.** As a conditional indirect effect, SSCC *sustainability* will negatively moderate the negative relationship between SSCC *privacy concerns* and *disclosure intentions*.

**H6b.** As a conditional direct effect, SSCC *sustainability* will negatively moderate the negative relationship between SSCC *privacy concerns* and *purchase intentions*.

### 3.6. Monetary Incentives for SSCCs

Consumers often make selfish decisions while sometimes behaving altruistically. Namely, consumers are generally sensitive to monetary incentives in privacy decision-making [46, 75]. Hann et al. [42] suggested that financial gains have a strong influence on individual preferences online with different privacy policies. Consequently, monetary rewards with perceived relevance lead to information disclosure behaviors [64]. For instance, consumers' location information disclosure is ultimately decided by calculating monetary incentives over the perceived risks [23]. The development of personal health information exchanges is also affected by incentives, coupled with privacy regulation in patient consent [3]. In the IoT and big data applications, Asikis and Pournaras [7] have found a trade-off between privacy and utilities, including monetary incentives. In the context of a car, government subsidies, such as the \$7,500 US federal tax credit and multiple state incentives for purchasing eco-friendly cars, play a critical role in stimulating consumers' eco-friendly car purchasing [14]. In addition, consumers tend to share personal information with car insurers for minor financial compensation [27]. General Motors has announced that they will monitor consumers' personal information (e.g., driving habits) based on car

insurance plans [109]. SSCC consumers can also save approximately 700 million liters of fuel consumption every year [12]. Thus, we propose the hypotheses regarding external privacy trade-offs (e.g., SSCC government subsidies):

**H7.** *Government subsidies* for purchasing SSCCs will positively influence *disclosure intentions* when adopting SSCCs.

**H8.** *Government subsidies* for purchasing SSCCs will positively influence *purchase intentions* when adopting SSCCs.

## 4. Methodology

We tested our theoretical model with a series of smaller studies described in this section. The fundamental assumption of our model was that SSCC consumers' privacy concerns negatively influence their disclosure intentions, which act as a mediator between SSCC privacy concerns and purchase intentions. Adding to this logical prediction, we assessed three types of SSCC sustainability and then tested the multiple predicted moderated–mediation effects of each type on the negative relationship between SSCC privacy concerns and both disclosure intentions and purchase intentions. Finally, we evaluated how disclosure intentions affect purchase intentions.

### 4.1. Experimental Survey Design

The online experimental design had a factorial approach of 5 (control/four brands) x 3 (control/low/high sustainability) for the three types of sustainability. First, we randomly assigned participants to four brands and a control group. Based on the level of sustainability, we then randomly assigned the participants to these groups a second time. Each group's participants were then asked to read three types of sustainability manipulation scenarios.

For the target cell size, we decided on a 0.05 Type I error ( $\alpha$ ), 80 percent power (1-Type II error), a 95 percent confidence level, 0.5 standard deviations, and a margin of error (or confidence interval) of  $\pm 0.05$ . Based on unknown population size or a large population size, we calculated the target cell size as 385 samples.<sup>9</sup> To calculate the sample size with G\*power software, we applied the smallest effect size (i.e.,  $d = 0.25$ ) among the effect sizes used in prior privacy research.<sup>10</sup> As a result, the model required at least 249 samples with a power ( $1-\beta$ ) of 0.8 and  $\alpha = 0.05$ . For the power of 0.95 and  $\alpha = 0.05$ , we needed 372 samples

based on G\*power version 3.1 [33]. Thus, we decided to collect 500 samples in the main study to minimize errors.

We recruited participants via Amazon Mechanical Turk (MTurk), managed by CloudResearch. We followed leading procedures for improving the attention of the participants and the data quality by applying several random attention-check questions, reverse-coded questions, lock-time functions, time tracking, specialized random codes, and marker variables [66]. For the first pilot test, we analyzed 100 samples and subsequently expanded the research model. The second pilot test used 93 out of 101 samples because eight samples were disqualified due to incorrect survey codes. Based on the results of the second pilot test, we collected 506 samples for the main study, 50 of which were excluded for failure to complete the survey correctly. Thus, ultimately, the analysis consisted of 456 sample responses.

The survey items were borrowed from the literature to minimize validity issues. We used a 7-point Likert-type scale for the post-experimental survey items. **Table 3** details the experimental variables of the survey.

**Table 3.** Survey Variables

Type of variable	Variable or construct	Origin
Demographics and other personal differences	Gender, age, ethnicity, household income, current employment status, education, data breach experience, technical knowledge, general privacy concerns, sustainability preference	Lowry et al. [68] Choi and Land [21] Haytko and Matulich [43]
Dependent variable	Disclosure intentions Purchase intentions	Zhao et al. [118] Xu et al. [113]
Independent variable	SSCC privacy concerns Disclosure intentions Government subsidies	Choi and Land [21] Zhao et al. [118] Hui et al. [46]
Independent variable + moderator variable	Fatal-accident rate (SSCC sustainability 1) CO <sub>2</sub> emissions (SSCC sustainability 2) Fuel and system efficiency (SSCC sustainability 3)	Topolšek et al. [98] Grunert et al. [39] Topolšek et al. [98]

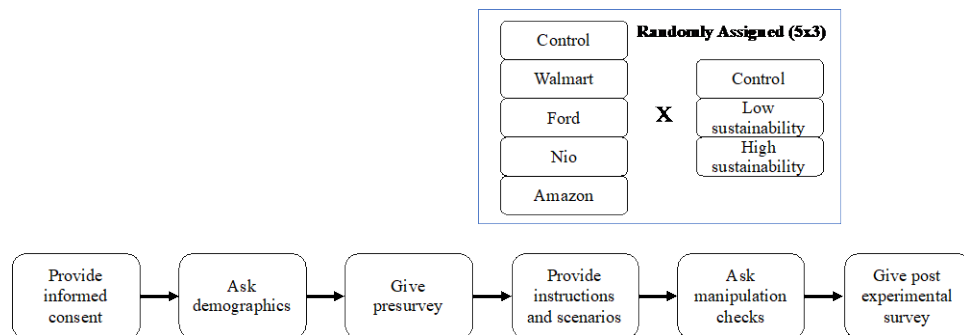
Note. SSCC = sustainable smart-connected cars.

## 4.2. Procedures

The instructions, manipulations, and surveys were delivered online through the Qualtrics XM™ survey and marketing-research platform. Eligible participants were required to read and sign the institutional review board’s consent form before deciding whether to participate in the survey. Those who consented

were asked to provide demographic information and answer presurvey questions about relevant aspects of their backgrounds, including data breach experiences, general privacy concerns, technical knowledge, and sustainability preferences.

Next, the participants read the experiment instructions (see **Figure 5**). The instructions included the definitions of conventional cars and SSCCs and two examples related to SSCC technology. The privacy risks of smart technology, such as real-time personal-data sharing, were also explained (see **Figure 6**). The Qualtrics time lock function was used to prevent participants from skimming or skipping instructions. Qualtrics then randomly assigned participants to one of five levels of brand and to one of three levels of sustainability (5 x 3). The randomly selected participants were asked to read a series of scenarios that included detailed features of sustainability: fatal-accident rates, CO<sub>2</sub> emissions, and fuel and system efficiency. After presenting the privacy features of a conventional car and an SSCC car, a combination of randomized features—some associated with conventional cars, and some associated with SSCCs—was provided. We thus generated five levels of brand<sup>11</sup> and three levels of sustainability randomized combinations. Together, these factors gave us enough experimental control to understand how specific sustainability features affected the outcomes. After reading the scenarios, participants answered manipulation-check questions. To improve the quality of this experimental design, we added multiple skip logics to those who did not choose a correct answer. As a result, participants who understood the scenarios correctly could begin answering the post-experimental survey questions.



**Figure 5.** Study Procedures

### 4.3. Manipulation Checks

After the participants were given their specific manipulations, they answered manipulation-check questions. These questions enabled us to determine whether participants remembered and understood the manipulations they were given. **Table 4** shows the number of samples, means, and standard deviations for each variable. We provided manipulation checks in the following two ways.

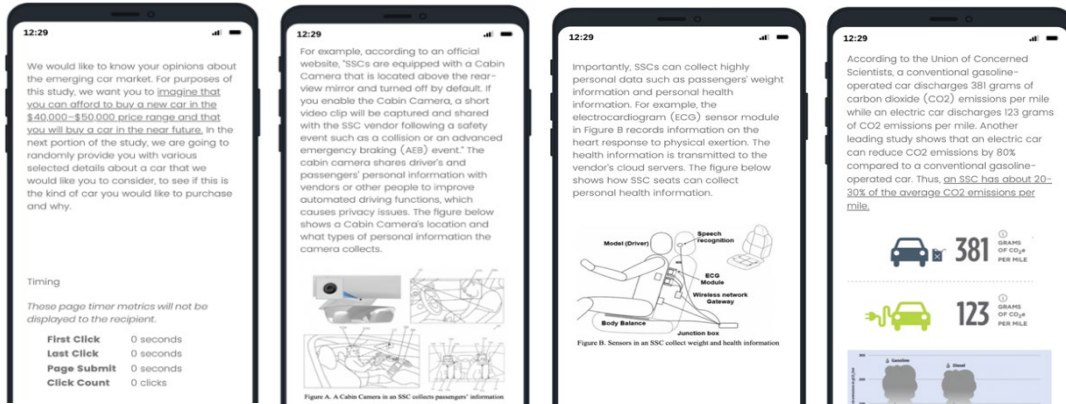


Figure 6. Examples of Scenarios

Table 4. Manipulation Checks

Variable	Level	Mean	SD	n
PC (privacy concerns)	Control	5.52	1.22	194
	Low	4.22	1.98	89
	High	5.64	1.17	173
FA (fatal-accident rate)	Control	5.23	1.17	194
	Low	3.91	1.23	89
	High	6.18	0.80	173
EV (CO <sub>2</sub> emissions)	Control	3.20	1.36	194
	Low	4.92	1.24	89
	High	2.02	0.86	173
FE (fuel and system efficiency)	Control	4.96	1.24	194
	Low	2.88	1.23	89
	High	6.16	0.70	173
GS (government subsidy)	Control	3.92	1.66	194
	Low	2.24	1.39	89
	High	3.98	2.05	173

Note. SD = standard deviation.

First, the manipulation check for car brands was a hybrid question because it was an advanced attention check as well as a manipulation check concerning the brand. In the manipulation checks related to “brand,” we added different brand names that were not included in the scenarios, such as Apple and Verizon. Participants who chose one of these options were barred from answering subsequent questions, because these responses clearly indicated a lack of attention. If participants selected “This was not stated in the

information I was given” or “I don’t know,” the survey was stopped if one of the treatment groups was assigned to them. Second, regarding the manipulation checks for the three types of sustainability, we provided a direct question about whether the fatal-accident rate for the randomly assigned car was lower than the average fatal-accident rate or one about whether the potential negative environmental impact of the randomly assigned car was greater than the average negative effect.

#### 4.4. Establishing Validity and Model Fits

We conducted preliminary tests to assess the reliability and validity of the responses. The measurement model analyses involved the reliabilities for each correlation alpha (CRA), called Cronbach’s alpha ( $\alpha$ ). **Table 5** shows that all the scores were over the threshold of 0.7 [20, 24]. Based on correlation matrix analyses, there were no critical issues regarding convergent validity and discriminant validity (see **Figure B.1**). Because all average variances extracted (AVEs) were greater than 0.5, there were no convergent validity issues. The AVE square roots were greater than interconstruct correlations, which also indicated discriminant validity. The total number of violations was less than one-half of the potential comparisons [17]. We also tested the variance inflation factor to examine for potential multicollinearity. Based on the recommended value of 5, it was good in all cases except FE (FA = 2.2, EV = 2.1, FE = 5.2, GS. = 4.8, PC = 1.1) [40]. We tested for and ruled out common method bias using a marker variable and common latent factors in AMOS [72]. Finally, the results of confirmatory factor analysis (CFA) for sustainability demonstrated strong model fit statistics; the root mean square error of approximation (RMSEA) value was 0.043, which is lower than 0.07 [93]; the comparative fit index (CFI) value was 0.985, which is greater than 0.90; the Tucker–Lewis index value (TLI) was 0.982, also greater than 0.90.

**Table 5.** Reliability

<b>Construct name</b>	<b>Sample item</b>	<b>Alpha (<math>\alpha</math>)</b>
Purchase intentions	How interested would you be in buying the car?	0.97
Disclosure intentions	I would be willing to disclose my personal driving information generated by the car.	0.93
SSCC privacy concerns	In general, I am concerned that the information generated by the car could be misused.	0.95
Human safety	The car that we would like you to consider buying would have safety systems to greatly reduce the fatal-accident rate.	0.95
Environmental performance	This particular car would increase environmental damage.	0.94
Fuel and system efficiency	The car that we would like you to consider buying would have low fuel consumption.	0.94

Government subsidies	The amount of US federal government subsidies for this particular car would be enough amount of money for sharing my car data.	0.99
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Note. Alpha ( $\alpha$ ) = Cronbach's alpha reliability value; SSCC = sustainable smart-connected cars.

#### 4.5. Results

Our experimental design incorporates specific scenarios in which consumers adopt SSCCs. Moreover, the design encompasses multiple manipulations with specific numbers regarding fatal accident rates, CO<sub>2</sub> emissions, and fuel and system efficiency to examine the relationship between sustainability, privacy concerns, government subsidies, disclosure intentions, and purchase intentions. Finally, we employed four different brands to mitigate any potential brand effects on the model.

A variety of age groups participated in this survey ( $Mean_{age} = 41.29, SD_{age} = 13.43$ ). Of these, 214 were male and 238 were female. We applied SPSS AMOS to conduct CFA and structural equation modeling. In our experiment, all the conditions involved identical survey items. For each participant, we evaluated the interaction effects of each type of sustainability with SSCC privacy concerns on disclosure intentions and purchase intentions. The results of the conditional interaction effects provided evidence that each type of sustainability negatively interacted with SSCC privacy concerns with respect to both disclosure and purchase intentions. Because disclosure intentions mediated the relationship between SSCC privacy concerns and purchase intentions, the conditional interaction effects between sustainability and SSCC privacy concerns were moderated–mediation effects.

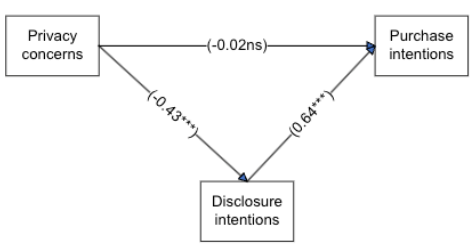
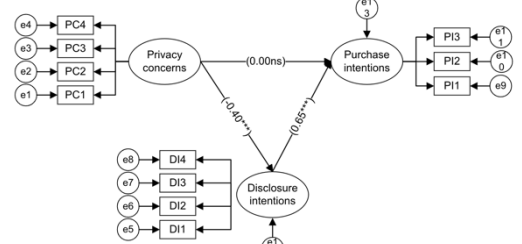
##### 4.5.1. Mediation effects

One of the purposes of our study was to determine the mediation effects of personal-information-disclosure intentions in relation to SSCC privacy concerns and consumers' SSCC purchase intentions. We found that the effect of consumers' privacy concerns on purchase intentions occurred through their disclosure intentions because H1 and H3 were supported regardless of the results of H2. Instead, H2 provided essential information about whether disclosure intentions are fully or partially mediated. Interestingly, in the second pilot study, privacy concerns exerted a significant influence on intentions to purchase SSCCs. However, the results of the main study (with a large sample) indicated that consumers' purchase intentions when buying SSCCs were not significantly affected by SSCC privacy concerns (H4

partially supported). These inconsistent results are in line with previous studies that have generated conflicting findings [19, 56, 76].

As **Table 6** shows, to analyze the mediation effects of disclosure intentions between privacy concerns and purchase intentions, we used two tools: SPSS Process and AMOS. The effects of SSCC privacy

**Table 6. Mediation Effects**

Tool	SPSS process output	AMOS output
<b>Mediation effect model</b>		

concerns on disclosure intentions ( $t_{(454)} = -8.82, p < 0$ ) and disclosure intentions on SSCC purchase intentions ( $t_{(454)} = 15.16, p < 0$ ) were significant (see **Table B.2** and **Table B.3**). We concluded that there were indirect effects of disclosure intentions between privacy concerns and purchase intentions because the interval between the lower level of confidence interval (BootLLCI) and the upper level of confidence interval (BootULCI) did not include zero (see **Table B.3**). The results of the model fit (GFI = 0.98, AGFI = 0.96, CFI = 0.99, RMSEA = 0.03) indicated that there was good model fit between the proposed model and the data, such that the data does not require re-specification (see **Table B.4**).

#### 4.5.2. Human safety (SSCC sustainability 1)

We found that human safety, one of the three sustainability types, interacted with privacy concerns and affected disclosure intentions and purchase intentions, respectively (H6a and H6b supported). **Figure B.1** shows the moderated–mediation model and its index, -0.09, which was calculated by SPSS Process 3.5 with 5,000 bootstrap samples. Because the moderated–mediation effects of the fatal-accident rate had a negative relationship with privacy concerns, the index value was negative. The zero did not fall in the interval between BootLLCI and BootULCI, which indicates that the fatal-accident rate of SSCCs played a significant role as a moderated mediator. We found that the conditional direct effects of the fatal-accident rate of SSCCs were one of two moderated mediations in the relationship between consumers’ privacy

concerns and purchase intentions. Because the effect of SSCC privacy concerns on purchase intentions occurred through consumers' information-disclosure intentions and interacted with the fatal-accident rate, we called the moderated–mediation effect “conditional indirect effects.” The Johnson–Neyman outputs shown in **Table 7** display these conditional effects: the effect was active only in the blue zone because the

**Table 7.** Conditional Direct and Indirect Effects of FA

Output	Conditional indirect effects: PC × Sustainability → DI → PI	Conditional direct effects PC × Sustainability → PI
FA Johnson–Neyman Output		
FA Histogram / Line Graph		

*Note.* Level of confidence for all confidence intervals in the output: 95%; Number of bootstrap samples for percentile bootstrap confidence intervals: 5,000; Red:  $p > 0.05$ , blue:  $p < 0.05$  (Johnson–Neyman Output). DI = disclosure intentions; FA = fatal-accident rate; PC = privacy concerns; PI = purchase intentions.

red zone represents nonsignificance ( $p > 0.05$ ). **Table B.5** and **Table B.6** provide the detailed outputs of the conditional indirect effects and the conditional direct effects of the fatal-accident rate of SSCCs.

### 4.5.3. Environmental performance (SSCC sustainability 2)

The environmental performance of SSCCs, the second sustainability type, conditionally influenced SSCC privacy concerns on disclosure intentions and privacy concerns on purchase intentions, respectively (H6a and H6b supported). The moderated–mediation index of the environmental performance of SSCCs was 0.08, calculation of SPSS Process 3.5 with 5,000 bootstrap samples (see **Figure B.2**). Because the interval between BootLLCI and BootULCI did not include the zero point, we concluded that the moderated–mediation effects were significant. The first moderated–mediation effect was the conditional

indirect effect of environmental performance on the relationship between privacy concerns and disclosure intentions. The second moderated–mediation effect was the conditional direct effect of environmental performance on privacy concerns and purchase intentions. Because lower CO<sub>2</sub> emissions entail better environmental performance, the blue zone (e.g.,  $p < 0.05$ ) in the Johnson–Neyman outputs is located on the left side (see **Table 8**). For example, when the CO<sub>2</sub> emission value is less than 5.7, environmental

**Table 8.** Conditional Direct and Indirect Effects of EV

Output	Conditional indirect effects: PC × Sustainability → DI → PI	Conditional direct effects: PC × Sustainability → PI
EV Johnson–Neyman Output		
EV Histogram/ Line Graph		

*Note.* Level of confidence for all confidence intervals in the output: 95%; Number of bootstrap samples for percentile bootstrap confidence intervals: 5,000; Red:  $p > 0.05$ , blue:  $p < 0.05$  (Johnson–Neyman Output). DI = disclosure intentions; EV = CO<sub>2</sub> emissions; PC = privacy concerns; PI = purchase intentions.

performance plays a role as a moderated mediator. In the conditional indirect effect model, SSCC privacy concerns on purchase intention were weakly significant (SPSS Process 3.5 outputs) or nonsignificant (AMOS outputs), in contrast to the conditional direct effect model (see **Table B.7** and **Table B.8**). This finding indicated that privacy concerns inconsistently influenced consumers’ purchase behaviors. Furthermore, we found that other factors could interact with privacy concerns to alter consumers’ purchase intentions for SSCCs, because the relationship between SSCC privacy concerns and consumers’ purchase intentions could be controlled by environmental performance. Thus, our study clarified previous studies’ mixed results concerning privacy decisions and purchase behaviors.

#### 4.5.4. Fuel and system efficiency (SSCC sustainability 3)

The third sustainability type, SSCCs' fuel and system efficiency, also conditionally affected SSCC privacy concerns on disclosure intentions and purchase intentions, respectively (H6a and H6b supported). The moderated–mediation index of the fuel and system efficiency of SSCCs was -0.07, and both BootLLCI and BootULCI were negative values, which means the moderated–mediation effects were significant based on SPSS Process 3.5 with 5,000 bootstrap samples (**Figure B.3**). The two Johnson–Neyman outputs for the two conditional effects, shown in **Table 9**, indicate that the fuel and system efficiency of SSCCs (i.e., a conditional indirect effect) not only could control consumers' privacy concerns on disclosure behaviors but could also affect the relationship between consumers' privacy concerns and purchase behaviors (i.e., a conditional direct effect). **Table B.9** and **Table B.10** detail the causal relationships among SSCC privacy concerns, disclosure intentions, purchase intentions, and fuel and system efficiency. In the conditional direct effect model, the SPSS Process 3.5 and AMOS outputs gave different results; based on the evaluation of the SPSS Process, SSCC privacy concerns on SSCC purchase intentions were nonsignificant, whereas the AMOS calculation indicated that SSCC privacy concerns influenced SSCC purchase intentions significantly.

**Table 9.** Conditional Direct and Indirect Effects of FE

Output	Conditional indirect effects: PC × Sustainability → DI → PI	Conditional direct effects: PC × Sustainability → PI
FE Johnson–Neyman Output		
FE Histogram/ Line Graph		

Note. Level of confidence for all confidence intervals in the output: 95%; Number of bootstrap samples for percentile bootstrap confidence intervals: 5,000; Red:  $p > 0.05$ , blue:  $p < 0.05$  (Johnson–Neyman Output). DI = disclosure intentions; FE = fuel and system efficiency; PC = privacy concerns; PI = purchase intentions.

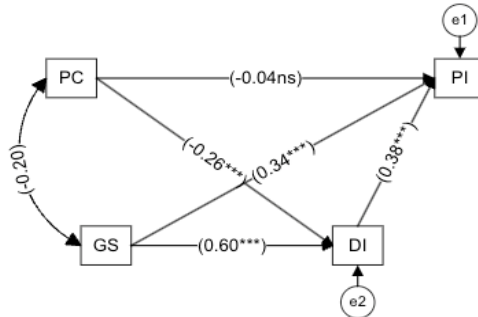
#### 4.5.5. Government subsidies (monetary incentives)

We analyzed the relationship between privacy concerns, government subsidies for SSCCs, consumers' disclosure intentions, and purchase intentions when adopting SSCCs. Government subsidies significantly affected consumers' disclosure intentions and purchase intentions when adopting SSCCs (H7 and H8 supported). Table 10 and Figure 7 show the results of the effect of government subsidies. The mediation

**Table 10.** The Effects of Government Subsidies

Path	Estimate	SE	CR	p-value	Support?
GS → DI	0.525	0.030	17.446	< 0.001***	H7 supported
GS → PI	0.318	0.043	7.453	< 0.001***	H8 supported
PC → DI	-0.297	0.038	-7.720	< 0.001***	H1 supported
DI → PI	0.399	0.051	7.739	< 0.001***	H3 supported
PC → PI	-0.047	0.045	-1.046	0.296	H2 not supported

Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; CR = critical ratio; DI = disclosure intentions; GS = government subsidies; PC = privacy concerns; PI = purchase intentions; SE = standard error



**Figure 7.** Results of the Government Subsidy Effects

Note. DI = disclosure intentions; GS = government subsidies; PC = privacy concerns; PI = purchase intentions.

effects of disclosure intentions between privacy concerns and purchase intentions when adopting SSCCs had the same results as the previous output because privacy concerns negatively influenced disclosure intentions (H1 supported) that positively affected purchase intentions (H3 supported). Privacy concerns did not directly affect consumers' purchase intentions (H2 not supported).

## 5. Discussion

Smart technology allows SSCCs to offer a range of new benefits at multiple levels to consumers and society, such as reducing fatal-accident rates and greenhouse-gas emissions and improving fuel and system efficiency. However, IT experts have warned of the privacy vulnerabilities of SSCCs, whose privacy issues

are dramatically more complex than those of mobile apps and social media. Although most consumers care about their privacy in a general sense, they lack an understanding of the complex factors involved in maintaining privacy with SSCCs because they are unaware of the extent to which SSCC firms own and mine their data [116]. Thus, our study interprets consumers' SSCC privacy decisions regarding the common good of sustainability and personal benefits. In this section, we conclude by providing a summary of our study results, noting key contributions to research and theory, emphasizing potential contributions to practice, and emphasizing the key limitations of our study, and the compelling future opportunities that it unfolds.

### **5.1. Summary of Primary Results**

**Table 11** summarizes the supported and unsupported hypotheses, and we now explain the key findings. We find that consumers' information-disclosure decisions can mediate privacy concerns when they are purchasing an SSCC. We identify the critical effects of the three types of SSCC sustainability on consumers' information-disclosure behaviors, which in turn explains the intuitive privacy trade-offs and external privacy trade-offs. Therefore, the results account for the proposed PCGT model with two types of privacy trade-off (intuitive privacy trade-offs and external privacy trade-offs) and bidirectional privacy reduction (personal benefits and the common good of sustainability).

The results also demonstrate the anchoring effects on sustainability that significantly affect consumers' information-disclosure behaviors concerning SSCCs. Privacy concerns occasionally have a significant influence on consumers' disclosure intentions and purchase intentions for SSCCs—and occasionally they do not. These inconsistent outcomes regarding consumers' privacy decisions are in line with a finding of previous privacy studies, namely that different circumstances can affect the relationship between privacy concerns and consumers' purchase intentions. However, in our study, when SSCC privacy concerns interact with other factors, such as sustainability, they always significantly affect consumers' disclosure decisions and purchase intentions.

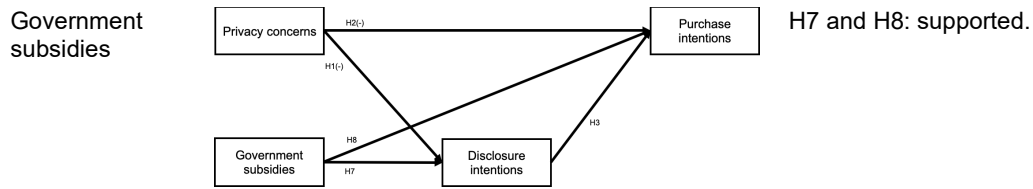
### **5.2. Contributions to Research and Theory**

Our study makes several theoretical contributions. First, the proposed PCGT model provides a different

lens for understanding consumers' privacy decisions regarding smart technology. We extend existing PCM and TBR approaches by demonstrating three sustainability features of SSCCs as a new type of intuitive privacy trade-off. We propose that SSCC consumers can intuitively or externally trade their privacy for personal benefits and long-term public sustainability. The results show that SSCC sustainability leads to making privacy sacrifices in adopting the new technology for the common good of sustainability. If these results hold, they will indicate that consumers' privacy evaluations in the SSCC context rely on more than cost-benefit calculations. Thus, researchers should add privacy sacrifices to existing privacy evaluations based on privacy costs and benefits. Furthermore, despite the high privacy risks of SSCCs, the common

**Table 11. Summary of the Results**

Effects	Model	Findings
Mediation effects PC → DI → PI		<p>H1 and H3: supported. H2: not supported. H4: partially supported. Disclosure intentions fully mediate the relationship between privacy concerns and purchase intentions.</p>
Moderated-mediation effects (human safety)		<p>H5, H6a, and H6b: supported. Human safety acts as (1) a moderated mediator between privacy concerns and disclosure intentions as conditional indirect effects and (2) a moderated mediator between privacy concerns and purchase intentions as conditional direct effects.</p>
Moderated-mediation effects (environmental performance)		<p>H5, H6a, and H6b: supported. The environmental performance acts as (1) a moderated mediator between privacy concerns and disclosure intentions as conditional indirect effects and (2) a moderated mediator between privacy concerns and purchase intentions as conditional direct effects.</p>
Moderated-mediation effects (fuel and system efficiency)		<p>H5, H6a, and H6b: supported. Fuel and system efficiency acts as (1) a moderated mediator between privacy concerns and disclosure intentions as conditional indirect effects and (2) a moderated mediator between privacy concerns and purchase intentions as conditional direct effects.</p>



H7 and H8: supported.

*Note.* DI = disclosure intentions; PC = privacy concerns; PI = purchase intentions.

good of sustainability can mitigate the tensions between the government, companies, and consumers regarding SSCCs, because this common good enables governments to encourage companies to develop sustainable products and services based on sustainability-related smart technologies, and it gives consumers a compelling reason to trade privacy for sustainability.

Second, we contribute to the understanding of how behavioral decision-making (intuitive trade-offs) interacts with rational decision-making (external trade-offs) in SSCC consumers’ privacy behaviors. Taken together, these two types of privacy trade-offs demonstrate how the existing TBR approach, based on a behavioral perspective, and the PCM approach, based on a rational perspective, can work together. A theory that uses only one of these perspectives will have a limited capacity to interpret consumers’ privacy behaviors. To more accurately understand or predict consumers’ privacy choices, researchers should examine both the rational and nonrational dimensions of consumers’ decision-making.

Third, we suggest new boundary conditions for the PCGT model by providing three assumptions (i.e., two types of privacy trade-offs, bidirectional privacy reduction, and anchoring effects). Specific boundary conditions are necessary for validating a theory’s accuracy, but existing PCM and TBR studies provide only the highly general boundary conditions of rationality and nonrationality, respectively. Our specific assumptions can help researchers understand the PCGT model and generalize it beyond the context of SSCCs.

Fourth, our approach to analyzing intuitive privacy trade-offs and the common good of SSCCs is a novel contribution to privacy research. Regarding technology adoption theories, our approach offers a new perspective that differs from the *unified theory of acceptance and use of technology 2*, which is grounded in the *technology acceptance model* [103-105]. Whereas each of the existing technology adoption theories requires a variety of constructs, such as usefulness, ease of use, personal experiences, social influence, and

facilitating conditions, our PCGT model focuses on the relationship between two essential factors of smart technology to explain consumer decisions regarding technology adoption. Moreover, the mediating role of disclosure intentions in the relationship between sustainability and purchase intentions offers new insights into the decision-making processes of consumers when considering purchasing SSCCs.

Fifth, we inform the testing procedures for three types of sustainability, whereas the existing sustainability literature usually addresses environmental performance alone. It is crucially important that researchers investigate sustainability in a well-rounded way because three types of sustainability decisively influence consumers' privacy decisions in adopting new technology. We further validated the robustness of the PCGT model because we tested the model three times with a variety of sustainability.

### **5.3. Contributions to Practice**

We demonstrate why SSCC consumers may disclose personal information despite high privacy risks. For example, we find that consumers trade their privacy concerns for specific features of sustainability, such as a low fatal-accident rate, low CO<sub>2</sub> emissions, and high fuel cost savings. Because consumers were anchored to multiple features of sustainability, all of which influenced their personal-information-disclosure intentions, they made this trade-off intuitively. Thus, our study can help consumers understand their nonrational privacy decisions, which are based on cognitive biases, while driving SSCCs.

Furthermore, we show that the personal benefits and long-term public sustainability of SSCCs can balance the tensions between governments, companies, and consumers. Our study can help consumers understand that SSCC stakeholders can incite them to sacrifice their personal information based on cognitive biases (e.g., anchoring effects) by emphasizing the common good of sustainability. Even government policies can act against consumers' privacy by encouraging the common good of sustainability. Conversely, governments and companies can employ distinct types of privacy trade-off to encourage consumers to drive SSCCs by focusing on sustainability, because consumers can be anchored in specific features of sustainability. If the privacy concerns of most SSCC consumers decrease due to the multilevel benefits of SSCCs, including benefits to consumers (e.g., low fatal-accident rate, low fuel costs) and public

benefits (e.g., low CO<sub>2</sub> emissions, high energy efficiency), consumer advocates and policymakers are warranted in their concerns.

#### **5.4. Limitations and Future Research**

Our study has several limitations that suggest compelling opportunities for future research. First, we performed a separate analysis of the effect of each type of sustainability and its interaction with privacy concerns regarding disclosure intentions and purchase intentions, because calculating the interaction effects of the three types of sustainability simultaneously is overly complicated. Future research should evaluate the interaction effects of privacy concerns on disclosure and purchase intentions and the three types of sustainability at the same time. In a subsequent study, we may calculate multiple combinations among the three types of sustainability and their interaction with privacy concerns to determine the maximal disclosure intentions and purchase intentions, respectively.

Second, we measured one variable for each type of sustainability (e.g., fatal-accident rates for people, CO<sub>2</sub> emissions for the planet). Future studies could measure other variables for each sustainability type. Suppose we measured multiple variables for each type of sustainability. Doing so would support our efforts to generalize the proposed PCGT model, and it could validate this study's results for consumers' privacy–common good behaviors.

Third, our study focused on anchoring effects as a cognitive bias despite a myriad of consumer cognitive biases, such as framing effects, judgment bias, status quo bias, optimism bias, attention bias, outcome bias, and pro-innovation bias [51, 61, 62, 89, 117]. Future scholars could assess these and other cognitive biases and their influence on consumers' privacy–common good decisions.

Fourth, the measurement of our proposed model is limited to the SSCC context. To generalize this new theory, future research should apply the PCGT model to other sustainable applications based on smart technology. This could include studies of consumers who have actually adopted products based on smart technology instead of studies of disclosure and purchase intentions. In addition, longitudinal studies of SSCC consumers' purchasing–decision processes would be highly useful.

Fifth, our SSCC fatal-accident rate was based on the performance of a specific brand (i.e., Tesla) over a short period, but many experts believe the fatal-accident rate of SSCCs will be much lower in the future. We can validate the results of this study in subsequent research with updated data. In addition, because consumers have yet to experience fully self-driving cars, future research should investigate fully developed SSCCs.

Sixth, the effects of human safety on other variables, including disclosure intentions, privacy concerns, and government subsidies, may be meaningful, because the autonomous driving feature and external cameras can be implemented in other vehicles running on fossil fuels. Thus, future research can expand on our model by examining the direct and indirect effect of the fatal accident rate, representing human safety, on various other variables.

Seventh, a combination of technical and legal solutions for SSCC consumers' privacy issues is also necessary. Government policies focus on economic growth and company profit instead of consumers' privacy concerns [70, 82, 116]. Accordingly, future research [5] should discuss new policies and issues of data ownership as they relate to SSCC data collection [5].

Finally, we did not consider cultural and legal environmental differences. However, individual and national cultural differences are critical factors because values concerning privacy differ across countries. Moreover, privacy is greatly affected by the corporate environment. For instance, the privacy regulations of companies that apply smart technologies (e.g., IoT, AI, big data) differ from those of traditional companies that do not, because such technologies usually require the collection of consumers' personal information. Similarly, the legal environment can have a critical influence on consumers' privacy decisions—Europe, for instance, has privacy laws that differ considerably from those of the US. Furthermore, perceptions of sustainability and legal frameworks differ at the individual and national levels. Thus, future studies should apply cultural and legal environmental differences to test the PCGT model.

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<sup>1</sup> Originally, Zhang [116] used the term “smart cars” instead of “smart-connected car.” This study uses the latter term to avoid confusion with the German automotive brand Smart. Smart cars have been defined as “any personal vehicle that has connectivity to the Internet, other devices, or surrounding vehicles or infrastructure, and is equipped with external or internal sensors and a method of recording data. Smart cars may be able to integrate across platforms and applications, perhaps becoming another interface where consumers’ digital profiles can be accessed” [116, p. 302].

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<sup>2</sup> According to the US National Highway Traffic Safety Administration, there is an automotive fatality every 86 miles in the US. The fatal-accident rate of SSCCs produced by Tesla is 3.7 times lower, with a fatality every 320 miles [97]. These trends caused [47] to predict that automotive accidents would decline by 90% by 2050.

<sup>3</sup> The European Field Operational Test (EuroFOT) is a collaboration by 28 organizations to test intelligent car systems in Europe; it consists of “car manufacturers, suppliers, universities, research institutes and other stakeholders” [32].

<sup>4</sup> SSCCs contain many innovative devices, such as multiple external cameras, dedicated computers for 3D real-time image processing, radar, lidar, wireless devices to communicate with virtually any IoT device inside or outside of the car, and backend cloud server farms to which massive amounts of real-time data are sent for further mining. In addition, various sensors are embedded in SSCCs, including ultrasonic sensors, vision sensors, heat sensors, sensors that communicate with road sensors, and sensors that communicate with other cars’ sensors, as well as all the baseline sensors found in typical modern cars.

<sup>5</sup> The aim of the SPY Bill “is to eliminate cyber-attacks on vehicles and address privacy concerns. The SPY Bill provides a concept of “driving data” that includes any electronic information collected about a vehicle’s status, including its location, speed, [and] information about users” [88, p. 1].

<sup>6</sup> “Shallow disclosure entails the sharing of one’s non-sensitive personal information such as one’s interests, whereas deep self-disclosure entails the sharing of one’s sensitive personal information such as one’s phone number or health concerns” [77, p. 74].

<sup>7</sup> Using a gambling example, consumers’ nonrational behaviors, prompted by nonrational decision-making in the same probability condition based on cognitive biases (e.g., framing effects), have been empirically tested [50].

<sup>8</sup> This observation was based on the results of 40 open-ended interviews and a survey of 167 participants.

<sup>9</sup> Necessary sample size =  $(Z\text{-score})^2 * SD*(1-SD) / (\text{margin of error})^2$ .

<sup>10</sup> The effect size of collection concerns (IV) on disclosure (DV) to a mobile app recommender ranged from 0.25 to 0.46, and the effect size of the number of applications (IV) on information disclosure (DV) was -0.35 [37, p. 247].

<sup>11</sup> In this study, we intentionally did not include Tesla because in initial pilot testing, respondents had conflicting brand images regarding Tesla. We thus plan to conduct a follow-up study that focuses on Tesla.

## Appendix A. Experimental Design and Survey Items

**Table A.1.** Informed Consent

	<b>Instructions</b>
(v=consent)	<p>You are invited to participate in a research study involving your opinions about conventional cars and sustainable smart-connected cars.</p> <ul style="list-style-type: none"> <li>• Yes, I consent.</li> <li>• No, I do not consent.</li> </ul>

**Table A.2.** Demographics

<b>Construct (Variable name)</b>	<b>Prompts, instructions, Items, and Scaling</b>	<b>Original Items</b>
Gender (v = gender)	<p>Prompt: Please indicate your gender.</p> <ul style="list-style-type: none"> <li>• Male</li> <li>• Female</li> <li>• Other</li> <li>• Prefer not to indicate</li> </ul>	<p>(Gender)</p> <ul style="list-style-type: none"> <li>• Male</li> <li>• Female</li> </ul>
Age (v = age)	<p>Prompt: Please indicate your age range.</p> <ul style="list-style-type: none"> <li>• Under 18</li> <li>• 18–24</li> <li>• 25–34</li> <li>• 35–44</li> <li>• 45–54</li> <li>• 55–64</li> <li>• 65 +</li> </ul>	<p>(Age)</p> <ul style="list-style-type: none"> <li>• Under 18</li> <li>• 18–24</li> <li>• 25–34</li> <li>• 35–44</li> <li>• 45–54</li> <li>• 55–64</li> <li>• 65 +</li> </ul>
Ethnicity (v = ethnicity)	<p>Prompt: Please indicate your ethnicity.</p> <ul style="list-style-type: none"> <li>• American Indian or Native American</li> <li>• Asian or Pacific Islander</li> <li>• African American</li> <li>• Hispanic or Latino</li> <li>• White or Caucasian</li> <li>• Other ()</li> </ul>	<p>(Race)</p> <ul style="list-style-type: none"> <li>• White/Caucasian</li> <li>• African American</li> <li>• Hispanic</li> <li>• Asian</li> <li>• Native American</li> <li>• Pacific Islander</li> <li>• Mixed/Other</li> </ul>
Household income (v = income)	<p>Prompt: Please indicate your household income.</p> <ul style="list-style-type: none"> <li>• Less than \$30,000</li> <li>• \$30,000–\$79,999</li> <li>• \$80,000–\$149,999</li> <li>• \$150,000–\$249,999</li> <li>• \$250,000–\$449,999</li> <li>• \$500,000 or more</li> </ul>	<p>(Annual income range)</p> <ul style="list-style-type: none"> <li>• \$19,999 &lt;</li> <li>• \$20,000–\$29,999</li> <li>• \$30,000–\$39,999</li> <li>• \$40,000–\$49,999</li> <li>• \$50,000–\$59,999</li> <li>• \$60,000–\$69,999</li> <li>• \$70,000–\$79,999</li> <li>• \$80,000–\$89,999</li> <li>• \$90,000 &lt;</li> </ul>

Construct (Variable name)	Prompts, instructions, Items, and Scaling	Original Items
Current employment status (v = employ)	Prompt: Please indicate your current employment status. <ul style="list-style-type: none"> <li>• Student</li> <li>• Employed part-time</li> <li>• Employed full-time</li> <li>• Unemployed</li> </ul>	(Current employment status) <ul style="list-style-type: none"> <li>• Student</li> <li>• Employed part-time</li> <li>• Employed full-time</li> <li>• Unemployed</li> </ul>
Education (v = edu)	Prompt: Please indicate your education. <ul style="list-style-type: none"> <li>• Less than high school</li> <li>• High school completed or equivalent</li> <li>• Some university, but have not completed a degree</li> <li>• Associate degree or two-year equivalent</li> <li>• Bachelor's degree</li> <li>• Master's degree</li> <li>• Doctorate / PhD</li> </ul>	(Education) <ul style="list-style-type: none"> <li>• Less than high school</li> <li>• High school completed or equivalent</li> <li>• Some university, but have not completed a degree</li> <li>• Associate degree or two-year equivalent</li> <li>• Bachelor's degree</li> <li>• Master's degree</li> <li>• Doctorate / Ph.D.</li> </ul>

**Table A.3.** Pre-experiment Survey

Construct (Variable)	Prompts, Items, and Scaling	Original Items	Origin
Blue attitude (Marker variable) (v = blue)	Prompt: Please indicate your color preference. <ul style="list-style-type: none"> <li>• [r] I prefer blue to other colors.</li> <li>• [r] I like the color blue.</li> <li>• [r] I like blue clothes.</li> </ul> Scaling: Likert-type 5-point reverse scale anchored on "1 = Strongly agree to 5 = Strongly disagree"	(Blue attitude) <ul style="list-style-type: none"> <li>• I prefer blue to other colors.</li> <li>• I like the color blue.</li> <li>• I like blue clothes.</li> </ul>	Miller and Marcia [8], Simmering et al. [9]
Data breach experience (v = breach)	Prompt: Please indicate your data breach experience. Have you ever been a victim of a data breach? (Yes/No)	(Cyberbullying experience) As just described, have you ever been a victim of cyberbullying? (yes/no)	Lowry et al. [5]
General privacy concerns (v = GPC)	(General privacy concerns) Prompt: Indicate your agreement with the following: "In general, I am concerned . . . <ul style="list-style-type: none"> <li>• . . . that the information I submit on the Internet could be misused.</li> <li>• . . . that a person can find private information about me on the Internet.</li> <li>• . . . about submitting information on the Internet, because of what others might do with it.</li> <li>• . . . about submitting information on the Internet because it could be used in a way, I did not foresee.</li> </ul> Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"	(General privacy concerns) <ul style="list-style-type: none"> <li>• In general, I am concerned that the information I submit on the Internet could be misused.</li> <li>• In general, I am concerned that a person can find private information about me on the Internet.</li> <li>• In general, I am concerned about submitting information on the Internet, because of what others might do with it.</li> <li>• In general, I am concerned about submitting information on the Internet, because it could be used in a way, I did not foresee.</li> </ul>	Choi and Land [1]

Construct (Variable)	Prompts, Items, and Scaling	Original Items	Origin
Technical knowledge (v = TK)	<p>Prompt: How would you judge your knowledge of the technical aspects <u>related to sustainable, smart connected cars (SSCCs)</u>?</p> <p>*An SSCC is a smart-connected car operated by electricity to provide various personal benefits, such as automated driving (e.g., self-driving) with high safety features, low carbon dioxide (CO<sub>2</sub>) emissions, and fuel cost savings.</p> <ul style="list-style-type: none"> <li>• I have a good idea about the technical details related to SSCCs.</li> <li>• I am very knowledgeable about the technical aspects of SSCCs.</li> </ul> <p>Scaling: Likert-type 5-point scale anchored on “1 = Strongly disagree to 5 = Strongly agree”</p> <ul style="list-style-type: none"> <li>• [r] I know very little about the technical particulars related to SSCCs.</li> <li>• [r] I have a vague idea about the technical aspects of SSCCs.</li> </ul> <p>Scaling: Likert-type 5-point reverse scale anchored on “1 = Strongly agree to 5 = Strongly disagree”</p>	(Knowledge) <ul style="list-style-type: none"> <li>• I don't know any technical details.</li> <li>• I have a vague idea of the technical details.</li> <li>• I have a good idea of the technical details.</li> <li>• I am very knowledgeable.</li> <li>• I am an expert.</li> </ul>	Martin [6]

Construct (Variable)	Prompts, Items, and Scaling	Original Items	Origin
Sustainability preference (v= SP)	<p>Prompt: In general, sustainability deals with avoiding the depletion of natural resources and is addressed in terms of people, the planet, and profit (e.g., human safety, greenhouse gases, and fuel/system efficiency). Sustainable products provide multiple benefits by protecting people, preserving the environment, and improving the efficient use of non-renewable resources. (Consumers' specific behaviors to green products and services)</p> <ul style="list-style-type: none"> <li>• I tend to be more loyal to products from companies that are made with "green" and sustainable practices.</li> <li>• I plan to switch to products and services that are advertised as being green.</li> <li>• I would pay more for products or services that are produced and advertised as being sustainable.</li> <li>• I prefer products with eco-labeled packages or that are known as sustainable.</li> <li>• Purchasing sustainable products is valuable to society.</li> </ul> <p>Scaling: Likert-type 5-point scale anchored on "1 = Strongly disagree to 5 = Strongly agree"</p>	<p>(Consumers' specific behaviors to green advertising)</p> <ul style="list-style-type: none"> <li>• I tend to be more loyal to products from companies that practice green advertising.</li> <li>• I plan to switch to products and services that were advertised as being green.</li> <li>• I would pay more for products or services that were advertised as being green.</li> <li>• I prefer products with eco-labeled packages.</li> </ul> <p>(Cognitive and affective responses to green advertising)</p> <ul style="list-style-type: none"> <li>• Green advertising is valuable to society.</li> <li>• Green advertising promotes materialism.</li> <li>• Green advertising leads people to be more socially responsible.</li> <li>• Green advertising shows the consumer that the firm is addressing consumers' environmental concerns.</li> <li>• Green advertising strengthens company image.</li> <li>• I think green advertising is good.</li> <li>• Most green advertising insults people's intelligence.</li> <li>• Green advertising claims are insincere.</li> <li>• Green advertising is a good business practice.</li> <li>• Green advertising is a weak form of advertising.</li> <li>• Green advertising is unprofessional.</li> </ul>	Haytko and Matulich [3]

**Table A.4. Instructions**

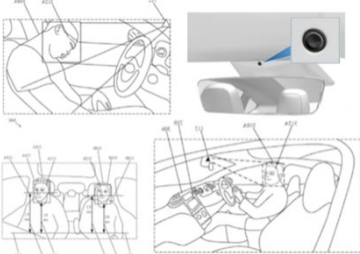
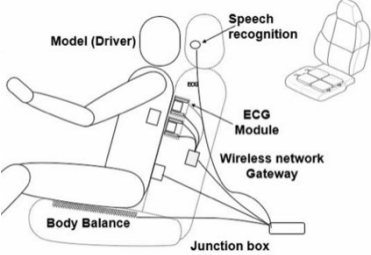




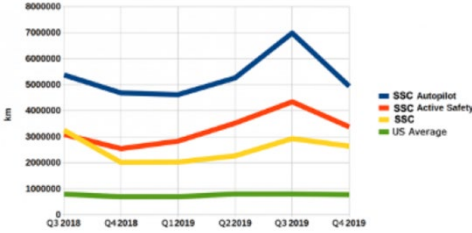
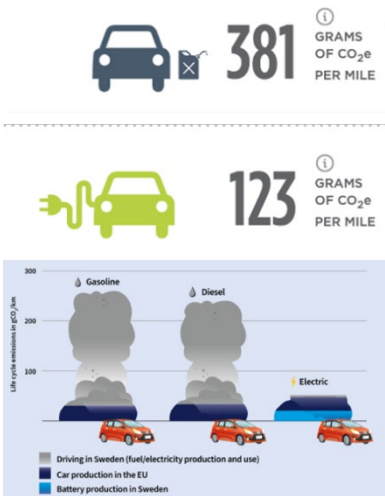
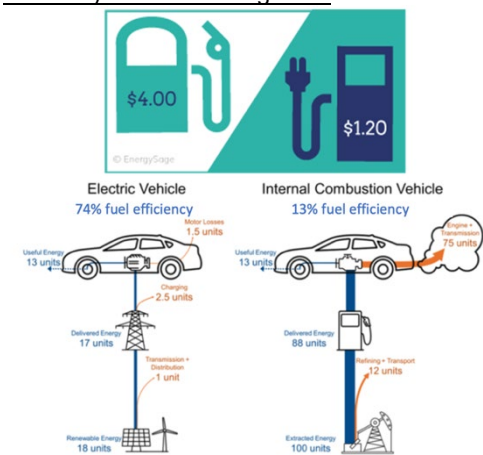
Instruction	Instruction Details
<p><b>Instruction</b> (v= instruction)</p>	<p>We would like to know your opinions about the emerging car market. For purposes of this study, we want you to <u>imagine that you can afford to buy a new car in the \$40,000–\$50,000 price range and that you will buy a car in the near future</u>. In the next portion of the study, we are going to randomly provide you with various selected details about a car that we would like you to consider, to see if this is the kind of car you would like to purchase and why.</p> <p>Imagine that you are shopping for a new car. In this study, we define <u>average conventional cars as vehicles that have the average features of conventional gasoline-operated cars and do not have advanced technology</u>. They do not have automated driving technology and high sustainable features that allow consumers to receive monetary benefits from firms or the government.</p> <p>Meanwhile, current advanced technology using consumers' personal information allows engineers to develop sustainable, smart connected cars (SSCCs) that have many unique features. <u>SSCCs operated by electricity use automated driving technology based on the cloud-based internet of things (IoT) and artificial intelligence (AI). Importantly, SSCCs collect your personal information through various sensors and cameras (e.g., weight, health, location, driving route, passenger information, all driving history)</u>. The information is automatically shared with your car vendor, your car insurer, the government, and other service firms in real-time to help improve automated driving, smart cities, ecommerce, and even personalized advertisements.</p> <p>For example, according to an official website, "SSCCs are equipped with a Cabin Camera that is located above the rear-view mirror and turned off by default. If you enable the Cabin Camera, a short video clip will be captured and shared with the SSCC vendor following a safety event such as a collision or an advanced emergency braking (AEB) event." The cabin camera shares driver's and passengers' personal information with vendors or other people to improve automated driving functions, which causes privacy issues. The figure below shows a Cabin Camera's location and what types of personal information the camera collects.</p>  <p>Figure A. A Cabin Camera in an SSCC collects passengers' information. Importantly, SSCCs can collect highly personal data such as passengers' weight information and personal health information. For example, the electrocardiogram (ECG) sensor module in Figure B records information on the heart response to physical exertion. The health information is transmitted to the vendor's cloud servers. The figure below shows how SSCC seats can collect personal health information.</p>  <p>Figure B. Sensors in an SSCC collect weight and health information</p>

Table A.5. Scenarios

Variable	Level	Scenario
Brand	Control (v = C_brand)	The company that manufactures and sells this car has chosen to remain anonymous.
	Treatment 1 (v = T_Walmart)	The car that we are asking you to consider purchasing is manufactured and sold by ____. 
	Treatment 2 (v = T_Ford)	The car that we are asking you to consider purchasing is manufactured and sold by ____. 
	Treatment 3 (v = T_Amazon)	The car that we are asking you to consider purchasing is manufactured and sold by ____. 
	Treatment 4 (v = T_Nio)	The car that we are asking you to consider purchasing is manufactured and sold by ____. 
Fatal accident rate	Manipulation 1 (v=T_FA)	<p><b>Current research shows that an average conventional car has a fatal accident about every 479,000 miles (766,400 km) in the United States while an average sustainable, smart connected car (SSCC) has a fatal accident about every 4,680,000 miles (7,488,000 km). Thus, an SSCC has about 10% of the average fatal accident rate.</b></p> <p>km between accidents in the United States</p> 
	Control (v = C_FA)	There is no information about this car in terms of its fatal accident rate.
	Average car (v = A_FA)	The car that we would like you to consider buying has the average fatal accident rate.
	SSCC (v = M_FA)	The car that we would like you to consider buying has about 10% of the average fatal accident rate.

Variable	Level	Scenario
Environmental performance	Manipulation 2 (v=T_EV)	<p>According to the Union of Concerned Scientists, a conventional gasoline-operated car discharges 381 grams of carbon dioxide (CO<sub>2</sub>) emissions per mile while an electric car discharges 123 grams of CO<sub>2</sub> emissions per mile. Another leading study shows that an electric car can reduce CO<sub>2</sub> emissions by 80% compared to a conventional gasoline-operated car. Thus, <u>an SSCC has about 20-30% of the average CO<sub>2</sub> emissions per mile.</u></p> 
	Control (v = C_EV)	There is no information about this car in terms of its CO <sub>2</sub> emissions or environmental impact.
	Average car (v = A_EV)	The car that we would like you to consider buying has <u>the average CO<sub>2</sub> emissions per mile.</u>
	SSCC (v = M_EV)	The car that we would like you to consider buying has <u>about 20-30% of the average CO<sub>2</sub> emissions per mile.</u>
Fuel and system efficiency	Manipulation 3 (v=T_FE)	<p>A 2018 study from the University of Michigan found that the average cost to operate an electric vehicle in the United States is \$485 per year, while the average for a gasoline-powered vehicle is \$1,117. Over the past 10 years, the cost of fuel ranged from \$1.50 to \$4.00 per gallon. By comparison, electric car drivers consistently paid about \$1.20 for the equivalent electricity to travel the same distance. Another leading study shows that on average electric vehicles have 74% fuel efficiency while average conventional gasoline operated cars have 13% fuel efficiency. Thus, <u>an SSCC has 3.5-times lower fuel costs and five times higher fuel efficiency than an average car.</u></p> 
	Control (v = C_FE)	There is no information about this car in terms of its fuel efficiency and cost savings.

Variable	Level	Scenario
	Average car (v = A_FE)	The car that we would like you to consider buying has <u>the average fuel costs of \$1,117 per year and 13% fuel efficiency.</u>
	SSCC (v = M_FE)	The car that we would like you to consider buying has <u>3.5-times lower fuel costs and five times higher fuel efficiency than an average car.</u>
Government subsidies	Manipulation 4 (v= T_GS)	<p>Most conventional cars do not have the US federal government's subsidies for data sharing since these cars have limited ability to collect and transmit driving data to the government's cloud servers. However, most sustainable, smart connected cars (SSCCs) have advanced wireless networks system and multiple sensors that allow transmission of such data.</p> <p>If you agree to share all your personal driving data with the US federal government in real-time, the US federal government supports a \$7,500 federal tax credit for purchasing a new car.</p> <div style="text-align: center;"> <p>The diagram shows two ribbon-like boxes. The left one is orange and labeled 'SS-CC Subsidies' with '\$7500 Federal tax credit' below it. The right one is blue and labeled 'Conventional Car Subsidies' with '\$0' below it. They are separated by 'vs.'.</p> </div>
	Control (v = C_GS)	There is no information about this car in terms of its US federal government subsidies if you agree to share your driving data with the US government.
	Average car (v = A_GS)	The car that we would like you to consider buying has <u>no US federal government subsidies if you agree to share your driving data with the US government.</u>
	SSCC (v = M_GS)	The car that we would like you to consider buying has <u>a \$7,500 US federal government subsidy if you agree to share your driving data with the US government.</u>

**Table A.6. Manipulation Check Questions**

Variable	Items
Brand (v=MC_brand)	<p>Please indicate which company you were told that manufactures and sells the car we want you to consider purchasing:</p> <ul style="list-style-type: none"> <li>• Apple. (End of Survey: only for invalid responses)</li> <li>• Amazon. (End of Survey: only for invalid responses)</li> <li>• Nio. (End of Survey: only for invalid responses)</li> <li>• Ford. (End of Survey: only for invalid responses)</li> <li>• Walmart. (End of Survey: only for invalid responses)</li> <li>• Verizon. (End of Survey: only for invalid responses)</li> <li>• This was not stated in the information I was given. (End of Survey: only for invalid responses)</li> <li>• I don't know. (End of Survey: only for invalid responses)</li> </ul>
Fatal accident rate (v=MC_FA)	<p>The fatal accident rate for the car that we would like you to consider buying is (select only one):</p> <ul style="list-style-type: none"> <li>• Lower than an average <b>car's fatal</b> accident rate. (End of Survey: only for invalid responses)</li> <li>• About an average <b>car's fatal</b> accident rate. (End of Survey: only for invalid responses)</li> <li>• Higher than an average <b>car's fatal</b> accident rate. (End of Survey: only for invalid responses)</li> <li>• This was not stated in the information I was given. (End of Survey: only for invalid responses)</li> <li>• I don't know. (End of Survey: only for invalid responses)</li> </ul>
Environmental performance (v=MC_EV)	<p>The potential negative environmental impact of the car that we would like you to consider buying is:</p> <ul style="list-style-type: none"> <li>• Lower than an average <b>car's</b> negative effect. (End of Survey: only for invalid responses)</li> <li>• About an average <b>car's</b> negative effect. (End of Survey: only for invalid responses)</li> <li>• Higher than an average <b>car's</b> negative effect. (End of Survey: only for invalid responses)</li> <li>• This was not stated in the information I was given. (End of Survey: only for invalid responses)</li> <li>• I don't know. (End of Survey: only for invalid responses)</li> </ul>
Fuel and system efficiency (v=MC_FE)	<p>The fuel and operating costs of the car that we would like you to consider buying is:</p> <ul style="list-style-type: none"> <li>• Lower than an average <b>car's</b> fuel and operating costs. (End of Survey: only for invalid responses)</li> <li>• About an average <b>car's</b> fuel and operating costs. (End of Survey: only for invalid responses)</li> <li>• Higher than an average <b>car's</b> fuel and operating costs. (End of Survey: only for invalid responses)</li> <li>• This was not stated in the information I was given. (End of Survey: only for invalid responses)</li> <li>• I don't know. (End of Survey: only for invalid responses)</li> </ul>
Attention 1	<p>If you are reading this statement fully then please only choose the answer, "Somewhat disagree." Scaling: Likert-type 5-point scale anchored on "1 = Strongly disagree to 5 = Strongly agree"</p>

Variable	Items
Government subsidies (v=MC_GS)	<p>For the car I was asked to consider buying, I was told there would be a substantial financial subsidy from the US federal government that would decrease the purchase price if I agreed to share my real-time driving information with them:</p> <ul style="list-style-type: none"> <li>• Yes. (End of Survey: only for invalid responses)</li> <li>• No. (End of Survey: only for invalid responses)</li> <li>• I don't know. (End of Survey: only for invalid responses)</li> </ul> <p>The financial subsidy from the US federal government for the car that we would like you to consider buying is:</p> <ul style="list-style-type: none"> <li>• Lower than an average <b>car's</b> financial subsidy from the US federal government. (End of Survey: only for invalid responses)</li> <li>• No financial subsidy from the US federal government. (End of Survey: only for invalid responses)</li> <li>• At least \$7,500 financial subsidy from the US federal government. (End of Survey: only for invalid responses)</li> <li>• This was not stated in the information I was given. (End of Survey: only for invalid responses)</li> </ul>
Privacy concerns (v=MC_PC)	<p>The potential privacy concerns about the car that we would like you to consider buying are:</p> <ul style="list-style-type: none"> <li>• Less than an average <b>car</b>. (End of Survey: only for invalid responses)</li> <li>• About the same as an average car. (End of Survey: only for invalid responses)</li> <li>• More than an average <b>car</b>. (End of Survey: only for invalid responses)</li> <li>• This was not stated in the information I was given. (End of Survey: only for invalid responses)</li> <li>• I don't know. (End of Survey: only for invalid responses)</li> </ul>

**Table A.7.** Post-Experiment Survey Items

Construct (Variable)	Prompts, Items, and Scaling	Original Items	Origin
Fatality rate (SSCC sustainability 1) (v = Q_FA)	<p>Prompt: Please indicate the degree to which you agree the car you are considering purchasing would be safe and reduce fatalities. Complete the sentence: "The car that we would like you to consider buying would have. . ."</p> <ul style="list-style-type: none"> <li>• . . . safety systems to greatly reduce the fatal accident rate.</li> <li>• . . . excellent safety features to protect me and my passengers.</li> <li>• . . . a low fatal accident rate.</li> <li>• . . . features that would prevent accidents.</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"</p>	(Car safety) What criteria were important to you when you bought the car you now own <ul style="list-style-type: none"> <li>• Accessories in terms of safety systems</li> <li>• General car safety</li> </ul>	Topolšek et al. [10]
Environmental performance (SSCC sustainability 2) (v = Q_EV)	<p>Prompt: Please consider the potential environmental impact of heavily driving the car we want you to consider purchasing. Complete the sentence: "This particular car would. . ."</p> <ul style="list-style-type: none"> <li>• . . . increase environmental damage.</li> <li>• . . . use too much of the world's natural resources.</li> <li>• . . . discharge high levels of carbon emissions.</li> <li>• . . . require a large amount of energy when driving the car.</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"</p>	(Concern about sustainability issues) <ul style="list-style-type: none"> <li>• The use of child labour in food production.</li> <li>• Deforestation of the rain forest.</li> <li>• Starvation and malnutrition in the world population.</li> <li>• The use of pesticides used in food production.</li> <li>• Poor treatment of animals in food production.</li> <li>• Environmental damage caused by human use of land and water.</li> <li>• The amount of food that is wasted.</li> <li>• Using too much of the world's natural resources for food production.</li> <li>• Poor working conditions and wages for food producers.</li> <li>• Packaging that is not recyclable The amount of packaging used on products.</li> <li>• Carbon emissions caused by food production.</li> <li>• The amount of energy used when transporting food products.</li> <li>• The amount of energy used when cooking food products.</li> </ul>	Grunert et al. [2]

Construct (Variable)	Prompts, Items, and Scaling	Original Items	Origin
Fuel and system efficiency (SSCC sustainability 3) (v = Q_FE)	<p>Prompt: For the car we have described, please consider the fuel efficiency and cost savings you might experience from owning it. Complete the sentence: "The car that we would like you to consider buying would have. . ."</p> <ul style="list-style-type: none"> <li>• . . . low maintenance costs.</li> <li>• . . . low fuel consumption.</li> <li>• . . . high fuel cost savings.</li> <li>• . . . good fuel efficiency.</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"</p>	<p>(Indirect car costs) What criteria were important to you when you bought the car you now own</p> <ul style="list-style-type: none"> <li>• Insurance price</li> <li>• Maintenance costs</li> <li>• Annual road use tax</li> <li>• Low fuel consumption</li> <li>• The price of the car</li> </ul>	Topolšek et al. [10]
Government subsidies (v = Q_GS)	<p>Prompt: Please consider the degree to which you would feel comfortable buying the particular car described in the scenario. Complete the sentence: "The amount of US federal government subsidies for the car that we would like you to consider buying would be. . ."</p> <ul style="list-style-type: none"> <li>• . . .adequate to compensate my car's data sharing.</li> <li>• . . .worth the information I gave.</li> <li>• . . .enough amount of money for sharing my car data.</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"</p>	<p>(Monetary incentive)</p> <ul style="list-style-type: none"> <li>• The amount of money I received is adequate to compensate my effort and time spent in participating in the mobile device survey.</li> <li>• The reward I received from participating in the mobile device survey is worth the information I gave.</li> </ul>	Hui et al. [4]
Privacy concerns (v = PC)	<p>Prompt: Please consider whether you would have privacy concerns about the personal driving information generated by the car <u>that we would like you to consider buying</u>. Depending on the type of car, this information could include things like the times driven, locations visited, unsafe driving behaviors, driving speed, heart rate of the driver, and weight of the passengers in the car. Complete the following: "In general, I am concerned. . ."</p> <ul style="list-style-type: none"> <li>• . . . that the information generated by the car could be misused.</li> <li>• . . . that people or companies could find private information about me on the Internet that is generated by the car.</li> <li>• . . . about the car submitting personal driving information about me to the company that manufactured and sold it.</li> <li>• . . . about the car submitting information on the Internet related to the car just described, because it could be used in a way I did not foresee.</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"</p>	<p>(General privacy concerns)</p> <ul style="list-style-type: none"> <li>• In general, I am concerned that the information I submit on the Internet could be misused.</li> <li>• In general, I am concerned that a person can find private information about me on the Internet.</li> <li>• In general, I am concerned about submitting information on the Internet, because of what others might do with it.</li> <li>• In general, I am concerned about submitting information on the Internet, because it could be used in a way, I did not foresee.</li> </ul>	Choi and Land [1]

Construct (Variable)	Prompts, Items, and Scaling	Original Items	Origin
Disclosure intentions (v = DI)	<p>Prompt: Please indicate the degree to which you would likely agree to disclose (e.g., allow the release of) your personal driving information collected <u>by the car that we would like you to consider buying</u>.</p> <p>Depending on the type of car, this information could include things like the times driven, locations visited, unsafe driving behaviors, driving speed, heart rate of the driver, and the weight of the passengers in the car that we would like you to consider buying.</p> <ul style="list-style-type: none"> <li>I would be willing to disclose my personal driving information generated by the car.</li> <li>I would be willing to disclose my personal health information recorded by the car.</li> <li>I would likely disclose my personal information related to using the car.</li> <li>[r] It is highly unlikely I would be willing to disclose my car-related driving and health information.</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"</p>	<p>(Intention to disclose location-related information)</p> <ul style="list-style-type: none"> <li>I am willing to disclose my location-related information using this LBSN in the future.</li> <li>I will probably disclose my location-related information using this LBSN in the near future.</li> <li>I will likely disclose my location-related information using this LBSN in the near future.</li> <li>I intend to disclose my location-related information using this LBSN if there is a chance.</li> </ul>	Zhao et al. [12]
Attention 2	<p>If you are reading this statement fully then please only choose the answer, "Somewhat agree."</p> <p>Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"</p>	n/a	n/a
Purchase intentions (v = PI)	<p>Prompt: Again, please assume you can afford the \$40,000-\$50,000 of <u>the car we just asked you to consider buying</u>. Given the features of the car and your personal preferences, please indicate the degree to which you would intend to buy such a car.</p> <ul style="list-style-type: none"> <li>How interested would you be in buying the car?</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Not interested at all to 7 = Extremely interested"</p> <ul style="list-style-type: none"> <li>How likely would you buy the car?</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Extremely unlikely to 7 = Extremely likely"</p> <ul style="list-style-type: none"> <li>How strongly would you agree to purchase the car?</li> </ul> <p>Scaling: Likert-type 7-point scale anchored on "1 = Strongly disagree to 7 = Strongly agree"</p>	<p>(Purchase intentions)</p> <ul style="list-style-type: none"> <li>How interested would you be in buying the movie ticket?</li> <li>How likely would you buy the movie ticket?</li> </ul> <p>(Purchase intentions)</p> <ul style="list-style-type: none"> <li>I find purchasing product/service advertised to be worthwhile.</li> <li>I will frequently purchase product/service advertised in the future.</li> <li>I will strongly recommend others to purchase product/service advertised.</li> </ul>	<p>Xu et al. [11]</p> <p>Martins et al. [7]</p>

## Appendix B. The Results of the Experimental Online Survey

**Table B.1.** The Correlation Matrix for Validity Checks (n = 456)

Construct	CR	AVE	Mean	SD	1	2	3	4	5	6	7
1. PC	0.95	0.84	5.30	1.48	0.92						
2. FA	0.95	0.82	5.30	1.34	0.21***	0.90					
3. EV	0.95	0.81	3.09	1.57	-0.23***	-0.59***	0.90				
4. FE	0.94	0.79	5.01	1.59	0.31***	0.76***	-0.76***	0.89			
5. GS	0.99	0.96	3.62	1.89	-0.20***	0.40***	-0.37***	0.44***	0.98		
6. DI	0.94	0.79	2.95	1.67	-0.39***	0.26***	-0.21***	0.23***	0.67***	0.89	
7. PI	0.98	0.93	3.54	1.76	-0.25***	0.40***	-0.33***	0.37***	0.61***	0.65***	0.96

Note. AVE = average variance extracted; CR = composite reliability; DI = disclosure intentions; EV = environmental performance; FA = fatal accident rate; FE = fuel and system efficiency; GS = government subsidies; PC = privacy concerns; PI = purchase intentions. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ .

**Table B.2.** Model Summary (SPSS Process)

R	R <sup>2</sup>	MSE	F	p-value
0.38	0.15	2.38	77.71 (1, 454)	< 0.001***

Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; MSE = mean square error.

**Table B.3.** Direct and Indirect Effects (SPSS Process)

	Coefficient/ Effect	SE	t	p-value	LLCI	ULCI
Constant	1.77	0.33	5.40	< 0.001***	1.13	2.42
PC → PI	-0.02 (Direct effect)	0.05	-0.49	0.630	-0.12	0.07
PC → DI	-0.43	0.05	-8.82	< 0.001***	-0.53	-0.33
DI → PI	0.64	0.04	15.16	< 0.001***	0.56	0.72
PC → DI → PI	-0.28 (Indirect effect)	0.05 (BootSE)	N/A	N/A	-0.37 (BootLLCI)	-0.19 (BootULCI)

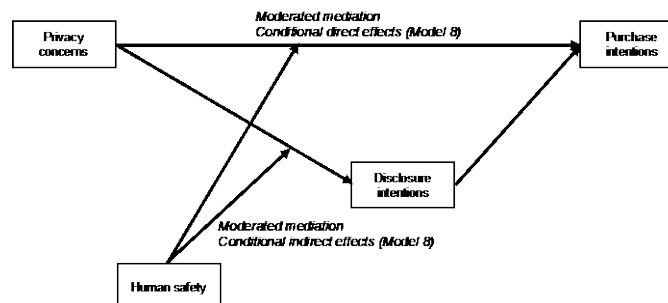
Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; DI = disclosure intentions; LLCI = lower-level confidence interval; PC = privacy concerns; PI = purchase intentions; SE = standard error; ULCI = upper-level confidence interval.

**Table B.4.** Model Fit Summary (AMOS)

GFI	AGFI	CFI	PCFI	RMSEA	PCLOSE	Chi-square	p-value	DF	CMIN/DF
0.98	0.96	0.99	0.74	0.03	0.95	61.71	0.02	41	1.51

Note. AGFI = adjusted goodness of fit index; CFI = comparative fit index (CFI); CMIN = Chi-square value; DF = degrees of freedom; GFI = goodness of fit index; PCFI = parsimony comparative fit index; PCLOSE =  $p$  of close fit; RMSEA = root-mean-square error of approximation.

**Figure B.1.** The Moderated-Mediation Index of Fatal Accident Rates



Note. Moderated-mediation index computed using SPSS Process 3.5; moderated mediation index: -0.09; BootSE: 0.02; BootLLCI: -0.13; BootULCI: -0.05.

**Table B.5.** The Comparison of SPSS Process and AMOS Outputs (Conditional Indirect Effects)

FA	SPSS Process Output		AMOS Output				
Causality	Coefficient	Statistics (Significance)	Estimate	Stand. Estimate	SE	CR	p-value
Constant	-0.64	N/A	N/A				
PC → DI	0.32	$t_{(452)} = 2.47, p = 0.010^{**}$	0.33	0.29	0.13	2.47	0.010 <sup>**</sup>
FA → DI	1.29	$t_{(452)} = 9.24, p < 0.001^{***}$	1.29	1.04	0.14	9.27	< 0.001 <sup>***</sup>
FA × PC → DI	-0.18	$t_{(452)} = -6.69, p < 0.001^{***}$	-0.18	-1.14	0.03	-6.71	< 0.001 <sup>***</sup>
DI → PI	0.49	$t_{(451)} = 11.05, p < 0.001^{***}$	0.64	0.61	0.04	15.19	< 0.001 <sup>***</sup>
PC → PI	0.18	$t_{(451)} = 1.40, p = 0.160$	-0.02	-0.02	0.05	-0.49	0.300

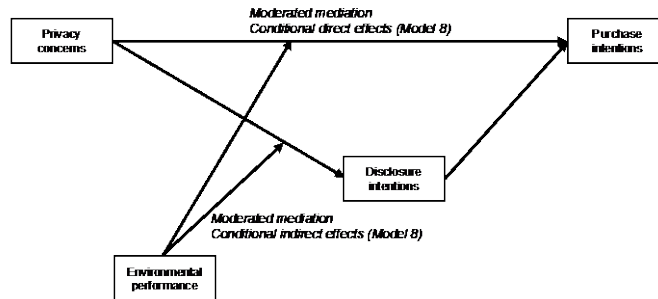
Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; CR = critical ratio; DI = disclosure intentions; FA = fatal accident rate; N/A = not applicable; PC = privacy concerns; PI = purchase intentions; SE = standard error.

**Table B.6.** The Comparison of SPSS Process and AMOS Outputs (Conditional Direct Effects)

FA	SPSS Process Output		AMOS Output				
Causality	Coefficient	Statistics (Significance)	Estimate	Stand. Estimate	SE	CR	p-value
Constant	-0.64	N/A	N/A				
PC → DI	0.32	$t_{(452)} = 2.47, p = 0.010^{**}$	-0.43	-0.38	0.05	-8.83	< 0.001 <sup>***</sup>
DI → PI	0.49	$t_{(451)} = 11.05, p < 0.001^{***}$	0.49	0.49	0.04	12.45	< 0.001 <sup>***</sup>
PC → PI	0.18	$t_{(451)} = 1.40, p = 0.163$	0.18	0.16	0.13	1.40	0.160
FA → PI	0.74	$t_{(451)} = 5.14, p < 0.001^{***}$	0.74	0.60	0.13	5.63	< 0.001 <sup>***</sup>
FA × PC → PI	-0.07	$t_{(451)} = -2.70, p = 0.010^{**}$	-0.07	-0.46	0.03	-2.85	0.010 <sup>**</sup>

Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; CR = critical ratio; DI = disclosure intentions; FA = fatal accident rate; N/A = not applicable; PC = privacy concerns; PI = purchase intention; SE = standard error.

**Figure B.2.** The Moderated Mediation Index of Environmental Performance



Note. Moderated-mediation index computed using SPSS Process 3.5; moderated-mediation Index: 0.08; BootSE: 0.02; BootLLCI: 0.05; BootULCI: 0.12.

**Table B.7.** The Comparison of SPSS Process and AMOS Outputs (Conditional Indirect Effects)

EV	SPSS Process Output		AMOS Output				
Causality	Coefficient	Statistics (Significance)	Estimate	Stand. Estimate	SE	CR	p-value
Constant	9.67	N/A	N/A				
PC → DI	-1.08	$t_{(452)} = -10.65, p < 0.001^{***}$	-1.08	-0.96	0.10	-10.69	< 0.001 <sup>***</sup>
EV → DI	-1.10	$t_{(452)} = -8.59, p < 0.001^{***}$	-1.10	-1.03	0.13	-8.62	< 0.001 <sup>***</sup>
EV × PC → DI	0.15	$t_{(452)} = 6.29, p < 0.001^{***}$	0.15	0.82	0.02	6.31	< 0.001 <sup>***</sup>
DI → PI	0.53	$t_{(451)} = 11.72, p < 0.001^{***}$	0.64	0.61	0.04	15.19	< 0.001 <sup>***</sup>
PC → PI	-0.34	$t_{(451)} = -3.13, p = 0.020^*$	-0.02	-0.02	0.05	-0.49	0.630

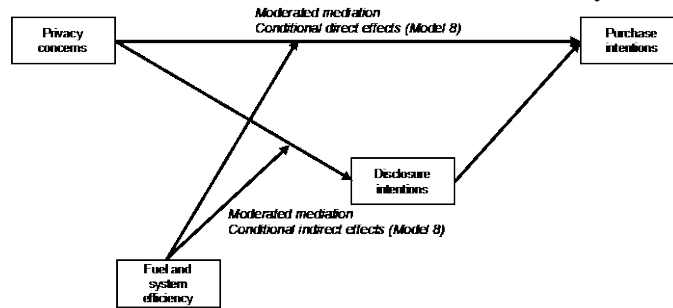
Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; CR = critical ratio; DI = disclosure intentions; EV = environmental performance; N/A = not applicable; PC = privacy concerns; PI = purchase intention; SE = standard error.

**Table B.8.** The Comparison of SPSS Process and AMOS Outputs (Conditional Direct Effects)

EV	SPSS Process Output		AMOS Output				
	Coefficient	Statistics (Significance)	Estimate	Stand. Estimate	SE	CR	p-value
Constant	9.67	N/A	N/A				
PC → DI	-1.08	$t_{(452)} = -10.65, p < 0.001^{***}$	-0.43	-0.38	0.05	-8.83	$< 0.001^{***}$
DI → PI	0.53	$t_{(451)} = 11.72, p < 0.001^{***}$	0.53	0.53	0.04	13.04	$< 0.001^{***}$
PC → PI	-0.34	$t_{(451)} = -3.14, p = 0.020^*$	-0.34	-0.30	0.10	-3.46	$< 0.001^{***}$
EV → PI	-0.54	$t_{(451)} = -4.04, p = 0.001^{***}$	-0.54	-0.50	0.12	-4.38	$< 0.001^{***}$
EV × PC → PI	0.06	$t_{(451)} = 2.30, p = 0.020^*$	0.06	0.30	0.02	2.41	0.020*

Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; CR = critical ratio; DI = disclosure intentions; EV = environmental performance; N/A = not applicable; PC = privacy concerns; PI = purchase intention; SE = standard error.

**Figure B.3.** The Moderated Mediation Index of Fuel and System Efficiency



\*SPSS Process 3.5; Moderated mediation Index: -0.07; BootSE: 0.02; BootLLCI: -0.11; BootULCI: -0.04

**Table B.9.** The Comparison of SPSS Process and AMOS Outputs (Conditional Indirect Effects)

FE	SPSS Process Output		AMOS Output				
	Coefficient	Statistics (Significance)	Estimate	Stand. Estimate	SE	CR	p-value
Constant	0.88	N/A	N/A				
PC → DI	0.08	$t_{(452)} = 0.79, p = 0.430$	0.08	0.08	0.11	0.80	0.430
FE → DI	1.15	$t_{(452)} = 9.41, p < 0.001^{***}$	1.15	1.10	0.12	9.44	$< 0.001^{***}$
FE × PC → DI	-0.15	$t_{(452)} = -6.55, p < 0.001^{***}$	-0.15	-1.06	0.02	-6.58	$< 0.001^{***}$
DI → PI	0.48	$t_{(451)} = 10.67, p < 0.001^{***}$	0.64	0.61	0.04	15.19	$< 0.001^{***}$
PC → PI	0.04	$t_{(451)} = 0.42, p = 0.670$	-0.02	-0.02	0.05	-0.49	0.630

Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; CR = critical ratio; DI = disclosure intentions; FE = fuel and system efficiency; N/A = not applicable; PC = privacy concerns; PI = purchase intention; SE = standard error.

**Table B.10.** The Comparison of SPSS Process and AMOS Outputs (Conditional Direct Effects)

FE	SPSS Process Output		AMOS Output				
	Coefficient	Statistics (Significance)	Estimate	Stand. Estimate	SE	CR	p-value
Constant	0.88	N/A	N/A				
PC → DI	0.08	$t_{(452)} = 0.79, p = 0.430$	-0.43	-0.38	0.05	-8.83	$< 0.001^{***}$
DI → PI	0.48	$t_{(451)} = 10.67, p < 0.001^{***}$	0.48	0.49	0.04	12.20	$< 0.001^{***}$
PC → PI	0.04	$t_{(451)} = 0.42, p = 0.670$	0.04	0.04	0.10	0.42	0.680
FE → PI	0.61	$t_{(451)} = 4.72, p < 0.001^{***}$	0.61	0.59	0.12	5.19	$< 0.001^{***}$
FE × PC → PI	-0.06	$t_{(451)} = -2.38, p = 0.020^*$	-0.06	-0.39	0.02	-2.50	0.010**

Note. \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; \*\*\* =  $p < 0.001$ ; CR = critical ratio; DI = disclosure intentions; FE = fuel and system efficiency; N/A = not applicable; PC = privacy concerns; PI = purchase intention; SE = standard error.

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