On the Duality of Stress in Information Systems Research – The Case of Electric Vehicles

Abstract

Previous research in the area of information systems (IS), stress, and behavior has emphasized either stress resulting from an inability to cope with information and communication technologies or the potential value of IS to reduce stress in certain situations. In this paper, we merge both approaches: we propose that there is a duality in the effect of IS on stress perceptions, particularly, the use of IS may lead to increased stress while at the same time, may be useful for overcoming stressful situations. Additionally, we explore the impact of both directions of effect on the attitude to perform a specific behavior. We designed a mental simulation experiment, using the example of range stress in electric vehicles. Drawing on a sample of 341 participants, our results support the existence of a dual effect of IS on stress perception and demonstrate that both effects have a contrary influence on the attitude construct.

Keywords: Stress, Technostress, Range Stress, Range Anxiety, In-Vehicle Information Systems, Electric Vehicle, Electric Mobility
Introduction

The human brain has an enormous capacity to process information and perform numerous complex tasks simultaneously. Despite this tremendous processing ability, adverse conditions such as cognitive overload may lead to strain and stress (Gaillard 2008). Stress seems to be an almost inevitable spin-off of almost every aspect of life, causing numerous physiological and mental health problems, ranging from burnout, heart disease, and asthma to depression or sleeplessness (Avey et al. 2003; Marin et al. 2011). It is therefore unsurprising that stress is a heavily debated topic, not only in the healthcare field but also in economics, political science, business, and information systems (IS) research. Generally, there is no solid agreement about the definition of stress, as it is a complex, multidimensional construct comprising various components (Levine and Ursin 1991). However, for our study, we conceptualize stress from a transaction-based perspective as a bilateral relationship between an individual and his or her surrounding environment that is characterized by certain psychological appraisal processes (Lazarus and Folkman 1984).

Within the IS community, the concept of stress has garnered popularity in association with the term technostress, which was first described by Brod (1984) as “a modern disease of adaptation caused by an inability to cope with new technologies in a healthy manner.” The use of IS poses major challenges because it requires continually increasing daily interactions, which may lead to serious negative impacts on psychological and physical health, such as increased blood pressure, depression, or frustration (Ragu-Nathan et al. 2008; Weil and Rosen 1997).

Literature in the research field of stress and IS has mostly focused on the causes, characteristics, and consequences of stress resulting from the interaction with IS in an organizational setting (Riedl 2012). In this context, Ragu-Nathan et al. (2008), for example, empirically validate measurement instruments for technostress creators and inhibitors while also examining the influence of IS-related stress on various job-related satisfaction criteria. Furthermore, the concept of technostress also features prominently in the private context. A recent study of Maier et al. (2014), for example, investigates the importance of technostress in association with the usage of social networking sites. However, while most studies on IS and stress have emphasized the dark side of IS use, there is surprisingly little research on the value of IS in reducing the perceived level of stress in specific situations. Only one recently published study approached this gap by examining the usefulness of car-related IS in reducing range anxiety in electric vehicles (EVs) (Eisel et al. 2014). The authors conceptualize range anxiety as a certain type of stress that is triggered by the concern of becoming stranded with a depleted battery in a limited range (range stress).

In summary, previous studies have investigated the influence of IS on stress and thus on behavior from a single perspective – either from an adverse perspective or (quite recently) from a beneficial point of view. From these standpoints, IS may either be useful for overcoming stressful situations or pose the risk of inducing stress. However, to the best of our knowledge, there are no studies capturing both perspectives at the same time. There is therefore a research gap on the duality of the effect of IS on stress and thus on behavioral outcomes. We suggest that when investigating the interdependency between IS, stress, and its effect on human behavior, it is highly important to take both the negative and positive effects of IS on stress into account, enabling a more precise prediction of IS-influenced behavioral tendencies in specific fields of application.

Given the research gap identified above, the main objective of this paper is to achieve a broader understanding of the ambiguous role of stress in IS research while also exploring the impact of both directions of effect on human behavior. We therefore elaborate on the following research questions:

*RQ1: Can the level of perceived stress simultaneously be reduced and induced by the use of IS?*

*RQ2: To what extent do the reduction and inducement of perceived stress influence the attitude toward behavior?*

To approach these research questions, our study combines findings from IS, stress, and behavior. We first propose a research model addressing the negative and positive effects of IS usage. We investigate the impact of IS on stress, applying the prominent transactional stress model by Lazarus and Folkman (1984). Furthermore, we relate the stress concept to the well-established construct of attitude toward a specific behavior – a core construct in most behavioral models, including the theory of planned behavior (Ajzen 1991).
As both effects of IS on stress seem to be observable in the use of EVs, we use this example to develop our proposed research model. On the one hand, the provision of range-related information through automotive IS appears to be useful for overcoming stressful situations that result from the limited driving range of battery EVs (e.g., Eisel et al. 2014; Rauh et al. 2014). On the other hand, interaction with a car’s IS may also lead to an increased workload and thus result in stress (e.g., Schiessl 2007). Furthermore, the dissemination of EVs is considered to be an attractive option on the pathway to achieving ambitious climate goals (e.g., Samaras and Meisterling 2008) and therefore constitutes a relevant research field.

In summary, this study makes several contributions. First, we enhance the existing literature on stress and IS by developing a comprehensive research model for the role of IS in stress reduction and stress inducement and investigate its effect on the attitude toward behavior. Moreover, we use the example of EVs to demonstrate the value of IS in reducing perceived range stress and the potential stress that results from interaction with IS in EVs. Our results should be of great interest to both researchers in the area of IS, stress, and behavior as well as practitioners in the sphere of EVs and IS design.

The reminder of this paper is structured as follows. In the following chapter, we review the theoretical concept of stress – specifically, Lazarus’s transactional perspective. We then reflect in the next chapter upon the value of IS for the dissemination of EVs before concluding with a literature review of stress in IS research. In the further course of this paper, we outline the design and procedure of the empirical investigation by means of the structural equation modeling technique. We then present the study results, including a data set of 341 participants from a mental simulation experiment. The paper concludes with a discussion on results, contributions, limitations, and implication for further research.

Theoretical Background and Related Work

In this section, we first review the foundations of stress and relate the stress concept to the widely used transactional theory of Lazarus and Folkman (1984). Afterwards, we briefly elaborate upon the role of IS in the context of EVs. Finally, we consider previous work in the research field of stress and IS.

The Stress Concept

The inherent complexity of the stress concept has led to considerable controversy about its meaning and measurement (Levine 2005; Cohen et al. 1997; Krohne 2001; Selye 1975). Levine and Ursin (1991) explain the basic obstacle to a consistent definition: “The major problem with the concept of stress is that we are confronted with a composite, multidimensional concept. All existing definitions include some components.”

Nevertheless, many explanatory approaches have focused on three main perspectives on stress (Bartlett 1998; Burchfield 1979; Cohen et al. 1997; Hobfoll 1989). First, the stimulus-based approach depicts stress based on the nature of certain stressors. Elliot and Eiersdorfer (1982), for example, distinguish between different sources of stress, namely acute, time-limited stressors (e.g., a dental appointment), stressor sequences (e.g., job loss), chronic intermittent stressors (e.g., an examination), and chronic stressors (e.g., energy-sapping illness). Second, response-based approaches frequently characterize stress by the individual or organismic response to certain events. In this regard, the work of Hans Selye (e.g., 1946; 1950) popularized the response-based view by emphasizing the non-specific physiological reaction in a three-stage pattern (alarm, resistance, and exhaustion), referred to as the theory of the general adaptation syndrome. Finally, in the interaction-based view, stress is not solely determined by a specific stimulus or reaction; the concept of stress goes beyond that by emphasizing the bilateral relationship (transaction) between individuals and their environment.

Lazarus and Folkman (1984) provide the most influential model of the interaction-based approach, defining stress as “a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being.” The theoretical assumptions of the transactional stress theory are based on three main cognitive appraisal processes: primary appraisal, secondary appraisal, and reappraisal (Lazarus 1966; Lazarus and Folkman 1984). Primary appraisal refers to the individual cognitive appraisal of an event for one’s own well-being, whereas secondary appraisal concerns an individual’s coping abilities.
Within primary appraisal, the individual evaluates an event for his or her well-being as benign-positive, irrelevant, or stressful (Lazarus and Folkman 1984). When an event has no implications for the individual’s well-being, it falls under the category of irrelevant. The differentiation between relevant and irrelevant is critical because individuals only mobilize for action if it is necessary. Events are appraised as benign-positive if the individual evaluates an event as positive for his or her well-being, often characterized by positive emotions such as joy, happiness, or exhilaration. Contrastingly, if an event is appraised as stressful, it is seen as either a harm (psychological damage that has already happened, e.g., bereavement), a threat (anticipated danger that has not yet taken place, e.g., anticipated thunderstorm), or challenge (difficult demands people feel confident about overcoming by effectively mobilizing personal resources, e.g., imminent examination). While threat is often related to negative emotions such as anger, fright, or anxiety, challenge may imply emotions such as eagerness or hopefulness (Lazarus 1993; Lazarus and Folkman 1984).

In case an event is appraised as stressful, individuals evaluate their resources for coping with this situation in the secondary appraisal – specifically, which solution options are available and applicable for overcoming the stressful event. Various coping options are assessed, such as accepting or changing the situation or searching for new information (Folkman et al. 1986; Lazarus and Folkman 1984). Jerusalem and Schwarzer (1989) refer to material, social, and personal resources for counteracting stressful demands.

Generally, psychological stress occurs when an individual perceives that their coping resources (secondary appraisal) seem insufficient to handle a situation previously appraised as stressful (primary appraisal). In such a case, coping strategies are triggered, comprising two major functions: problem-centered coping is geared toward dealing with the problem that is causing the stress, while emotion-centered coping is directed toward regulating the accompanying emotions (Folkman et al. 1986; Lazarus and Folkman 1984). Finally, if there is any perceived change from environment, a reappraisal may occur. For example, an event initially appraised as a threat may be classified as irrelevant after considering new information from the environment (Lazarus and Folkman 1984).

The Value of Information Systems for the Dissemination of Electric Vehicles

The automobile is one of the most influential inventions, instantly changing the cityscape and becoming an indispensable means of transportation. In recent years, the introduction of electric vehicles has been considered an attractive option on the pathway to achieving ambitious government climate goals such as the reduction of greenhouse gas emissions or global warming (e.g., Chan and Wong 2004; Samaras and Meisterling 2008).

Electric vehicles are defined as any vehicle powered partially or entirely by an electric motor, including battery electric vehicles, hybrid electric vehicles, and fuel-cell electric vehicles (Chan and Wong 2004). Although many governments have placed significant effort into promoting the diffusion of electric vehicles, their success is still pending (e.g., Zhang et al. 2014). According to the International Council on Clean Transportation, in 2012, vehicles equipped with internal combustion engines accounted for more than 97% of new registrations in the European market; electric vehicles constituted the remaining 3% (ICCT 2013).

A considerable body of literature suggests that, besides high initial costs and the insufficient charging infrastructure, the limited range is one of the main barriers to the market success of battery electric vehicles (e.g., Chan 2007; Chan and Wong 2004; Hidrue et al. 2011; Zhang et al. 2014). In this context, the phenomenon of range anxiety, defined as the “continual concern and fear of becoming stranded with a discharged battery in a limited range” (Tate et al. 2008), is garnering increasing attention from the IS community (e.g., Eisel et al. 2014; Ferreira et al. 2014). Range anxiety is related to a certain type of stress (range stress) characterized by the perceived inability to handle a critical range situation in electric vehicles (Franke et al. 2012; Rauh et al. 2014). Along with the limited driving range of approximately 100 miles, the lack of available charging stations is considered to be a main reason for range stress (Feng and Figliozzi 2012). Furthermore, practical experience with electric vehicles seems to be a significant variable influencing the phenomenon of range stress; some authors suggest that experienced electric vehicle drivers exhibit less range stress than inexperienced drivers (e.g., Rauh et al. 2014; Wellings et al. 2011).
Eisel and Schmidt (2014) suggest the provision of range-related information through automobile IS to reduce the phenomenon of range stress. In general, in-vehicle IS provide the driver with a variety of functions and services, such as route planning, vehicle monitoring, navigation, traffic and weather updates, or entertainment by radio or DVD (Cao et al. 2010; Gil-Castiñeira et al. 2009). In this context, Kantowitz and Moyer (1999) derive three different in-vehicle categories. First, convenience and entertainment systems comprise IS used to make traveling more comfortable and enjoyable, such as television, radio, or car phones. Second, safety and collision-avoidance systems include all systems employed to prevent road accidents and thus ensure driver safety. Third, advanced traveler information systems inform drivers about road conditions and traffic situations; traffic information systems, radio data systems, or global positioning systems are used to provide relevant information to the driver. Brandt (2013) picks up this classification and suggests a categorization of IS within automobiles according to the object of interest about the system provides information. Based on the categorization of Kantowitz and Moyer (1999), the author suggests a further category: vehicle-monitoring systems. This category encompasses various IS used to provide the driver with information about the status of the car (e.g., speedometers, fuel gauges, light status).

However, the evolution of intelligent IS in automobiles is continuing under certain keywords such as autonomous cars, intelligent navigation systems, or car-to-car communication. This development is promoted by the expectation that Internet in the car will not only be accessible via portable devices, but instead, future cars will be directly connected with the Internet (Abdelkafi et al. 2013; Dijk et al. 2013).

Stress in Information Systems Research

Most studies in the research field of stress and IS have focused on the causes, characteristics, and consequences of stress resulting from interaction with information and communication technologies (Riedl 2012). In this context, Brod (1984) defines stress as an inability to cope with new technologies in a healthy way. Weil and Rosen (1997) enhance this definition by conceptualizing technostress as “any negative impact on attitudes, thoughts, behaviors, or body physiology that is caused either directly or indirectly by technology.”

In recent years, considerable research has been conducted in this field. Tu et al. (2005), for example, shed light on the influence of computer-related stress on Chinese employees. The authors reveal that an increased level of technostress leads to a loss of productivity and an increasing employee turnover. Ragu-Nathan et al. (2008) examine the influence of technostress on job-related satisfaction criteria, such as commitment to organization or intention to stay. By using survey data from organizational end-users of information and communication technologies, the authors develop and empirically validate measurement instruments for technostress creators (e.g., techno-complexity) and technostress inhibitors (e.g., technical support provision). In another instance, Ayyagari et al. (2011) investigate in their research model of technostress whether specific stressors (e.g., work overload) are related to certain technology characteristics, namely intrusiveness (e.g., anonymity), usability (e.g., reliability), and dynamism (e.g., velocity of technological change). Tarafdar et al. (2011) investigate technostress in the professional sales context. By integrating literature from technostress and social cognitive theory, the authors explore the relationships among technostress, technology self-efficacy, technology-enabled performance, and role stress (created due to role conflict and role overload). In a further study, Tarafdar et al. (2015) highlight potential mechanisms for counteracting the negative impact of technology on stress. The authors revealed that, for example, building technology competence or developing technology self-efficacy and IS literacy enhancement are useful for inhibiting the negative effect of interaction with technologies. Galluch et al. (2015) investigate the effect of contemporary information and communication technologies (ICT) such as e-mail or instant messaging on perceived stress level and business productivity. Based on the transactional stress model of Lazarus and Folkman (1984), the authors reveal in two laboratory experiments that various control factors (e.g., timing control, which refers to an individual’s autonomy to decide when to respond to messages) can influence the relationship between ICT-enabled stressors, stress, and strain.

Recent research has also highlighted the importance of technostress when using technology in the private setting. In this context, Maier et al. (2012) identify five social networking–specific techno-stressors – invasion, pattern, complexity, disclosure, and uncertainty – that are determinants of exhaustion by or satisfaction with social network sites. Furthermore, it has been shown that extent of usage, number of
friends, subjective social support norms, and type of relationship are antecedents of social overload and that negative association with social networking sites may lead to exhaustion, low levels of user satisfaction, and even a high intention to stop using such sites (Maier et al. 2014).

While most studies in the field of IS and stress have emphasized the dark side of IS use in organizations, there is surprisingly little research on the usefulness of IS in reducing the perceived level of stress in specific situations. Among the first, Eisel et al. (2014) launched into this gap by investigating the value of car-related IS for the reduction of stress resulting from the limited driving range of battery-driven EVs. In the literature there are many further indications of the potential positive impact that IS could have on an individual’s perception of stress. Garg et al. (2005), for example, systematically review the effects of computerized clinical decision-support systems on practitioner performance and patient outcomes; the synthesis clearly illustrates the positive impact of these systems on the performance of health professionals by reducing perceived work stress. Lohaus (2010) reports on the development and evaluation of an e-learning, platform-based stress-prevention program for adolescents. The results of the study indicate a significant improvement in self-efficacy and a reduction of stress symptoms for those involved in the program.

Research Model and Hypotheses Development

Based on the theoretical background discussed in Chapter 2, we derived a research model that aims to integrate both perspectives on stress in IS research – specifically, the potential positive and negative effects of IS on perceived stress in a specific situation. To do so, we apply Lazarus’s transactional stress model (Lazarus and Folkman 1984) to express the ambiguous role of stress in IS research. We assume that IS usage can influence the cognitive appraisal processes – the primary and secondary appraisals – within the transactional stress model for a certain situation by providing relevant information and thus supporting the decision-making process (Huber 1990). While in the primary appraisal process individuals evaluate an event as either a threat or challenge, secondary appraisal encompasses various personal coping options. The two most frequently studied personal coping resources contain two main psychological factors: internal locus of control and self-esteem (Thoits 1995). The former describes the general belief of an individual that he or she is in control of a certain event (Rotter 1966). Self-esteem refers to positive attitude toward oneself (Pearlin and Schooler 1978) and is closely linked to the self-concept that reflects both the perception of how others evaluate the self and the adoption of those others’ views (Crocker and Major 1989). Furthermore, we state that stress influences the attitude toward a specific behavior, which in turn influences an individual’s plan to perform a specified future behavior (Ajzen and Madden 1986). Our research model is illustrated in Figure 1 below.

![Figure 1. Research Model: On the Duality of Stress in Information Systems Research](image-url)
We posit that, on one side, IS can reduce perceived stress by providing relevant information in a timely and appropriate manner. We use the case of range anxiety to explain how IS could have a positive effect on an individual’s perception of stress. Generally, anxiety corresponds to a particular state of uncertainty and is closely linked to the concept of stress, as it represents a basic negative emotion (Zeidner and Matthews 2011). Some authors attribute the phenomenon of range anxiety to a domain-specific form of stress, namely range stress (e.g., Eisel et al. 2014; Franke et al. 2012). In this context, Rauh et al. (2014) conceptualize range stress as an individual’s perceived inability to manage a critical range situation in an electric vehicle with the resources available. Eisel and Schmidt (2014) identify insufficient automobile IS as a main driver of range stress, as providing range-related information—for example, location of charging stations, traffic data, or estimated range based on specific data (e.g., weather or altitude)—would diminish existing doubts, thereby reducing the concern of becoming stranded with a depleted battery. Ferreira (2014) arrives at similar findings, stating that the provision of relevant information through a mobile application for electric vehicles contributes to better trip planning and energy usage, thus reducing range stress. Therefore, we refer in our research model to supportive IS as in-vehicle systems that provide additional information to the driver about, e.g., the location of charging stations, estimated range, or traffic data.

Coming to the primary appraisal process of stress, several authors suggest that the amount of information available mainly determines the perception of uncertainty about a situation and thus influences the individual’s appraisal of a situation as threatening or challenging (e.g., Krohne 1997; Lazarus and Folkman 1984; Milliken 1987; Monat et al. 1972). In this context, Greco and Roger (2003) investigate the relationship between uncertainty and stress reactions based on an experimental research design; the results show that uncertainty increases the perceived level of stress. Clauson (1996) comes to similar results in his study about uncertainty and stress in pregnant women.

However, individuals evaluate uncontrollable situations as more likely to be threatening than situations over which they perceive to have control (Lazarus and Folkman 1984). In this context, anticipated future harm or loss might lead to an increased threat appraisal (Jerusalem and Schwarzer 1992). We assume that without relevant information about the distance–range ratio (provided by supportive in-vehicle IS), individuals are unable to estimate whether they will reach the final destination and hence might anticipate a future harm or loss. This can be, for example, an anticipated personal harm due to missing an important appointment or getting stranded with the electric vehicle in an uncomfortable situation (e.g., at night on a highway).

Moreover, the task of driving an electric vehicle equipped with supportive in-vehicle IS is less difficult, as individuals are provided with relevant information about the trip and hence are not required to invest additional cognitive effort regarding how to reach their destination. On a related note, Fuller (2005) refers to task difficulty that is shaped mainly by the “dynamic interface between the demands of the driving task and the capability of the driver.” We assume that the provision of relevant information to the driver through supportive IS leads to a better assessment of the specific demand elicited by the critical distance–range ratio remaining, leading to a decreased task difficulty and thereby less challenge appraisal.

Supporting our assumption, a recent study of Eisel et al. (2014) found that individuals perceive general critical range situations in electric vehicles to be more threatening and more challenging when less information about, for example, route, alternative charging stations, or other range-related information is available to the driver. Accordingly, we summarize our assumptions in the following pair of hypotheses:

**H1a**: Individuals perceive the critical range situation in EVs as less threatening when supportive in-vehicle IS are provided.

**H1b**: Individuals perceive the critical range situation in EVs as less challenging when supportive in-vehicle IS are provided.

As explained earlier, coping options in the secondary appraisal process encompass the subdimensions of both self-concept of one’s own abilities as well as locus of control. Kienhues and Bromme (2011) argue that consistent information about a situation fosters the self-concept of one’s own competencies (which is generally characterized by the belief in one’s own competencies) and thus empowers individuals to feel capable of solving specific tasks. The degree to which an individual evaluates his or her own capabilities to manage a task is furthermore determined by the uncertainty the task involves. In this context, the uncertainty correlates with the probability that an individual is able to foresee an event that, in turn,
determines the evaluation of his or her own abilities to handle the respective situation (Babrow et al. 2000; Brashers 2001). Transferred to the context of electric vehicles, the provision of range-related information enables individuals to detect alternative actions for reaching the destination and hence strengthens the self-concept of one’s own abilities (Eisel et al. 2014). Moreover, uncertainty also constitutes an important part in the individual’s perception of being in control of events (Hilton 1993). In their study about dimensions of driver stress, Gulian et al. (1989) point out that on a situational level, stress is induced by specific events over which the driver has only limited control. In this context, the more difficult a task becomes, the more the driver loses control over a situation (Fuller 2005). In a cross-border context, the ride in an electric vehicle without in-vehicle IS constitutes a far more difficult task than the ride with appropriate information. Following this line of argumentation, we expect that the provision of information improves the self-concept of one’s own abilities and locus of control. We establish these assumptions in the following pair of hypotheses:

**H2a:** Individuals perceive their self-concepts to be reinforced regarding the critical range situation in EVs when supportive in-vehicle IS are provided.

**H2b:** Individuals perceive that they are more in control over the critical range situation in EVs when supportive in-vehicle IS are provided.

Furthermore, we rely on the concept of technostress and posit that, at the same time, the use of information and communication technologies may cause stress. We use the application of advanced IS in electric vehicles to explain the negative psychological link of IS use. Generally, the driving process constitutes a complex and challenging task that requires high concentration and may result in driver tension and stress reactions (e.g., Gulian et al. 1989; Hennessy and Wiesenthal 1999). Even further stress factors can originate from the use of information and communication systems such as navigation systems or mobile phones while driving (Alm and Nilsson 1995; Schiessl 2007). In addition to primary tasks such as accelerating, braking, or changing gears, interaction with in-vehicle IS constitutes a supplementary demand that can divert the driver's attention from the road and thus exceed his or her information-processing capacity (Harvey et al. 2011). This additional attention demand on the driver can lead to distraction from traffic, resulting in an anticipated threat of getting involved in an accident (Bach et al. 2009; Cao et al. 2010; Neale et al. 2005). We assume that individuals might transfer the threat to crash to the interaction with in-vehicle IS.

Furthermore, the complexity of IS increases with the degree of its provided functionalities. Ragu-Nathan (2008), for example, refers to the increasing complexity of technical capabilities and terminology associated with IS, fostering the uncertainty of how to use the IS in an appropriate manner. We expect users of supportive in-vehicle IS to spend more time and effort to understand certain aspects of the technology provided. Moreover, the complexity could lead to a greater challenge appraisal in interacting with the in-vehicle IS. Matthews (2002) explains that in-vehicle IS that are complex and difficult to operate may even provoke frustration or hostility, inevitably leading to high stress reactions. Following this logic, we assume that the interaction with supportive in-vehicle IS leads to an overload of information-processing capacity and thus influences the appraisal of interaction as threatening or challenging in the following manner:

**H3a:** Individuals perceive interaction with supportive in-vehicle IS to be more threatening with an increasing number of functionalities.

**H3b:** Individuals perceive interaction with in-vehicle IS to be more challenging with an increasing number of functionalities.

Considering the secondary appraisal process, we assume that with an increasing number of functionalities of the in-vehicle IS, individuals are less confident in handling the system and perceive themselves to be less in control over the system. Ragu-Nathan (2008) highlights the potential danger of information overload, as information and communication technologies use information from multiple sources, thus creating a flood of information that users are potentially unable to handle. According to Hollnagel et al. (2003), drivers must sometimes to compete with semi- and fully automated information systems in vehicles, paying attention to several tasks at the same time. Bach et al. (2009) point out that in-vehicle IS are one of the main culprits regarding information overload, as interaction with the system relies on the same capacity as the driving task.
In that regard, Heylighen (2002) explains that information overload produces a loss of control over a situation, as the individual’s capacity for decision-making is limited, thereby rendering individuals unable to consider the optimal option for resolving an associated problem. In the case of electric vehicles, by interacting with supportive in-vehicle IS, individuals are exposed to a plethora of information, such as the permanently changing state of charge, remaining distance display, battery health, or navigation system. We also assume that the complexity of the supportive in-vehicle IS not only leads to a perceived loss of control but also affects the self-concept of own abilities in a negative manner. The range of functionalities to which an individual is exposed via supportive in-vehicle IS may lead to a certain level of uncertainty regarding how to use the system and interpret the respective information, which might, in turn, lead to a decrease in self-confidence. Following this logic, we summarize our assumption in the following pair of hypotheses:

**H4a**: Individuals are less self-confident in handling the in-vehicle IS with an increasing number of functionalities.

**H4b**: Individuals perceive themselves to be less in control over in-vehicle IS with an increasing number of functionalities.

In our study, attitude toward behavior plays an important role in predicting behavior. Ajzen (2005) defines attitude as “a disposition to respond favorably or unfavorably to an object, person, institution, or event.” Many studies emphasize the necessity of distinguishing between attitude toward an object (e.g., electric vehicle as an object) and attitude toward a specific behavior (e.g., driving an electric vehicle for a specific route) in order to explain behavior (Ajzen and Fishbein 1977; Zhang 2007). In the further course of our paper, we focus on attitude toward a specific behavior because it represents a better predictor of intention and thus behavior (Ajzen and Fishbein 2005; Zhang 2007).

Separation of the attitude construct into three main classes of responses (often referred to as the tri-component attitude model) has achieved widespread adoption and almost no criticism among researchers (Ajzen 2005; Breckler 1984; Greenwald 2014). In this classification, the cognitive dimension refers to the individual’s knowledge, thoughts, and beliefs about performing a specific behavior; the affective component of attitude involves the individual’s feelings and emotions; and the conative (behavioral) response reflects the tendency of actual behavior to occur. This classification is essential for our study because emotions (affective response of attitude) are inextricably linked with the concept of stress (Lazarus 1993a). Lazarus (1993a) even considers stress to be a subset of emotions, as certain negative emotions, such as anxiety, shame, or anger, arise from stressful situations. Following this logic, emotions (and thus stress) influence attitude toward behavior. This statement is also supported by a variety of studies. Kulviwat (2007) comprehensively measures emotions by applying the Pleasure–Arousal–Dominance (PAD) paradigm, demonstrating its effect on attitude toward adoption of a personal digital assistant. Eisel et al. (2014) reveal a negative effect of range stress on the attitude toward EV use, while, Saadé and Kira (2006) reveal a negative influence of anxiety on the use of an online learning system. Furthermore, Djamasesbi et al. (2009) demonstrate the effect of positive and negative affect (representing moods and emotions) on user attitudes toward using healthcare information systems. We therefore posit that a higher level of stress has a negative impact on the attitude toward a specific behavior – in our case, toward using an electric vehicle for a specific route. Following this logic, we propose the following pair of hypotheses:

**H5**: Range stress is negatively associated with attitude toward using an electric vehicle.

**H6**: Technostress is negatively associated with attitude toward using an electric vehicle.

Research Methodology

To assess the proposed hypothesis, we designed and conducted a mental simulation experiment with a between-subjects design, using the example of EVs. We decided to use a mental experiment for two reasons: first, it is efficient to conduct and, second, prior studies have given us sufficient indication of its applicability and the effectiveness of the treatments in the context of stress and electric mobility research (Castaño et al. 2008; Eisel et al. 2014; Taylor et al. 1998).

As part of the experiment, we developed two hypothetical scenarios in which participants had to pick up a friend from a railway station 110 kilometers away. For the trip, participants were provided an EV
Volkswagen eGolf) with an estimated remaining range of 125 kilometers; the close total-distance-remaining range ratio was chosen to elicit a stressful range situation (Eisel et al. 2014; Franke et al. 2012). For the two scenarios, the treatment differed in terms of the information systems provided with the EV. While one EV was equipped with simple and straightforward IS for the mandatory drive, the other vehicle included advanced IS such as navigation support, various in-vehicle monitoring systems, and traveler information systems that calculate the remaining range based on driving style, road conditions, and traffic. Furthermore, to emphasize the differences between both systems, we distinguished their interface design; while the interface of the advanced IS was designed in a more innovative and fresh way, the other interface remained rather traditional (Stroemberg et al. 2008). The descriptions of both scenarios entailed rich explanations including pictures of the car’s cockpit and information provided by the IS. Each participant was to imagine the respective situation, with the goal of arousing a cognitive evaluation process (Zeimbekis 2011).

Measurement of Constructs

To assess the cognitive appraisal processes of the anticipated stress situations, we use the Primary Appraisal Secondary Appraisal (PASA) questionnaire (Gaab 2009; Gaab et al. 2005), which refers to the transactional stress model of Lazarus and Folkman (1984). The related questionnaire assesses the cognitive appraisal processes (primary and secondary appraisal) with two subscales. Primary appraisal is assessed with the scales threat and challenge, while secondary appraisal evaluated using the scales self-concept of own abilities and control expectancy. According to the transactional stress model, the threat scale measures the anticipated harm or loss that has not yet taken place but could. The challenge scale refers to critical demands that individuals perceive as conquerable. During the secondary appraisal process, an individual evaluates his or her coping resources; in this context, the self-concept of own abilities scale involves the individual’s expectation about his or her ability to handle a situation. The control expectancy scale refers to the individual’s general belief of being in control of a certain situation or event. The 16-item questionnaire uses a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The PASA questionnaire has been used in several studies and its applicability in the context of EV usage has been proven (e.g., Franke and Krems 2013; Hammerfald et al. 2006; Rauh et al. 2014; Storch et al. 2007).

Furthermore, attitude toward using the EV for the trip to the railway station was operationalized on a 7-point Likert scale, which was adopted and adjusted from the theory of planned behavior (Ajzen 1991). We controlled for affinity for technology as well as experience with EVs and in-vehicle IS because these factors might have an impact on attitude toward using the EV (Eisel et al. 2014; Franke et al. 2012a; Rauh et al. 2014). Affinity for technology is measured by five items on a 7-point Likert scale, which we adapted in our context from a previous study of Edison and Geissler (2003). Experience related to EVs and car-related IS are operationalized by one item each on a 7-point Likert scale. Respondents also had to answer to certain stimulation checks on a nominal scale (“yes” or “no”), such as “Were you provided with a navigation system within the case study?” or “Were you provided with an intelligent route planning systems within the case study?” Furthermore, to assess whether participants were able to empathize with the respective scenarios, we asked for responses on a 7-point Likert scale regarding whether they could imagine the respective scenario.

Data-Collection Procedure and Sampling

Data was collected between October 2014 and January 2015. Participants received the scenarios and related questionnaires in paper-based form via drop-off/pick-up methodology (Steele et al. 2001). In order to obtain a snowball sampling, we requested the initial participants to invite their friends and acquaintances to participate in the study (Biernacki and Waldorf 1981). Both scenarios were pre-tested by interviewing researchers in the area of IS and stress. The interviews led to minor changes in the wording and length of the scenarios and scales. The first part of the questionnaire included a detailed description of the respective scenario. Afterwards, participants were asked to respond to the related constructs. The questionnaire ended with the manipulation check and questions regarding the participant’s characteristics. After excluding data sets due to quality criteria such as missing data, implausibility of demographics, failed manipulation check (wrong assignment of in-vehicle IS to the respective scenario), and inability to empathize with the respective scenario (score lower than 3 on the empathize scale), we
ended up with 341 complete responses. The average respondent was at an age of 32.57 years. In the sample, 36.95% stated that their highest level of education completed was an A level, 35.19% had a college degree, and 3.81% received a Ph.D. Females made up 42.82% of the sample, while 53.67% of our sample stated that they already own a car.

**Data Analysis and Results**

To analyze the data, we used partial least squares structural equation modeling (PLS-SEM), as implemented in the software SmartPLS 2.0.M3 (Ringle et al. 2005). We decided to apply variance-based model estimation instead of covariance-based SEM for two reasons: (1) PLS requires fewer statistical specifications and constraints on the data (e.g., assumptions of normally distributed input data), and (2) PLS is especially useful for causal-predictive analysis (Ringle et al. 2012; Urbach and Ahlemann 2010). Furthermore, PLS provides a prediction-oriented method that enables the estimation of a model with multiple dependent variables and their relations at the same time, seeking to maximize variances that are explained in the constructs (Barclay et al. 1995; Gefen et al. 2011). We have included the between-subjects factor as a dichotomous variable with the categories “without IS” and “supportive IS.” In SmartPLS, the between-subjects factor was affecting both types of stress, namely technostress and range stress. As our research aim is to investigate the influence of in-vehicle IS on the respective subdimensions of stress, we used IBM SPSS Statistics 22 to analyze the differences between both groups. The widely adopted two-step approach for data analysis suggested by Anderson and Gerbing (1988) was followed in this study; we first evaluated the measurement model to ensure the reliability and validity of the instruments and then tested the structural model in the second step.

**Measurement Validation**

In the first step, we checked the survey data for the threat of common method bias as all measures were collected through the same questionnaire. We used Harman’s single factor test to check the presence of common method bias and ran an explorative factor analysis (Podsakoff et al. 2003). The results indicated that no single factor emerged from the factor analysis and that no general factor accounts for the majority of variance among the measures. Therefore, we argue that common method bias is not of great concern to our study.

Furthermore, as both stress and attitude are measured by reflective indicators, we examined content, convergent, and discriminant validities to assess the quality of the respective constructs (Hair et al. 2012; Haynes et al. 1995).

Content validity is defined by the extent to which a measure represents the target construct for the specific assessment purpose (Haynes et al. 1995). As discussed above, the items we used follow well-established theories and measures. We therefore argue that content validity is given.

Convergent validity (CV) refers to the degree to which multiple measures of the underlying construct are in agreement (Bagozzi and Phillips 1991). CV can be examined by calculating individual indicator reliability, composite construct reliability (CR), and average variance extracted (AVE), as suggested by Fornell and Larcker (1981). All items loaded on their respective constructs of .60 or higher, which implies an acceptable limit of indicator reliability (Chin 1998). Furthermore, the CR varies above the acceptable limit of .70 (Hulland 1999) and all AVEs also exceed the suggested limit of .50 (Bhattacherjee and Premkumar 2004).

Discriminant validity is defined by the degree to which measures of a given construct differ from measures of other constructs in the same model (Bagozzi and Phillips 1991). Each item loaded on its related construct higher than on other model constructs, indicating that the items represent their assigned construct better than any other construct in the model (Chin 1998). Moreover, we computed the square root of the AVEs. As these square root values are greater than the corresponding construct correlations, we can assume that discriminant validity is given (Fornell and Larcker 1981). The results are summarized in Table 1.
On the Duality of Stress in IS Research

Table 1. Factor loadings, CR, AVE, and Inter-Construct Correlations

Hypotheses Testing

To evaluate hypotheses H1 to H4, we decided to check for group differences. Before selecting an appropriate method for assessing the differences between both groups, we first tested the data for non-normality and homoscedasticity. The test for non-normality shows highly significant results for all variables (Kolmogorov-Smirnov test: $p < .01$; Shapiro-Wilk W-test: $p < .01$), thus indicating non-normally distributed data. Furthermore, the Leven test for assessing the homogeneity of variance among groups shows significant results for the constructs attitude ($F = 9.569; p = .002$), range-threat ($F = 89.839; p = .000$), range-self-concept ($F = 5.056; p = .025$), and techno-threat ($F = 6.619; p = .011$), thus indicating heteroscedasticity.

Since our data is non-normally distributed and heteroscedastic, we decided to apply the non-parametric Mann–Whitney U test to analyze whether both groups came from the same population (Nachar 2008). Moreover, to report a measure of strength, we calculated the approximate effect size by dividing the z-score by the square root of the sample size (Field et al. 2013). Effect sizes between .10 and .30 are regarded as small to medium, while those between .30 and .50 are considered medium to large (Cohen 1992). The results of the Mann–Whitney U test are presented in Table 2.

Table 2. Results of the Mann-Whitney U-test
The results demonstrate a significant negative effect of supportive IS on perceived range-threat (Mdn. = 1.255; $p < .001$, $r = .421$) and range-challenge (Mdn. = 1.311; $p < .001$, $r = .456$). Furthermore, the results reveal a positive effect of supportive IS toward the range-related self-concept (Mdn. = -0.717; $p < .001$, $r = .279$) and locus of control (Mdn. = -1.863; $p < .001$, $r = .431$). Regarding the IS-related stress perception, the results imply a significant positive effect of supportive IS on challenge (Mdn. = -1.146; $p < .001$, $r = .417$) and a significant negative effect of supportive IS on self-concept (Mdn. = 0.367; $p < .05$, $r = .144$) and locus of control (Mdn. = 0.422; $p < .05$, $r = .175$). However, we could not find any significant effect of supportive IS on techno-threat (Mdn. = -0.008; $p > .05$, $r = 0.030$).

Furthermore, to assess hypotheses H5 and H6, we examined the influence of technostress and range stress on attitude toward using an EV for a certain route. Because we measured the respective stress constructs with four subdimensions, we operationalized stress as a reflective-reflective second-order construct. On this account, primary appraisal (challenge and threat) and secondary appraisal (locus of control and self-concept) are conceptualized as lower-order constructs of stress. We used the indicator-reuse approach because all lower-order constructs have the same number of indicators (Lohmoeller 1989; Ringle et al. 2012).

The bootstrapping re-sampling procedure (Chin 1998) was used to evaluate the structural path of the model. We examined the significance of the regression parameter estimates using bootstrapping with a sample of $n = 5000$ (Hair et al. 2011). Applying a two-tailed t-test, the critical values are 1.65 (10% significance level); 1.96 (5% significance level); and 2.58 (1% significance level). Figure 2 presents the results of the structural model estimations. PLS regression analysis revealed a significant negative effect of both range stress (b = -0.577; $p < .01$) and stress resulting from interaction with IS (b = -0.086; $p < .10$) on attitude toward driving an EV. Furthermore, the results indicate that experience with EVs (b = 0.162; $p < .01$) and affinity for technology (b = 0.137; $p < .05$) both have a significant positive effect on attitude. However, experience with car-related IS (b = -0.129, $p < .05$) seems to have a significant negative effect on the attitude toward using an EV for a certain route. Overall, the model can explain 40.1% of the variance in attitude, indicating an above-average explained variance (Chin 1998).
Discussion and Implications

Our study addresses an important gap in technostress research. While existing literature picks up the interdependency between IS and stress and its effect on behavior from a single perspective – either from an adverse or (more recently) a beneficial point of view – we suggest that there is a research gap on the duality in the effect of IS on stress and thereby on behavioral outcomes. Therefore, we proposed and tested a research model that integrates both perspectives simultaneously using the example of EVs. Our results provide interesting findings for both research and practice.

We could find differing varieties of the tested factors between the groups with and without supportive in-vehicle IS. First, our results indicate that through the provision of supportive IS such as warning and redirection systems, intelligent navigation, and range-related information in terms of location of charging stations or traffic situation, individuals perceive less range stress. A closer look at the subdimensions of the stress process indicates that individuals perceive the critical remaining range-distance ratio to be less threatening (mean value decreased from 3.993 to 1.354) and less challenging (mean value decreased from 4.653 to 3.342). Furthermore, the provision of supportive in-vehicle IS had a significant positive effect on the secondary appraisal process subscales of range-self-concept (mean value increased from 3.578 to 4.255) and range-locus of control (mean value increased from 3.062 to 4.295). Our results clearly show that participants were able to better assess the critical remaining range-distance situation through the provision of range-related information, thus giving them confidence in their smooth arrival at the railway station. This difference can be explained by the degree of information available, which determines the perception of uncertainty about a situation and thus influences the appraisal process of stress (Krohne 1997; Monat et al. 1972). Without sufficient information about the trip – particularly range-related matters – individuals are unable to predict the probability of the outcomes of certain events (Garner 1962; Lawrence and Lorsch 1967). In this context, Millikan (1987) differentiates between two important types of uncertainty that can be applied in our research context. One type refers to the uncertainty that is created through the environment. When driving with an EV, this could be an unexpected traffic jam or a detour that leads to a higher energy consumption of the vehicle and hence an intensification of the critical range/distance ratio. However, supportive IS can counter this effect by contributing to better predicting such environmental changes. Furthermore, Millikan (1987) points out that uncertainty is also related to the ability to predict the consequences of an environmental change for the individual. Transferring this to the context of EV use, supportive IS contribute to a better prediction of, for example, the effect of a detour or changing road conditions on the remaining range. In summary, supportive in-vehicle IS are useful for reducing uncertainty regarding the remaining range-distance ratio and thereby reducing concern about not reaching a planned destination due to a depleted battery.

In contrast to the positive effect of IS on perceived range stress, we found strong evidence that interaction with supportive in-vehicle IS also leads to perception of stress that we refer to as technostress. Our results clearly show a significant negative effect of supportive in-vehicle IS on the techno-challenge scale (mean value increased from 2.798 to 3.944). Furthermore, we could observe a negative effect of supportive in-vehicle IS on techno-self-concept (mean value decreased from 4.450 to 4.083) and techno-locus of control (mean value decreased from 4.439 to 4.017). However, we could not find a significant effect of supportive IS on the techno-threat scale. In both scenarios, participants rated very low on the threat scale (mean value increased negligible from 2.483 to 2.491). We expect that participants did not perceive a real threat or danger resulting from interaction with both types of in-vehicle IS.

Although our results do not indicate a high relevance of the threat scale, participants perceived interaction with the supportive in-vehicle IS to be more stressful than with the simple IS. In this context, Ragu-Nathan et al. (2008) identify multiple factors created by information and communication technologies that may trigger the stress process. One major factor is that IS leads users to feel dependent on technology as the trend of always being connected with technology increases. In our context, individuals may perceive that they are too dependent on the information provided for reaching the planned destination and thereby not free in their own decision-making processes. Another stress factor is characterized by the increasing complexity of technical capabilities and terminology associated with IS, forcing individuals to spend more time and effort understanding certain aspects of the technology. In our scenario with supportive in-vehicle IS, participants were confronted with terminology that is to some extent currently available in EVs but not usual in conventional vehicles. This may be evaluated by participants as complex, requiring effort.
to understand how to interpret the information provided and to grasp all functionalities of the IS. Moreover, Ragu-Nathan (2008) note that information and communication systems use information from a variety of sources, such as the Internet, subjecting individuals to a flood of information that they are unable to handle efficiently. Translating this assumption to our context, participants were exposed to plenty of information, such as state of charge, distance remaining to the final destination and to the next charging station, estimated loss of range due to certain electricity consumers, battery health, or the ecometer, which enables conclusions to be drawn about the driving style.

Furthermore, our findings reflect that both range stress ($b = -0.577$) and technostress ($b = -0.086$) negatively influence the attitude toward using an EV for a certain route. Participants seem to be reluctant to use an EV for a certain route when they perceive a high level of stress. This can be explained by the affective component of the attitude construct, which represents an individual’s feelings and emotions toward a specific behavior (Ajzen and Fishbein 2005). Because stress is inextricably linked to emotions (Lazarus 1993a), a higher perception of stress leads to an increased association with negative emotions and thus negatively influences the attitude toward using an EV.

Moreover, we could demonstrate that experience with EVs ($b = 0.162$) and an affinity for technology ($b = 0.137$) both have a significant positive effect on attitude toward using an EV. This result is supported by Rauh et al.’s (2014) study showing that with increasing EV experience, the level of perceived range stress decreases, which – as our results show – influences the attitude construct. However, the significant negative relationship between experience with car-related IS and attitude toward using an EV is surprising, as we expected that a higher degree of experience would support the processing confidence and lead to a better estimation of the functionality and value of in-vehicle IS. A possible explanation could be that the participants had previously undergone a negative experience with in-vehicle IS and then transferred this negative experience to their attitude toward using the EV. Since this aspect was not the focus of our research, we suggest that this relationship be investigated in detail in further studies.

Focusing on the duality in the effect of IS on stress, another intriguing finding of our study was that participants perceived the value of IS (reduced range stress) to be higher than the adverse effect (stress caused by the in-vehicle IS). Taking the attitude construct as an equal measure for the effect of technostress and range stress, the results indicate a significant higher attitude toward using an EV for a certain route ($p < .01$) in the vehicle with supportive IS (mean value = 4.522) than in vehicles without supportive IS (mean value = 3.225). We summarize our findings in Table 3.

<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis</th>
<th>Support?</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a</td>
<td>Decreased range-threat appraisal through supportive in-vehicle IS</td>
<td>Yes</td>
</tr>
<tr>
<td>H1b</td>
<td>Decreased range-challenge appraisal through supportive in-vehicle IS</td>
<td>Yes</td>
</tr>
<tr>
<td>H2a</td>
<td>Increased range-self-concept appraisal through supportive in-vehicle IS</td>
<td>Yes</td>
</tr>
<tr>
<td>H2b</td>
<td>Increased range-locus of control appraisal through supportive in-vehicle IS</td>
<td>Yes</td>
</tr>
<tr>
<td>H3a</td>
<td>Increased techno-threat appraisal through supportive in-vehicle IS</td>
<td>Yes</td>
</tr>
<tr>
<td>H3b</td>
<td>Increased techno-challenge appraisal through supportive in-vehicle IS</td>
<td>No</td>
</tr>
<tr>
<td>H4a</td>
<td>Decreased techno-self-concept appraisal through supportive in-vehicle IS</td>
<td>Yes</td>
</tr>
<tr>
<td>H4b</td>
<td>Decreased techno-locus of control appraisal through supportive in-vehicle IS</td>
<td>Yes</td>
</tr>
<tr>
<td>H5</td>
<td>Negative association of range stress and attitude toward using an EV</td>
<td>Yes</td>
</tr>
<tr>
<td>H6</td>
<td>Negative association of technostress and attitude toward using an EV</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Table 3. Summary of Hypotheses**

In summary, regarding Research Question 1 (RQ1), our results clearly illustrate that there is a duality in the effect of IS on stress. On the one hand, IS are useful for overcoming stressful situations (in our case, the concern of becoming stranded due to a depleted battery), However, at the same time, the use of IS (here, the interaction with supportive in-vehicle IS) leads to stress perception. Regarding Research Question 2 (RQ2), we could observe that stress (range stress and technostress) negatively influences the
attitude toward using an EV for a certain route. Overall, our model was able to successfully account for a considerable variance in attitude toward using an EV for a certain route.

Although our paper has a theoretical focus, there are also important implications for practitioners, as our research model demonstrates that the provision of relevant information in an appropriate way may decrease the perceived level of range stress and thereby contribute to a higher dissemination of EVs. Furthermore, for a successful in-vehicle IS design, practitioners should keep in mind that the interaction with advanced automobile IS can lead to perceived stress and thus influence the attitude toward using an EV. In this context, various factors may cause stress, such as dependence on technology, IS complexity, or information overload. The variety of functionalities provided by in-vehicle IS could also be harmful to driving safety because they constitute additional attention demands on the driver and can thus lead to distraction from traffic (Cao et al. 2010). In this context, Neale et al. (2005) find in a one-year, large-scale study that over 78 percent of traffic crashes and over 65 percent of near-crashes were caused by secondary task engagements such as interacting with in-vehicle IS. Therefore, the extent of functionalities and the design of in-vehicle IS for EVs should on the one hand aim to maximize the benefit for the driver (e.g., provide relevant information in a timely and appropriate way to reduce sources of driver stress such as concerns related to the short range) and on the other hand minimize stress and distraction that result from interacting with in-vehicle IS. Finally, the negative effect of stress on attitude should also be of high relevance for practitioners because the intention to perform a specific behavior is considered to be influenced by the attitude toward behavior, thus determining actual behavior (Ajzen 1991; Ajzen and Madden 1986).

Limitations and Future Research

The following limitations should be considered when interpreting the results. Generally, participant’s ages, knowledge about EVs or in-vehicle IS, and level of education are likely to bias the sample. Considering this, most of the participants were young people (mean age: 32.57 years) with higher educational qualifications. An extension and variation of our sample size could increase the predictive power of our model. Furthermore, our questionnaire was based on a specific scenario in the field of electric mobility. Using a different scenario to evaluate the proposed model might also lead to different results. Moreover, our results are based on self-report questionnaires that may not be free of certain response distortions (Razavi 2001). Further studies should include additional assessment methods beyond psychometric measures, such as physiological stress responses with the assessment of cortisol in saliva (Kirschbaum and Hellhammer 1994). In addition, future research should validate the proposed research model by conducting a field experiment. Since our sample consists entirely of participants from one specific European country, a useful extension of this study would be the investigation of the effect of different cultural backgrounds. Finally, future research could focus on the way in which IS should be presented in EVs and which kinds of IS have an impact on different dimensions of driver stress. In this context, the investigation of explicit creators and inhibitors of stress that are associated with in-vehicle IS is of great interest. Apart from electric mobility, the research model could also be applied in further fields of application, such as clinical decision-support systems. The implementation of these systems may contribute to ease the decision-making process of physicians under stress but also may lead to increased stress perception (Chang et al. 2007; Garg et al. 2005; Hakkinen et al. 2003).

Conclusion

The objective of this paper was to achieve a broader understanding of the role of stress in IS research. For this reason, we connected the research stream of technostress with that of IS-induced stress reduction. We suggest that there is a duality in the effect of IS on stress perceptions: IS can contribute to reducing perceived stress in certain situations but can also lead at the same time to stress reactions. We developed and validated a comprehensive research model that integrates both perspectives. To do so, we related the prominent transactional stress model of Lazarus and Folkman (1984) to the well-established attitude construct, which in turn predicts behavioral intention and thus behavior. Through our example of advanced IS use when driving electric vehicles in a stressful range scenario, we revealed that appropriate in-vehicle IS contribute to reducing range stress while at the same time eliciting stress in drivers of EVs. Thus, we provide a foundation for further research in the field of stress, IS, and behavior.
References


Thirty Sixth International Conference on Information Systems, Fort Worth 2015 17


On the Duality of Stress in IS Research


