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**An Investigation of Young Consumers' Perceptions
towards the Adoption of Electric Cars**

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Abstract

Battery-powered electric cars have an important role in terms of future mobility. The purpose of this study is therefore, to investigate the factors that influence young consumers' acceptance of electric cars. The theoretical framework of the study was guided by the Technology Acceptance Model (TAM). The research examined the relationships between perceived usefulness, trust, value, risk and intentions to use electric cars by young consumers in South Africa. The study is quantitative in nature, 380 completed survey questionnaires were collected and analysed. The participants included young consumers who reside in Johannesburg and Gauteng in South Africa. Data was analysed through Structural Equation Modelling (SEM) using AMOS 23 and SPSS 23 statistical software. The findings of the study showed that the intentions to use electric cars were influenced by perceived usefulness, risk and value. Furthermore, it was noted that perceived trust had no statistically significant influence on the intentions to use electric cars. The study contributes to understanding the factors which influence the intentions to use electric cars by young consumers who represent a potential future market for electric car manufacturers. In this vein, technology orientated manufacturers of electric cars, marketers and policy makers can gain valuable insight from the study.

Keywords: *Perceived Usefulness, Perceived Trust, Perceived Value, Perceived Risk, Intention to Use, South Africa*

Introduction

Climate change is the greatest global threat of our time and possibly the greatest challenge ever for the human species. In recent times, the global average temperature has risen by 0.8 degrees from pre-industrial revolution (International Energy Agency, 2015). The biggest contributor of carbon emissions in the world is fuel combustion transportation (Onat, Kucukvar & Tatari, 2014). Climate change and the need to eradicate fossil fuel emissions are the chief reasons leading to hydrogen technology (Nikolaidis & Poullikkas, 2017). When companies enter a new market, the manner in which the customers will respond to the brand is uncertain and totally different from a well-known brand, especially in response to climate change (Kotler & Keller, 2009). Over the past few decades, studies have increasingly investigated on different facets of technology which are able to reduce carbon emissions from vehicles (Osswald, Wurhofer, Trösterer, Beck & Tscheligi, 2012). From research,

It has been noted that the most expedient way for the enhancement of fuel efficiency and lessening of emissions is to develop 'hybrid' electric vehicles (Gallagher & Muchlegger, 2011; Osswald et al., 2012). However, these vehicles (hybrid electric) may not be conducive to the environment. It has been discovered that most of these vehicles are furnished with diesel engine components which further perpetuate 'carbon dioxide' and result in 'air pollution'. Electric vehicles are a sound alternative to carbon dioxide and air pollution (energy provided by a battery). Furthermore, there is zero-emission potential when the electricity driving the car is produced by a renewable energy source (Gerssen-Gondelach & Faaij, 2012).

Onat, Kucukvar and Tatari (2014) argue that charging electric vehicles through solar power stations could lessen the greenhouse gas (GHG) emissions caused by these vehicles by up to 34%. While the existence of full electric vehicles has been in the motor industry since the early 1900s, these vehicles were not very popular across the globe (Williamson, Emadi, & Rajashekara, 2007). Due to environmental concerns as well as climate change in the 21st century, the motor industry has been increasingly focusing on electric vehicles (Gerssen-Gondelach & Faaij, 2012). Many car manufacturers have embarked on mass-production of full electric vehicles for this emerging market. With the growing demand and urgency for electric cars, there is a need to examine the factors that influence the consumer acceptance of these vehicles (Egbue & Long, 2012; Williamson, Emadi, & Rajashekara, 2007). This research therefore looks into young consumers' perceptions towards adoption of electric cars. These consumers could also be considered to fall into the Generation Y category of people. Generation Y are individuals born between 1977 and 1994) who hold views that differ sharply from those representing other generations (Kim, Knight & Crutsinger, 2009; Weiss, 2003). Individuals categorised as Generation Y are very active in the marketplace (Maziriri & Madinga, 2015). This then makes investigating the Generation Y customers interesting from a consumer's perspective

Schuitema, Anable, Skippon and Kinnear (2013) suggest that electric cars are not a new invention and were not necessary a "must-have" as oil prices were low in the past. This then suggests that due to oil price rises and climate-change, having electric cars is now a necessity. To this end, the statement of the problem is identified prompting the present research. It is therefore important to understand which attributes of this

innovative type of vehicle are most likely to influence peoples' perceptions (Schuitema et al., 2013). Worldwide climate-change has led to the need for electrification of products such as electric vehicles and the uptake of these vehicles will depend on how consumers perceive them (Schuitema et al., 2013). The objective of this research is thus to empirically investigate perceptions of young consumers towards the adoption of electric cars. The electric car market is increasingly becoming the next mega market in the automobile industry across the world (Onat, Kucukvar & Tatari, 2014) and South Africa is no exception. Most emerging markets are gradually venturing into the world of electric cars, and this development poses a positive development for manufacturers of electric cars. Furthermore, most emerging markets are characterised by high populations of youth, with the greatest proportion of the South African population (66%) comprising of youth between the ages of 18 years and 35 years (Stats SA, 2016). Organisations that are able to predict future trends and technologies are able to be market leaders in their respective industries (Kotler & Keller, 2009). In this vein, understanding the intentions to accept electric cars among young consumers in South Africa will enable vehicle manufacturers to ascertain the needs of this future potential

Green marketing involves the marketing of goods or services that are acknowledged as friendly to the environment (Chen & Cheng, 2012). On the other hand, green marketing is viewed as “marketing practices, policies, and procedures that explicitly account for concerns about the natural environment in pursuing the goal of creating revenue and providing outcomes that satisfy organisational and individual objectives for a product or line” (Kotler & Keller, 2009). As such, green marketing integrates some wide-ranging activities, including product adjustment, deviations to the manufacturing processes, sustainable packaging, as well as changes in marketing. Green marketing is catapulted by the idea of consumer environmentalism which has gained popularity globally, thereby compelling more consumers to take heed of eco-friendly purchasing practices (Chen & Chang, 2012; Kotler & Keller, 2009). This has resulted in consumers' willingness to acquire more green products that are user friendly to the wellbeing of the atmosphere. The popularity of 'going-green' and the emergence of well monitored or environmental regulations have led most companies to rethink their business models to incorporate green market opportunities (Chen & Chang, 2012). In order for organisations to incorporate green marketing practices in their

initiatives, there is a need for them to articulate sound green marketing strategies.

Green marketing plans are therefore imperative to the implementation of the green marketing strategy. Further to the green marketing plans, marketers need to develop green marketing programmes to ensure successful implementation of green marketing strategies. Thus, green marketing programmes can be conceptualised as programmes designed to execute organisational goals that are strategic and aimed at minimising any negative (or enhancing positive) potential impacts on the natural environment (Kotler & Keller, 2009). With the rise in global warming, coupled by high levels of toxic emissions from motor vehicles, the automobile industry is under pressure to radically transform and combat the high emission rates entering the atmosphere (Collins & Chambers, 2005; Long & Egbue, 2012). The automobile industry has introduced electric cars that have enhanced technology to mitigate any damage to the environment. Some of the technologies in electric cars enable the cars to detect any potential risks to the environment and mitigate them thereafter (Lin & Huang, 2012; Musti & Kockelman, 2011).). Due to the concerns stemming from climate change the motor industry continues to be innovative and adaptive. Hence, different types of electric cars have been produced, which include, battery powered electric vehicles and plug-in hybrid vehicles (Lin & Huang, 2012).

Plug-in-Electric-Vehicles (PHEV) are plugged into electricity power points to recharge the vehicles. The power points can be accessed in the comfort of a user's residence. Hence, PHEVs have an advantage of being less dependent on formal localised recharging infrastructure. On the other hand, battery powered electric cars are predominantly powered by full batteries that need to be regularly recharged with electricity. Lin and Huang (2012) describes electric cars to have a significant presence of cyber and intelligent components, this includes: intelligent driver assistance, vehicle to vehicle communication, automated driving (e.g. autopilot driving for Tesla Motors). In most countries in the west, including United States of America, the demand and purchase of electric cars is increasing. However, less is known about the demand and behaviour towards electric cars in developing countries including South Africa. The next section will provide a discussion of the TAM adopted in the present study.

Technology Acceptance Model (TAM)

The TAM theory was developed by Davis (1986) as an extension to Theory of Reasoned Action to predict individual adoption and use of new information technologies. This theory explains and predicts the acceptance of information systems and technologies (Osswald et al., 2012). In explaining the TAM theory, Davis (1986) posits that individuals' behavioural intention to use an information technology is determined by two beliefs: (1) perceived usefulness and (2) perceived ease of use. Perceived usefulness is defined as the extent to which a person believes that using an information technology will enhance his or her performance. Previous studies have shown that perceived usefulness has a direct influence on the attitudes towards actual usage of technology (Chen & Chang, 2012; Davis, Bagozzi, & Warshaw (1989). On the other hand, perceived ease of use is defined as the degree to which a person believes that using an information technology will be free of effort (Osswald et al., 2012). Furthermore, TAM hypothesises that the effort of external variables on behavioural intention will be mediated by perceived usefulness (Davis, 1986) and perceived ease of use (Osswald et al., 2012). Drawing from TAM, perceived trust (Chen & Chang, 2012), value (Ponte, Carvajal-Trujillo & Escobar-Rodríguez, 2015) and risk (Bauer, 1960; Littlejohn & Foss, 2010; Mwencha, Muathe, & Thuo, 2014) are noted as constructs that influence the behavioural intentions to accept technology.

Discussion of the Research Constructs

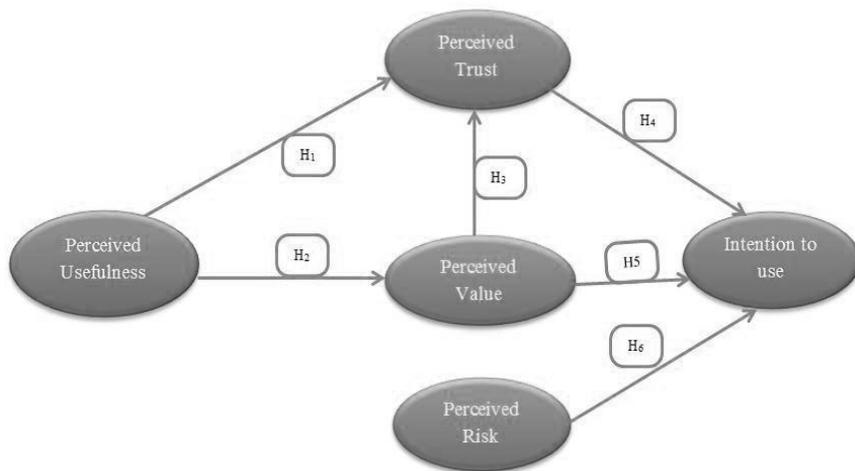
Trust is viewed as positively and directly influencing perceived usefulness (Alalwan, Baabdullah, Rana, Tamilmani, & Dwivedi, 2018). In addition, Alalwan et al. (2018) postulated that perceived usefulness not only impacts behavioural intention, but also mediates the relationship between trust and behavioural intention. Perceived usefulness has a relationship with behavioural intention (López-Nicolás, Molina-Castillo & Bouwman, 2008) while consumers' trust levels are associated with perception of risk and intention to adopt (Munoz-Leiva, Climent-Climent & Liébana-Cabanillas, 2017). To this end, it could be posited that young consumers' perception of trust influences their perceptions of risk associated with products and this has an impact on whether or not they intend to use the product? Agag and El-Masry (2016) argue that trust with products

mediates the relationship between perceived usefulness and attitudes that consumers have towards products. This then insinuates that young consumers' intention to purchase electric cars could be driven by their attitudes. It was suggested by Shaw and Sergueeva (2019) that intention to use a product is a result of the consumers' perception of value. Lastly, it can be assumed that young peoples' perception of value would lead them to actually using a product. The hypothesised model is presented in the following section.

Proposed Conceptual Model

For the purposes of the present study, to investigate the factors which influence young consumer's acceptance of electric cars in South Africa, a conceptual model was developed drawing from TAM (Davis, 1986).

Proposed Conceptual Model



Source: an adaption of TAM by Davis (1986)

Hypothesis Development

Perceived Usefulness

Perceived usefulness is the “extent to which an individual views the technology developed as superior than the existing one” (Chen & Chang, 2012). Perceived usefulness of a product directly influenced by the level of trust that consumers have towards it (Alalwan, et al. 2018). Previous studies (Chen & Chang, 2012; Ponte, Carvajal-Trujillo & Escobar-Rodríguez, 2015) have shown that perceived usefulness has a direct influence on the attitudes, value and trust towards actual usage of technology (Chen & Chang, 2012; Davis et al. 1989). Perceived ease of use of automated vehicles, vehicles that self-drive without human control influences the perception of being useful (Zhang, Tao, Qu, Zhang, Lin & Zhang, 2019). These vehicles could be viewed in the same light as the ones in this study (electric cars) as they are both not traditional vehicles. Thus it was deemed appropriate to make reference to the automated vehicles. It is believed that any work done can be noted as valuable and efficient if the technology being used is perceived as useful by that particular user (Chen & Chang, 2012). Therefore, drawing from the above-mentioned empirical evidence the following two hypotheses were proposed:

H1: Perceived usefulness has a positive influence on perceived trust

H2: Perceived usefulness has a positive influence on perceived value

Perceived Value

Perceived value is defined as the customer’s evaluation of beliefs verses the costs of making a particular purchase (Ponte, Carvajal-Trujillo & Escobar-Rodríguez, 2015). It is believed that perceived usefulness of a product influences the consumer’s behavioural intention to use it (Alalwan et al. 2018). Chew, Shingi and Ahmad (2006) suggest that perceived customer value is an important factor of the ‘acquisition transaction’ behaviour. Furthermore, perceived value is noted as shaping perceptions of trust in the product. This includes repeat usage of the product or service. Perceived value is noted as a determinant for intentions to purchase and use a product (Cretu, & Brodie, 2007). Perceived risk of green products (products considered as favourable to

the environment) and perceived value of green products both influence trust which in turn leads to purchase intention Chen and Chang (2012). In the context of the present research electric cars are considered to be green products as they are less harmful to the environment in comparison to conventional cars. From the aforementioned assertions, the following two hypotheses are proposed:

H3: Perceived value has a positive influence on perceived trust.

H5: Perceived value has a positive influence on intention to use.

Perceived Trust

Trust is defined as an emotional state that involves understanding and sentimental assurance (Chang & Chen, 2008; Johnson and Grayson, 2005). Trust in purchasing and using automated vehicles (self-driving vehicles) influences three factors, namely; perceived usefulness, perceived ease of use and perceived risk (Zhang, Tao, Qu, Zhang, Lin & Zhang, 2019). In addition, perceived risk of these advanced vehicles is neither linked to perceived usefulness or perceived ease of use even though all three lead to behaviour intentions towards the cars Zhang et al. (2019). Empirical work indicates that intentions to purchase a product are influenced by the confidence in the buyer of the ability of the product to perform its function (Chen & Chang, 2012; Gefen, Karahanna & Straub 2003; Corritore, Kracher, & Wiedenbeck, 2003). It was suggested by Benleulmi and Blecker (2017) that trusting fully automated cars directly led to consumers' behavioural intention to use them and this ultimately led to consumers' intention to prefer automated cars over conventional vehicles. From the aforementioned assertions, the following hypothesis is proposed:

H4: Perceived trust has a positive influence on purchase intentions.

Perceived Risk

Perceived risk involves uncertainty in the purchase transaction in delivering the desired outcome (Littlejohn & Foss, 2010; Mwencha, Muathe & Thuo, 2014). Zhang et al., (2019) postulated that perceived risk associated with having automated vehicles directly influences behavioural intention towards the vehicles, however, the relationship

represents insignificant paths at the $p < 0.05$ level. This implies that the perception of risk actually pulls-away potential customers from purchasing unconventional vehicles such as electric cars. From various empirical work it has been noted that high levels of perceived risk dissuade the purchase and usage of products or services (Kim, Ferrin, & Rao 2008; Mwencha, Muathe, & Thuo, 2014). Drawing from the aforementioned assertions and empirical evidence, the following hypothesis is proposed:

H6: Perceived risk has a negative influence on purchase intentions.

Methodology

The study followed a cross-sectional quantitative research design. Data was collected through survey questionnaires that were obtained from a sample of 380 research participants. The research participants included young consumers who resided in Johannesburg and Gauteng South Africa who were 18 to 25 years of age. Data was collected through a self-administered questionnaire. The survey questionnaire used in the present study was adapted from instruments from previous empirical research (Chen, Lam, Yeung, 2006; Kanchanapibul, Lacka, Wang & Chan, 2014; Verkasalo, López-Nicolás, Molina-Castillo & Bouwman, 2010). Data analysis was performed through SPSS 23 and AMOS 23 statistical software. To ascertain causal relationships of constructs, Structural Equation Modelling (SEM) was performed. The results of the study are presented in the section that follows.

Results

This section will commence by presenting the demographic profile (gender, age, of the research participants. Thereafter, the results of the statistical analysis performed in the study will be presented.

Table 1: Gender

Gender	Frequency	Percentage
Male	177	46.6 %
Female	200	52.6 %
Prefer not to say	3	0.8 %
Total	380	100 %

From Table 1 above it can be noted that the majority of the research participants were females (52.6%). Few participants preferred not to disclose their gender (0.8%)

Table 2: Age

Age	Frequency	Percentage
18-19	127	33.4 %
20-25	253	66.6 %
>25	0	0%
Total	380	100 %

It can be noted that the majority of the research participants were in the age group 20-25 years (66.6%). None of the research participants were older than 25 years (0%).

Table 3: Educational Background

Educational Background	Frequency	Percentage
High School	226	59.5 %
Diploma	54	14.2 %
Degree	70	18.4 %
Post Graduate Qualification	13	3.4 %
Other Qualification	17	4.5 %
Total	380	100 %

As indicated in Table 3, the majority of the research participants had attended high school (59.5%). Some of the participants were in possession of a degree (18.4%) and the smallest proportion of participants was in possession of a postgraduate qualification (3.4%).

Table 4: Occupation

Occupation	Frequency	Percentage
Student	243	63.9 %
Employed	56	14.7 %
Self-employed	54	14.2 %
Unemployed	27	7.1 %
Total	380	100 %

From Table 4, it can be noted that the majority of the research participants were students (63.9%). On the other hand, 14.7% of the participants were employed. The lowest proportion of participants was unemployed (7.1%).

Reliability and Validity

To assess the reliability of the research instrument adopted in the present study, Cronbach Alpha coefficients were computed. A cut-off of 0.7 is the recommended score to deem a scale reliable (Pallant, 2007). From Table 5, below it can be noted that the overall Cronbach Alpha coefficient score for the instrument was 0.896 which exceeds the recommended threshold.

Table 5: Reliability tests

Variable	Cronbach's Alpha	N of Items
Perceived usefulness	0.855	3
Perceived risk	0.916	5
Perceived trust	0.949	3
Perceived value	0.885	4
Purchase intention	0.877	5
Total	0.896	20

The Inter-construct correlation matrix presented in table 6 was used to check for discriminant validity. It can be noted that all paired latent variables are below 1, implying that discriminant reliability exists between the constructs.

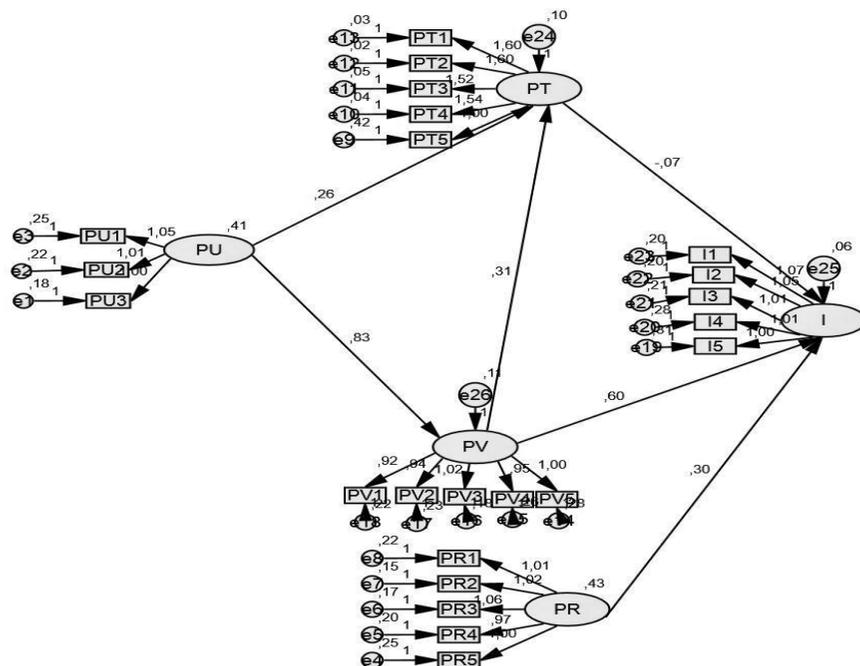
Table 6: The Inter-Construct Correlation Matrix

	PU	PR	PT	PV	I
Perceive Usefulness - PU	1				
Perceived Risk - PR	0.734**	1			
Perceived Trust - PT	0.677**	0.889**	1		
Perceived Value - PV	0.718**	0.714**	0.734**	1	
Intention to Use - I	0.718**	0.734**	0.709**	0.757**	1

***.* Correlation is significant at the 0.01 level (2-tailed)

Figure 1: Structural equation model

Key; PU: Perceived Usefulness, PT: Perceived Trust, PV: Perceived Value, I: Intention to use



Model fit results are presented in table 7 below followed by a discussion.

Table 7: Model fit results

(χ^2 /DF)	GFI	NFI	RFI	IFI	TLI	CFI	RMSEA
2.375	0.905	0.949	0.936	0.970	0.962	0.969	0.06

(χ^2 /DF): Chi-square; GFI: Goodness of fit index; NFI: Normed Fit index; RFI: Relative Fit Index; IFI: Incremental Fit Index; TLI: Tucker Lewis Index; CFI: Comparative Fit Index. RMSEA: Root Measure Standard Error Approximation

The proposed conceptual model was tested through Structural Equation Modelling (SEM). The results from SEM performed in the study indicated that the ratio of chi-square over degree-of-freedom was 2.375, which was within the acceptable model fit of values between 1 and 3. From Table 7 above, Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI) Tucker Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA) values were

0.905, 0.949, 0.936, 0.970, 0.962, 0.969 and 0.06, respectively. The model fits measures exceeded the recommended and acceptable threshold of more than 0.8 for GFI, CFI, TLI and for RMSEA the model fit was lower than the acceptable threshold of 0.08 (Gatignon, 2010; Hair et al., 2010; Hooper et al., 2008). These results indicated that the model fit was acceptable.

Path Modelling and Hypothesis Testing

Table 7 below presents the results of the hypothesis testing, followed by a discussion of the hypothesis.

Table 7: Results of Structural Equation Model Analysis

Hypothesised Relationship	Hypothesis	Path Coefficient	P-Value	Results
PU → PT	H1	0,262	***	Supported and significant
PU → PV	H2	0,826	***	Supported and significant
PV → PT	H3	0,312	***	Supported and significant
PT → I	H4	0,069	0,249	Supported but not significant
PV → I	H5	0,605	***	Supported and significant
PR → I	H6	0,298	***	Not supported but significant

*Significance level $p < 0.01$ ****

Key; PU: Perceived Usefulness, PT: Perceived Trust, PV: Perceived Value, I: Intention to use

Discussion of Hypothesis Results

From the results, it can be noted that four of the hypotheses (H1, H2, H3, H5) were supported. The first hypothesis (H1) of the study was supported by the findings ($p < 0.01$), implying that perceived usefulness of electric cars by young consumers has a statistically significant positive influence on perceived trust of electric cars. This finding is in line with the findings by Chen and Chang (2012) who found that perceived usefulness impacted perceived trust of new technology. The second hypothesis (H2) of the study was supported by the findings ($p < 0.01$),

implying that perceived usefulness of electric cars by young consumers has a statistically significant positive influence on perceived value of electric cars. This finding is in line with the assertions by Cretu, & Brodie (2007) who purports that perceiving new technology as useful will positively impact on the perceived value of the technology. Similarly, the third hypothesis (H3) of the study was supported ($p < 0.01$), implying that perceived value of electric cars by young consumers has a statistically significant positive influence on the perceived trust of electric cars. This finding is in line with assertions by several scholars (Cretu, & Brodie, 2007; Chew, Shingi & Ahmad, 2006) that perceived value of new technology shapes the perceptions towards that technology. The fourth hypothesis (H4) was supported by the findings, but it was not significant ($p > 0.01$). It can be noted that perceived trust of electric cars by young consumers does not positively influence their intentions to use electric cars. This finding is contrary to literature which purports that the intentions to purchase a new technology are influenced by having confidence in the functionality of the technology (Gefen, Karahanna & Straub 2003; Corritore, Kracher, & Wiedenbeck, 2003). The fifth hypothesis (H5) of the study was supported and significant ($p < 0.01$), implying that the perceived value of electric cars by young consumers has a statistically significant positive influence on their intentions to use electric vehicle. Chew, Shingi and Ahmad (2006) argue that the value consumers give to a product influences their purchase intentions to acquire and use that product. Lastly, the sixth hypothesis (H6) of the study was not supported although the findings were significant ($p < 0.01$). The results showed that perceived risk of electric cars by young consumers positively influenced their purchase intentions of the electric cars. This is contrary to several scholars (Kim, Ferrin, & Rao 2008; Mwencha, Muathe, & Thuo, 2014) who purports that high levels of perceived risk dissuade the intentions to purchase and use a product.

Conclusions and Managerial Implications

The study intended to investigate young consumer's perceptions towards the adoption of smart cars. Based on the empirical evidence established by the research, it was confirmed that young consumers indeed accepted the idea of adopting electric cars as indicated by a strong path-coefficient. This relationship, between perceived usefulness and perceived value had a path-coefficient of 0.826 and was significant at $p < 0.01$ showing strong

association between young consumers and electric car adoption. Interestingly, it was the strongest relationship of all the proposed hypotheses. Green marketing within the automobile industry is a growing trend both internationally and locally in South Africa. Due to concerns of global warming and climate change, much focus is increasingly being placed on the use motor vehicles that do not emit toxic emissions that contribute to climate change. The study set out to investigate the factors (namely, perceived usefulness, trust, value, risk) which influence young consumer's acceptance and intentions to use and adopt electric cars in South Africa. The results showed that the perceived usefulness of electric cars by young consumers positively influenced their perceived trust and perceived value of electric cars. On the other hand, the perceived trust and risk of electric cars did not have an effect of dissuading young consumers of having intentions to use the electric cars. Marketing managers within the automobile industry in South Africa who would like to introduce electric cars can be guided by the study and pay more attention in ensuring that young consumers have positive perceptions of the perceived usefulness and value of electric cars since this will positively influence their intentions to use electric cars. From an Africanisation perspective, the study contributes to literature and theory on acceptance and intentions to use new technology (specifically, electric cars).

Limitations and Future Research

Future research can be in the form of longitudinal studies to examine the factors which influence the intentions to use electric cars by young consumers in South Africa over an extended period of time. Furthermore, future research can be in the form of qualitative research designs. Additionally, data collection techniques can include in-depth interviews and focus group discussions with the research participants. In the study, the sample of the population was limited to Gauteng province of South Africa; hence, future research can include all the geographical provinces of South Africa. Lastly, future researchers could empirically measure the effect of perceived usefulness on perceive risk as it was not tested in this research, only literature was reviewed regarding these constructs. Possible new interesting insights could emerge from the results.

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