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Hybrid Electric Vehicles: Driving Towards Sustainability

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A research report submitted to the Faculty of Humanities

University of the Witwatersrand

In partial fulfilment of the requirements for the degree of

Masters of Arts in Organisational Psychology

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Declaration

I hereby declare that this research report if my own independent work and has not been presented for any degree at any other academic institution, or published in any form.

It is submitted in partial fulfilment of the requirements of Masters of Arts in Organisational Psychology at the University of the Witwatersrand.

_____ _____

Signed by Divia Riga Date

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- Thanks mom and dad

Abstract

A great deal of interest in energy efficiency and social consciousness has been evidenced by the growing concerns associated with fuel consumption in automobiles, hence the development of sustainable vehicle technologies such as Hybrid Electric Vehicles (HEVs). There are many factors that affect Intention to Adopt such technologies which brings the main premise of this study to light. This study attempts to analyse the factors that may potentially affect Intention to Adopt Hybrid Electric Vehicles. The factors investigated in this study were the four dimensions of the Unified Theory of Acceptance and Use of Technology (UTAUT) model (i.e. Performance Expectancy, Effort Expectancy, Social influence, and Facilitating Conditions), as well as three additional variables of Aesthetic Appeal, Moral Justification and Environmental Concern, in predicting the Intention to Adopt HEVs. With a sample consisting of 235 third year Engineering and Psychology students and utilising an adapted UTAUT model, Semantic Differential scales for assessing aesthetic appeal, a Moral Justification scale, a Nature Relatedness scale, and an Intention to Adopt scale, multiple linear regressions were used to test the direct and interactional effects of Moral Justification and Environmental Concern on the relationship between the subscales of the UTAUT model and Aesthetic Appeal, onto Intention to Adopt HEVs. The UTAUT scales presented with good internal reliability. The Semantic Differential scale utilised in the main study from the three analysed in the pilot study proved to have a low internal consistency. The results revealed a significant direct effect of the UTAUT factors on Intention to Adopt HEVs, with no significant effect of Aesthetic Appeal on intention. The results also revealed significant interaction effects of Moral Justification but not for Environmental Concern.

Keywords: Sustainability, Hybrid Electric Vehicles, Intention to Adopt, South Africa

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Chapter 1: Introduction

In a world where energy crises are at the centre of attention from increasing awareness of this massive crisis to solutions being proposed in terms of more energy efficient products being produced, a great deal of interest in energy efficiency and social consciousness has been evidenced (Khan & Kar, 2009). This has been indicated by the growing concerns associated with fuel consumption in automobiles, hence the development of sustainable technologies.

Hybrid Electric Vehicles

The transportation sector, according to Khan and Kar (2009, p. 2032), "is one of the highest consumers of fossil fuels and the largest contributor of Greenhouse Gas (GHG) emissions…". Light weight vehicles are responsible for a significant amount of GHG emissions and have caused a major strain on the economy with fluctuating oil prices. Low carbon technologies such as Hybrid Electric Vehicles (HEVs) can be considered to be a more fuel-efficient alternative to conventional combustion automobiles that are powered by both electricity and either petrol or diesel (Khan & Kar, 2009). The HEV combines an electric motor-based drivetrain with a conventional internal combustion engine (ICE) to reduce fuel consumption, produce fewer vehicle emissions, as well as lowering overall fuel costs (SEI, 2007). HEVs also make use of 'regenerative braking', whereby energy is captured from braking to be returned to the battery (SEI, 2007). This improves the energy efficiency of HEVs and reduces brake-wear, and hence can be considered as a sustainable technology. The electricity used in HEV technology is only used as an immediate energy storage medium that improves the overall efficiency of the vehicle as it does not use electricity to recharge the battery as fully electric plug-in vehicles require and, therefore, save energy and prevent strain on power grids.

This is a very important factor to consider in South Africa due to the immense amount of pressure that is already being placed on the power grid and its energy supply According to Lui, Hildebrandt, and Glasser (2012, p. 1), this is related to the "cleanliness" of the electricity grid, which in South Africa is not good. The coal-fired

powered stations in South Africa contribute to the most amount of GHG emissions compared to nuclear waste, pumped storage and other manufacturing processes. According to Lui et al. (2012), Eskom predicts that the demand for electricity will only increase and will place further strain on the power grid. Therefore, the adoption of fully electric plug-in vehicles could add to this demand and hence place excessive strain on the energy supply, which in turn would release more dangerous chemicals into the air.

Factors Affecting the Adoption of HEVs

Although sustainable technologies, such as HEVs exist, many market innovators and designers are aware that not every effectively engineered innovation will be successful in the marketplace. According to Thatcher, Lekitlane, and Riga (2014), many authors have warned about the slow adoption of sustainable technologies despite several developments in these technologies (Hekkert, Negro, Farla, Alkemade, Suurs, Weterings, Vandeberg, & van Alphen, 2008; Hensley, Knupfer, & Pinner, 2009; Kassie, Zikhali, Manjur, & Edwards, 2009). As such, technology in the form of HEVs are available for adoption but are not being adopted. Green (2001) suggests many reasons as to why individuals may choose to adopt or make use of a technology other than its cost and technical qualities. Decisions tend be based more on social influences, the ability of a product to enhance consumers' lives, having access to information, the products perceived applicability within a society, and the consumer's ability to use the technology. Thatcher et al. (2014, p. 2) also suggest four potential reasons as to why individuals may not or would not adopt a technology. Firstly, they suggest that ineffective marketing of the technology would result in the individual knowing very little about the technology, hence insufficient information being received by the individual about the benefits of adopting the sustainable technology. Secondly, individuals may not see much value in changing to the new technology. Change is associated with the cost of acquiring the new technology and the cost of time and effort expended on installing and learning to use the technology. Thirdly, the design and functionality of the technology may require special resources for the continuation of use and could result in the disuse of the technology (e.g. an HEV requires specialised mechanical parts and particular battery for its operation). Finally, individuals may

misuse a technology such that they "use a sustainable technology in an non-sustainable way" (Thatcher et al., 2014, p. 2).

In relation to the aforementioned factors that affect Intention to Adopt technologies, Moons, De Bont, De Pelsmacker, and Standaert (2009) assert the importance of understanding and taking note of consumers' desires when designing for sustainability. According to these researchers, consumers generally seek out products with an aesthetic appeal and ones that are usable. These aspects need to be implanted into the design of sustainable products for successful adoption. Research conducted by Chua, Lee and Sadeque (2010) on intention to purchase either a conventional motor vehicle or an HEV found that buyers of conventionally fuelled automobiles reported quality and performance of the motor vehicle to be important determinants of choice; whereas buyers of HEVs considered the opinions of others and the sustainable qualities (a "green" image) of the vehicle to be important when it came to purchasing decisions. This study suggested that these findings would equip motor vehicle manufacturers with the knowledge to promote the diffusion of environmentally-friendly vehicles into society based on the opinion and behaviours of consumers.

Consumer Behaviour

In designing sustainable technologies, consumer behaviour needs to be taken into account. This is related to the role of the user in the adoption process. In a study by Moons et al. (2009) it was found that multiple factors impact on a consumer's decision to adopt an electric car. They found that factors such as complexity, in terms of the car's perceived ease of use, was an important consideration in the adoption of the electric cars. Other factors included the relative advantage or perceived usefulness of the car (how it contributes to the environment); the symbolic function of the brand of cars, in terms of whether the car reflects a consumer's self-image, and matches with their existing values and current needs; and perceived ability and external source constraints pertaining to value for money and the effort and time expended to charge and change the electric vehicle batteries. These factors relate to the subscales of the UTAUT model. The UTAUT model has been used to examine different types of

technologies, but has yet to be assessed in terms of sustainable technologies, and more specifically, HEVs. This study provides a way to fill this gap in the research sphere through examination of the main constructs of the UTAUT model (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions); Aesthetic Appeal; and more importantly the moderators of Moral Justification and Environmental Concern, and will determine how these factors affect Intention to Adopt HEVs. To date, no studies have looked at the UTAUT model, Moral Justification and Environmental Concern in relation to HEVs. However, there have been some studies that have looked at the design of HEVs in terms of aesthetic preference or appeal, such as Herman, Lee, Vu, and Warda (2007) and Diels, Siamatas, and Johnson (2013), but not within a South African context. As such, the relationship between these variables, within a South African context, was explored.

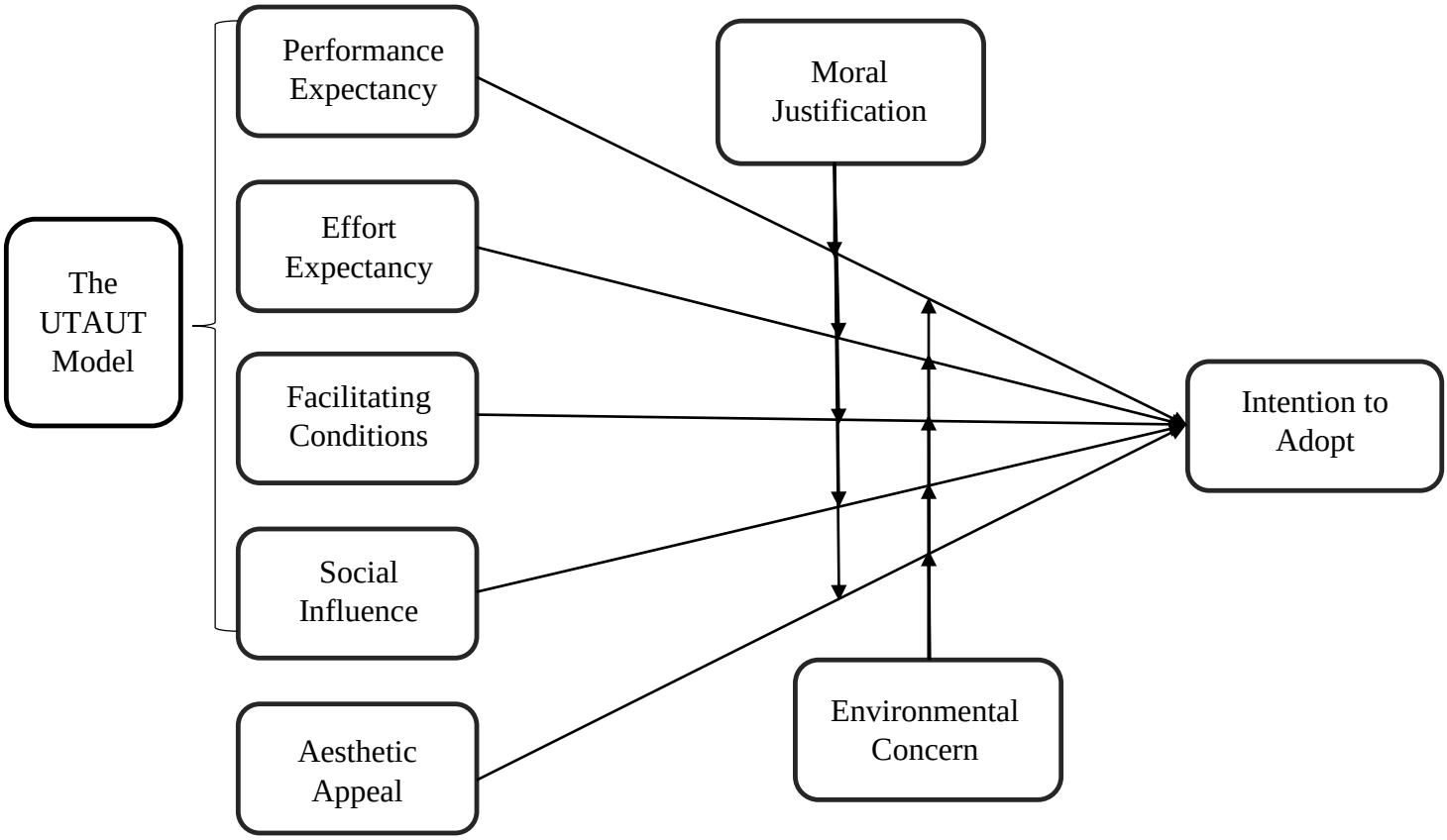
The South African Context

In addition to the theoretical and methodological contributions, this study is particularly unique to the South African context. The adoption of HEVs within first world countries such as China, Japan, and the USA have been extensive due to manufacturing of such vehicles in these countries decreasing the cost to the consumer, as well as financial rebates and cash incentives provided by first-world governments (Beresteanu & Li, 2008). Within South Africa, a government tax subsidery in the form of the Motor Vehicle Carbon Dioxide (CO_2) Emission levy has been implemented as a way to promote the adoption of HEVs by consumers having to pay more tax on the purchase of a conventionally fuelled automobile owing to more CO_2 emissions emitted from such vehicles. Despite the inclusion of this incentive within tax law, HEVs still remain too expensive for the majority of South Africans to afford, with the "cheapest" HEV ranging between R400 000 to R500 000. As a result, the majority opt to purchase conventionally fuelled automobiles, predominately petroleum fuelled vehicles than diesel or HEVs (Lui et al., 2012). Additionally, the slow adoption of HEVs in South Africa is due to miminal knowledge aquired by South Africans relating to the benefits of adopting HEVs, since the cost of purchasing such a technology often outweighs its adoption. There are other factors, such as social influence, effort expended to use this technology and the performance of this technology in meeting the needs of consumers

that may affect adoption of sustainable techologies. These factors have not been examined within a South African context since research in this area is limited. It is of importance that such factors are taken into account by the motor industry in South Africa to ensure a higher level of diffusion of HEVs into society to make for a more sustainable environment within the country, and improve the overall impact of GHG emissions on the world.

As previously mentioned, the current study was situated within a South African context and aims to add to the limited research conducted around the factors that affect Intention to Adopt HEVs based on the UTAUT model, Aesthetic Appeal, Moral Justification, and Environmental Concern. Below is the model that was tested in the current study, which will be referred throughout this report.

Figure 1: Adapted UTAUT Model



Chapter 2: Literature Review

Adoption of Sustainable Technologies: A Broader Framework

With rapidly increasing demands for energy, a growing concern about economic and environmental consequences has called for the adoption of sustainable energy technology throughout the world. Sustainable development through the implementation of sustainable technologies is one of the greatest challenges of today. Sustainable development looks towards eradicating global problems of climate change, environmental desolation, pollution, overpopulation, poverty and starvation, and global inequity (Mudler, Ferrer, & van Lente, 2011). Technology plays an important role in creating these problems that the world faces and will play an important role in solving them. Sustainable development, according to Mudler et al. (2011), is not necessarily a technological mission, it is a mission for the entire world to strive towards. However, technology is a significant influencing factor in society such that without it, society will disintegrate. Technological changes as compared to lifestyle changes can be seen as easier to manage and are needed for a much smoother lifestyle transition towards acting in a sustainable manner (Mudler et al., 2011). Hence, changes towards new innovations and the adoption of sustainable technologies would provide a way to combat the problems faced by the world, rather than having people change their lifestyles completely and drastically.

Sustainable technologies can be seen as an articulation of sustainable development, whereby innovations need to adhere to the principles of social, economic and ecological sustainability. Mudler et al. (2011) suggest that this is to ensure that the needs of the present do not compromise the ability of future generations to meet their own needs. With specific reference to sustainable development and the implementation of sustainable technologies in various companies, the concept of sustainability has become more and more prominent in the global corporate arena. Companies are focusing more on producing "ergonomically and ecologically optimized products" (Steimle and Zink, 2006, p. 2358). In other words, companies are focusing more on producing products

that are less harmful to the environment and utilizing renewable resources thereby supporting the long-term ecological balance.

Although climate change has been a wide topic of discussion throughout the world, sustainable technologies have faced a number of constraints that have affected their rate of adoption. This is due to many factors that are explored by Hekkert et al. (2008), Hensley et al. (2009), and Kassie et al. (2009), amongst other authors. An attempt has been made in this study to identify the major factors that influence the adoption of green energy technologies (HEVs) in the South African context.

With the prominence of climate changes, the adoption of low carbon technologies such as electrified transportation appear to be the most sensible alternative to current forms of transportation. Battery or Plug-in Electric Vehicles and HEVs can be considered as low carbon technologies. As low carbon technologies, these vehicles offer a way of reducing average vehicle energy consumption, hence reducing carbon dioxide emissions (SEI, 2007). The UK government has implemented a programme into the research, development and demonstration of low carbon technologies in order to provide a greater awareness of such technologies and increase adoption rates. However, Musa, Meso, and Mbarika (2005) argue that within Sub-Saharan Africa there is a low rate of adoption of "foreign technologies" such as HEVs, since the majority of technology adoption in such countries consists of basic smart technology in the form of mobile devices and laptops for status and socialisation purposes. The authors deem that the true benefit of technology, such as sustainable technologies, will come from its "meaningful application to enhance the standards of living, which comes from systematic unrestricted access to technology over time and within the right social and cultural context" (Musa et al., 2005, p. 22). If Sub-Saharan African countries are to adopt sustainable technologies, factors such as socio-economic and human development needs are to be met first, since these inhibit accessibility, exposure and therefore adoption of such technologies.

HEVs as Sustainable Technologies

Although socio-economic and cultural factors impede on the abilities of people to adopt sustainable technologies in the form of HEVs, other disadvantages associated with HEVs can hinder the intention to adopt them. Such disadvantages include the very high capital costs due to the additional components needed to run the vehicle, the expensive battery technology, as well as higher disposal emissions to those of conventional combustion automobiles (SEI, 2007). Disposal emissions refers to the release of dangerous or harmful particulate matter from the decompostion of substances such as metal used in the manufacturing of an HEV or the vehicle battery that is transported by wind and air currents onto the land and water from dumping the solid waste. Despite these impeding factors, HEVs can, to an extent, be considered as a sustainable technology (SEI, 2007). The improved fuel consumption, reduction in running costs, and the reduction of in-use carbon dioxide and other harmful emissions make it a sustainable technology.

However, there has been a slow adoption of sustainable technologies by the general public especially the adoption rate of low-carbon technologies such as HEVs (Hekkert et al., 2008). Khan and Kar (2009) suggest that the low consumer acceptance and adoption of HEVs is due to public ignorance of the performance and reliability of HEV technology, as well as the high initial cost of hybrid vehicles. Hong, Khan, and Abdullah (2013), and Soon, Seng, Luen, and Siang (2013) have also examined the low adoption rates of HEVs and have provided some insight as to why this may be the case. Hong et al. (2013), investigated the factors that influenced consumers' Intention to Adopt HEVs. This study found that relative advantage in terms of fuel economy; compatibility in terms of consumer's lifestyle and working style; and pro-environmental behaviour in relation to consumer's concern about climate change (Environmental Concern), were all found to significantly impact Intention to Adopt hybrid vehicles for young males with higher level of education and a higher level of income. The second study found that financial condition in relation to high initial cost of HEVs and perceptions of additional costs affect a consumer's choice to adopt such automobiles (Soon et al., 2013). This study found that in the long run, HEVs do save money for

consumers, which should persuade their interest in adopting HEVs. The quality of the vehicle, such as its environmental pollution levels and the preference for clean vehicle technology, also affect purchasing decisions of consumers. In addition to this, consumer awareness towards HEVs in terms of familiarity and understanding about alternative fuel vehicles is also seen to influence Intention to Adopt this sustainable technology. There are a multitude of additional factors that can influence intention that have been examined through the theories of technology acceptance that constitute the UTAUT model.

Theories and Models of Technology Acceptance

This section provides an overview of those theories and models that constitute the UTAUT model that the researcher feels are most pertinent to this study being, the Theory of Reasoned Action (TRA), which discusses one of the main variables in this study being Intention to Adopt; the Technology Acceptance Model (TAM), which is the main underlying theory of the UTAUT model; Diffusion of Innovation theory (DOI), which discusses factors that may influence individuals' decisions to either adopt or reject a technology; and lastly Social Cognitive Theory (SCT) that forms part of the UTAUT model but also makes explicit reference to the important moderator of Moral Justification. These theories are also important since their limitations propagated the development of the UTAUT model which addresses these and provides for a more integrated approach to assessing technology acceptance.

Theory of Reasoned Action (TRA)

TRA is considered to be the oldest model that explained technology adoption in the social psychology discipline according to Al-Qeisi (2009). This theory is concerned with explaining volitional behaviours. In other words, TRA is a theory that explores the conscious choices made by individuals to perform a behaviour. The performance of a certain behaviour is determined by an individual's behavioural intention to perform that behaviour, and behavioural intention is in turn determined by both a person's attitude and subjective norm concerning that specific behaviour (Davis et al., 1989). Attitude refers to an individual's evaluative feelings of performing the behaviour, which can

either be positive or negative. Subjective norm is another term for explaining Social Influence where the person takes into account the opinions of important others as to whether they think the individual should or should not perform a specific behaviour (Fishbein & Azjen, 1975). This theory was specifically developed by Fishbein and Azjen with the aim to predict, explain, and influence human behaviour.

The main assumptions of this theory contend that individuals are rational and consider the consequences of their behaviour before engaging in any action, and therefore make informed decisions based on the information that they have acquired to either perform or not perform the behaviour (Al-Qeisi, 2009). It is behavioural intention that is the most important determinant of behaviour within TRA.

There has been extensive research conducted in support of TRA both in general (Azjen & Fishbein, 1980; Taylor & Todd, 1995, Dillon & Morris, 1996; and Yousafzai, Fozall, & Pallister, 2010) and more specifically sustainable consumption (Jackson, 2005; and Addo-Yobo, Njiru, & Sohail, 2006). TRA has been applied in various research settings and has been well received in social psychology, however it is not without its limitations. Al-Qeisi (2009) points to limitation of correspondence suggesting that for TRA to predict particular behaviours, there must be a link between attitude and intention in terms of action, the situation, the objective, and the specificity, which for this theory is absent. Another limitation is based on the notion of volitional control such that the theory only applies to those behaviours planned in advance, therefore, spontaneous, irrational or habitual behaviour not thought through beforehand is unable to be explained by TRA. The limitations of this model is addressed by the Theory of Planned Behaviour (Azjen, 1985), which also has its own limitations.

Technology Acceptance Model (TAM)

The TRA was extended by Davis (1986) who developed a model of technology acceptance to explain and predict the individual's acceptance and eventual use of information technology. Influenced by the TRA (Ajzen & Fishbein, 1980), SCT and decision making theory, Davis (1989) identified two technology-related attitudes that he believed to predict usage outcomes. The first attitude is *perceived ease of use* (PEOU),

defined as the "degree to which a person believes that using a particular system would be free of effort" (Davis, 1989 p. 320). PEOU can be linked to self-efficacy in SCT as a similar outcome judgement. The second attitude is *perceived usefulness* (PU), being the "degree to which a person believes that using a particular system would enhance his or her job performance [or in everyday life]" (Davis, 1989, p. 320). In other words, it is the degree to which a particular system would improve personal objectives. According to Davis (1989), TAM theorises that PEOU influences PU since a technology will be more useful the easier it is to use.

TAM has been evaluated in various settings on a variety of technologies including general information systems (Adam, Nelson, & Todd, 1992 ; Agrawal & Prasad, 1998); Alwahaishi & Snasel, 2013; Dillon & Morris, 1996; Genuardi, 2004), computer applications (Park, 2009), email (Straub, Keil, & Benner, 1997), the World Wide Web (Lederer, Maupin, Sena, & Zhuang, 2000); mobile phone applications (Dlodlo & Mafini, 2013; Phan & Daim, 2011; López-Nicolás, Molina-Castilloa, & Bouwman, 2008), and amidst several other technological applications (Al-Qeisi, 2009). TAM has also gone through a validation processes to confirm the psychometric properties of PEOU and PU with researchers confirming that TAM does in fact provide an accurate measurement of a consumer's acceptance behaviour for different technologies. Davis (1989) made use of external variables to account for unexplained effects on the relationships between these attitudes and their outcomes. Such external variables included gender, age, past experience, and prior education.

The extension of TAM to TAM2 (Venkatesh & Davis, 2000) saw the inclusion of additional key determinants of usage intention due to the limitations of TAM in its explanatory power and the inconsistent relationships between the major constructs of TAM. The additional determinants to explain PU and usage intentions were social influences in terms of social norms, voluntariness and image; cognitive instrumental factors in terms of perceived relevance and perceived output quality; and a user's past experience. These additional constructs were suggested to influence intention behaviours and have been used to measure some of the main constructs and moderators of the UTAUT as seen above. This model has also been utilised in other fields other

than in social psychology, including organisational psychology where Ozag and Dugama (2004) explored the organisational commitment process including person-job fit; the health sector, where Chismar and Wiley-Patton (2003) assessed the applicability of TAM2 to the acceptance of internet-based health applications among paediatric physicians; and in cognitive psychology within South Africa to ascertain how cognitive processes influence the perceived usefulness of an online analytical processing technology (Hart & Porter, 2004). In relation to sustainable technologies, Feng (2012) investigated key factors that would affect people's intention of adopting energy efficient technologies. This study utilised TRA, TAM and Roger's Diffusion of Innovation theory to examine technology acceptance and the influencing factors. The results revealed support for the use of the three models in explaining Intention to Adopt sustainable tehcnologies, with the most significant influencing factor being perceived usefulness, followed by compatibility and attitude.

Diffusion of Innovation Theory (DOI)

Research on Intention to Adopt a specific technology has shown that intention may well vary at different stages of the technology implementation process. This pertains to Rogers' Diffusion of Innovation Theory (DOI) which examines the different stages of adoption in accordance with the different characteristics of the technology. Diffusion can be defined as a process through which an innovation or a new idea is communicated (taken up) in a society over time and hence examines the process of social change. The main premise of DOI is to provide individuals with an understanding of how an individual makes a choice to accept or reject a technology (Rogers, 1983). This theory also offers three valuable insights into the process of social change: what qualities make an innovation spread; the importance of conversations and networking within a community; and understanding the needs of different stakeholders.

Rogers identified five attributes of an innovation that could influence its adoption and the rate at which they are adopted: relative advantage, compatibility, complexity, trialability, and observability. According to Karahanna, Straub and Chervany (1999) there are two attributes that can be used interchangeably with Davis' two technology-related attitudes, namely relative advantage as an approximate for PU, and complexity

being similar to PEOU. In terms of TAM2, compatibility is interchangeable with perceived relevance, and observability is closely related to perceived output quality. Moore and Benbasat (1996) have asserted that compatibility, PU and PEOU were the most influential when it came to usage decisions, but trialability was not significant in determining usage behaviours and thus was not included in the UTAUT.

Karahanna et al. (1999) suggest that there are aspects of DOI that are met with criticism, such as a lack of evidence on how attitude progresses to accept or reject decisions. Another limitation involves how the characteristics of the innovation/technology fit into the accept/reject process and how they form attitudes, despite the fact that Rogers asserts rejection can occur at any stage in the decision process. However, it should be noted that individuals are attracted to different aspects of different innovations, and therefore it is impractical to anticipate for one model to generalise how positive and negative attitudes are constructed based on the characteristics of the innovation, stages of adoption and categories of adopters.

There have been various studies investigating different forms of sustainable technologies within the research sphere such as organic farming (Simin & Jabkovic, 2014), the hotel industry (Smerecnik & Andersen (2011), and tourism practices (Hollenhorst &Triplett, 2005). In relation to this study, Brauer (2011) and Cao (2004) investigated the future potential of HEVs with the use of Roger's Diffusion of Innovation theory. Brauer (2011) found that diffusion models are able to predict future demands in the market of heavy duty HEVs (trucks, trains, and busses) and other alternative fuel vehicles with innovative technology and solutions. The results also revealed that intentions to adopt HEVs or their diffusion into society would be slow initially, but would steadly increase in adoption rate by 40 to 50 percent by 2030. Cao (2004) suggests that diffusion models tested in their study indicate that although liquefied petroleum gas (LPG) vehicles are popular in society, most automakers, fuel providers, and government agencies' focus has shifted considerably towards HEVs, hence resulting in a decline in LPG markets. The researcher has suggested that HEVs do have the potential to replace conventionally fuelled vehicles with increasing growth of adoption by 2025. However, facilitating conditions, such as gasoline prices and

consumer knowledge of HEV technology are factors that affect adoption and market diffusion of such technologies, as found by the researcher. As with mention made by Beresteanu and Li (2008), in terms of countries such as USA and China offering incentives to promote the adoption of HEVs, Cao (2004) suggests offering a tax credit to those purchasing HEVs and developing a wider range of HEV models, as this would fast-track adoption and development of HEVs.

Within the South African motor industry, a tax levy has been passed pertaining to motor vehicle CO_2 emissions. The tax levy is paid by the manufacturers of motor vehicles that emit fumes exceeding a threshold deemed harmful to the environment, which in turn increases the price paid by the consumer. According to SARS (SARS, 2014), the levy is to encourage motor indusries and consumers to become more energy efficient and aware of the impact that such emissions have on the environment.

It should noted that there are two aspects of the model of PC Utilisation (Thompson et al., 1991) that are not included in earlier models, but have been included in the UTAUT model: *job fit*, and *Facilitating Conditions* which are "objective factors in the environment that observers agree make an act easy to accomplish" (Venkatesh et al., 2003, p. 430). In relation to the UTAUT model, job fit is used to contribute to Performance Expectancy, and Facilitating Conditions is used as a key determinant of behavioural Intention to Adopt technologies.

The following sections will focus on the examining the intergrated UTAUT model and the other independent variable of Aesthetic Appeal. In addition to such sections, the Social Cognitive Theory (SCT) will be discussed, which forms part of the UTAUT model, and includes within its framework the moderator variable of Moral Justification . This is followed by a discussion of the moderators of Moral Justification and Environmental Concern and their addition to the current research as a means of addressing the limitations of the UTAUT model.

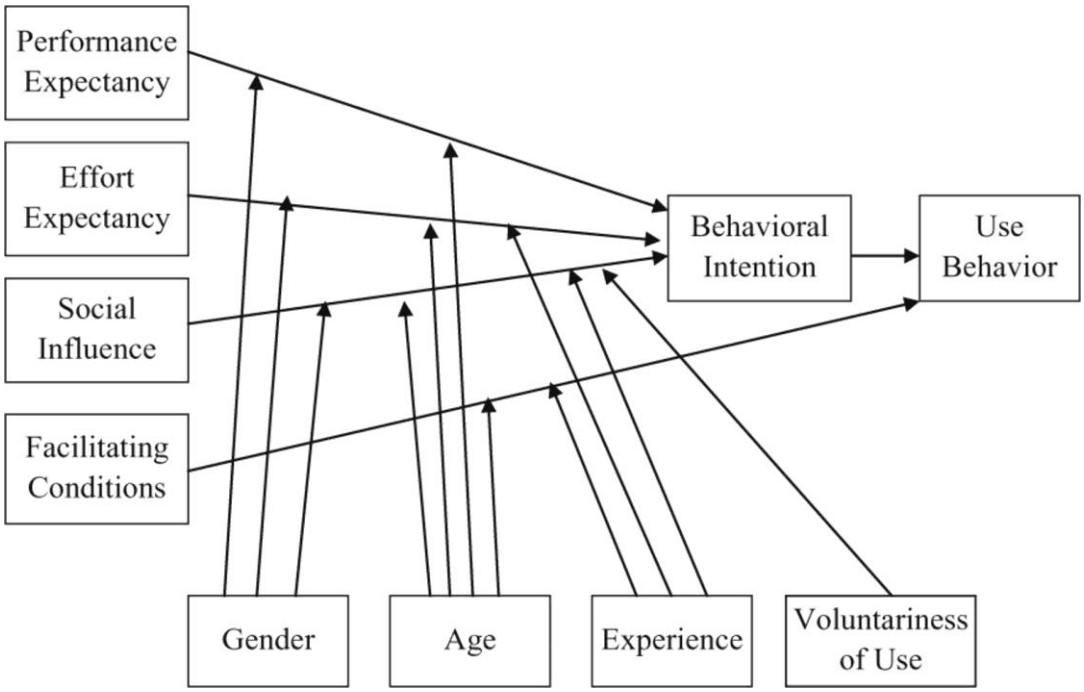
Unified Theory of Acceptance and Use of Technology (UTAUT) Model

Venkatesh, Morris, Davis, and Davis (2003) fashioned a theory of technology acceptance – UTAUT – through a review and consolidation of various technology

adoption models, some of which have been disccused above and below [i.e. Theory of Reasoned Action (TRA) (Fishbein & Azjen, 1975), Technology Acceptance Model (TAM) (Davis, 1989), Diffusion of Innovation Theory (DOI) (Rodgers, 1962), the Model of PC Utilisation (MPCU) (Thompson, Higgins, & Howell, 1991), and Social Cognitive Theory (SCT) (Bandura, 1982)]. The central component of the UTAUT model is TAM, which is the most widely employed theoretical model of technology acceptance (Brown, Dennis, & Venkatesh, 2010). TAM has been applied to various information and communcaition technologies and has proven to be highly predictive of technology adoption and usage. Such technologies include software applications for personal computers (Agrawal & Prasad, 1999), online help system and a multimedia system for Windows 95 (Venkatesh, 2000), and a data and information retrieval system (Venkatesh & Morris, 2007). The UTAUT extends the TAM by integrating Social Influence and Facilitating Conditions within the model. The UTAUT model is an effort towards an integrated model that combines the different perspectives in the field of technology acceptance. The authors of this model suggested that three of the four key factors, being Performance Expectancy, Effort Expectancy, and Social Influence would be sufficient determinates of Intention to Adopt, however the fourth factor, Facilitating Conditions, was included to examine the impact of external variables on technology adoption (Al-Qeisi, 2009).

Together with the four key constructs of intention and usage, the UTAUT model also incorporates four different moderators of individual use behaviours, namely; gender (male and female), age (continuous), experience (ordinal – low, medium and high), and voluntariness of use (categorical – high, low) (please refer to Figure 2). For the purposes of this study, only the main constructs of intention were investigated, being Performance Expectancy, Effort Expectancy, Social influence, and Facilitating Conditions.

Figure 2: General UTAUT Model



Key Constructs of the UTAUT Model

The first construct, *Performance expectancy*, is a key predictor of intention to use technology (Wang & Wang, 2010) and is defined by Venkatesh et al. (2003) as the degree to which the user expects that using the technology will help him or her to attain gains in performance. Applying this construct to that of HEVs, implies that people will be more likely to utilise HEVs if it helps them to accomplish their personal performance objectives in an efficient way. The constructs from the behavioural theories that contribute to Performance Expectancy include PU from TAM, job fit from MPCU, and outcome expectations from SCT. Secondly, *Effort expectancy* is "the degree of ease associated with the use of a system" (Venkatesh et al., 2003, p. 450). The constructs from the aforementioned theories have sought to measure some dimension of Effort Expectancy. These include PEOU from TAM, complexity from MPCU, and ease of use from DOI. The implication for this study pertaining to HEVs is that of accessibility of these vehicles to people and the degree of effort required to use this sustainable technology. According to Wang and Wang (2010), the technology or product needs to be effortless to utilise, therefore, the more complex the system, the prospect of adoption

will be lower. Thirdly, *Social influence* can be defined as "the degree to which an individual perceives that important others believe he or she should use the system" (Venkatesh et al., 2003, p. 451). Three constructs have attempted to measure Social Influence from previous theories, including subjective norms from TRA and the TAM extension, social factors in MPCU, and image in DOI. Social Influence is associated with factors such as peer pressure and social support concerning the use of HEVs (Venkatesh et al., 2003). These factors are important for adoption decisions as consumers modify their behaviours based on the expectations of others or their take on others' viewpoints and thoughts (Venkatesh et al., 2003). Persuasion to utilise a system occurs once significant others are familiar with the product or system (Wang & Wang, 2010). In the current setting of this study, significant others to students would pertain to lecturers, parents, other students, significant others (romantic partners, celebrities, etc.), or other people that have already adopted HEVs. Finally, *Facilitating Conditions* refers to the "degree to which an individual believes that the organisational and technical infrastructure exists to support the use of the system" (Venkatesh et al., 2003, p. 453). Two constructs from the theories have sought to measure Facilitating Conditions, including: Facilitating Conditions from MPCU, and compatibility from DOI. In this study, Facilitating Conditions was used to gain insight into those additonal, yet important factors that consumers may consider as important when purchasing HEVs, such as cost of the HEV, if adopting an HEV is well suited with that person's lifestyle, so more about image and status, as well as whether people would have the necessary resources in place to aquire such a technology.

Behavioural Intention

The main variable of interest to the researcher in this study is behavioural Intention to Adopt HEVs and not actual usage behaviour, as this is beyond the scope of this study. The researcher opted to study a student population who have not actually purchased HEVs. In order to examine usage behaviour, students would have had to purchase and utilise them for a significant amount of time to ascertain whether it would provide any benefit over conventionally fuelled vehicles. In addition, results for this study were obtained through a single instance of measurement rather than over a period time, which

is also required to study usage behaviours, hence the reason for only examining usage intention in this study. Several researchers have affirmed behavioural intention to be the most important determinant of actual behaviour. For example, Zhou (2008) argued that the most important factor that determines user acceptance and use of a technology such as HEVs, is the user's intention. Behavioural intention has been extensively researched, especially within the information and communication systems research. However there is a need to extend the research conduted on behavioural intention in the sustainable technology sphere to enhance people's understanding of the phenomenon.

Behavioural Intention originates from the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) such that this theory assumes that people act upon their intentions, therefore, making intention a key component of this study. *Behavioural Intention* can be defined as "a measure of the strength of one's intent to perform a specified behaviour" (Davis, Bagozzi, & Warshaw, 1989, p. 984). Intentions within TRA are comprised of two major attributes: the first being an individual's attitude toward a behaviour in terms of whether it is right or wrong; and an individual's opinion regarding social influences that place pressure on the individual to either perform or not perform the behaviour. Intention was not defined by Venkatesh et al. (2003) in their development of the UTAUT model, although mention is made to measuring intention using items adopted fromm Davis et al. (1989) that have been "extensively used in much of the previous individual acceptance research" (Venkatesh et al. 2003, p. 438). For the purposes of this study, intention meant whether people would consider purchasing and/or using an HEV in the future. This study therefore employed an Intention to Adopt subscale which was incorporated together with the other constructs that comprise the UTAUT model. Items included for each subscale of the UTAUT model were adapted from those included by Venkatesh et al. (2003) and Marchewka, Lui, and Kotiswa (2007) to measure the constructs pertaining to the UTAUT model.

Aesthetic Appeal

According to Thatcher et al. (2014), there is another factor that could influence sustainable technology adoption – the aesthetic or visually appealing qualities of the technology. This variable was added as a primary predictor to this study since it

extends on the factors explored by the UTAUT model through an emotional dimension that centres around this variable. Sonderregger, Sauer, and Eichenberger (2013) suggest that aesthetic appeal can be treated as a primary predictor on the basis of expressive and classical aesthetics. In other words, these researchers propose that aesthetic appeal is an important predictor of intention to adopt technologies based on its degree of novelty or visual appeal, and/or the functionality or percieved usefulness of the technology. Aesthetic appeal, therefore, relates to the emotional preferences people have towards the technology or innovation on the basis of how visually attractive the technology is. Aethetics is important to consider in technology acceptance and adoption since Sonderregger et al (2013) and other researchers such as Khalid (2006); Sauer and Sonderegger (2010); Helander (2003); Tractinsky, Katz, and Ikar (2000); and Schenkman and Jönsson (2000), have found that aesthetics has a direct and positive impact on perceived usability, and therefore, on intention to adopt sustainable technologies. As such, this variable was included as a primary predictor in this study.

The area of study with which aesthetics is associated, is referred to as "affective design" that. "Affective design" examines an individual's emotional experience in various situations with a variety of technologies (Thatcher, 2012). It is considered to be 'design for emotion' that explores how emotion and interactions with a particular product or system are connected (Thatcher et al., 2014). Affective design can be examined at both pre- and post-adoption stages. However for the purposes of this study, aesthetic appeal was only examined up to the point where a decision is made by the consumer to express an intention to adopt the technology. According to Khalid (2006), the likelihood of a user adopting a particular product or system based on their feelings and emotions towards the product or system is what affective design attempts to understand. It has been found by Helander (2003) and Sonderegger and Sauer (2010) that positive affect towards a product or system results in the acceptance of the design, and a much better likelihood of adoption of that product or system.

In light of encouraging consumers to adopt and use HEVs, it is important to consider that uptake will be to a very large extent determined by the visual appearance and associated customer product affection (Diels et al., 2013). Raymond Loewy (1951)

believed that aesthetic appeal was essentially a balancing act between two variables: novelty (uniqueness) and typicality (familiarity). To find the optimal balance between these variables was to find the commercial sweet spot for success. According to Loewy (1951), the sweet spot is identified using his Most Advanced Yet Acceptable (MAYA) principle, which asserts that the most advanced form of a product or system that is still recognisable as something familiar will have the best prospects for commercial success. There is some discrepancy between the two variables, such that a preference for the familiar over the unique can be considered as a mechanism to avoid risk in any venture into the unknown (Diels et al., 2013). On the other hand, it can be rewarding to seek out novelty, as knowledge is acquired, and this can be stimulating. Hekkert, Snelders, and van Wieringen (2003) assessed the MAYA principle using a range of products including vehicles. Both variables, novelty and typicality, determined aesthetic preference but both supressed the positive effect of each other (i.e. they were negatively correlated). It was concluded by these authors that a balance needs to be found between novelty and typicality for a product to be as innovative as possible, while maintaining as much of the typicality of the design as possible. Very similar results were found by Diels et al. (2013) when they sought to investigate the relationship between consumers' responses to novel electric vehicle designs.

The MAYA principle is evaluated by means of a Semantic Differential Scale. This is the most widespread technique to assess emotional factors related to the design of a product or system. The Semantic Differential technique was developed by Osgood, Suci, and Tannenbaum (1957) to capture the collection of psychological feelings of users and to measure the emotional content of a word or object in a more objective way (Dahlgaard, Schutte, Ayas, & Dahlgaard-Park, 2008). This technique makes use of a questionnaire where participants rate signs, words, or objects on bipolar scales (Osgood et al., 1957). These bipolar scales are defined as a number of contradicting adjectives at each end on which the participants check off the position which best represents how well every adjective suits the product (Karlsson, Aronsson, & Svensson, 2003). The next section will focus on another theory that includes the examination of emotion and cognition when deciding to adopt a sustainable technology or not. The

theory of Social Cognitive Theory is important to consider in such a study as this, since it draws on actual thought patterns when making imporant decisions such as technology adoption.

Social Cognitive Theory (SCT)

The Social Cognitive Theory (SCT) has its roots in Social Learning Theory (SLT) and developed as a result of Albert Bandura incorporating the constructs of reciprocal determinism, vicarious learning or modelling, and self-efficacy (Al-Qeisi, 2009). Studies that have used SCT to explain behaviours related to information and communication technology have focused on the role of cognitive factors. (Compeau & Higgins, 1995; Compeau, Higgins, & Huff, 1999). Compeau et al. (1999) focuses on two sets of expectations as the main cognitive factors that influence behaviour. The first set of expectations, self-efficacy, is related to an individual's beliefs about their ability to perform a certain behaviour (Genuardi, 2004). It is based on the belief that an individual can complete a specific task given a set of circumstances. The second set of expectations, expected outcomes, suggests that individuals will be more likely to perform a particular behaviour when they expect that behaviour to have favourable outcomes (Genuardi, 2004). For the purposes of this study, outcome expectations were focused on as they are linked to the important moderator of Moral Justification .

Outcome expectations are important in SCT because they shape the decisions people make about what actions to take and which behaviours to supress (Bandura, 1989). The frequency of a behaviour increases when the outcome expected is valued, whereas behaviours associated with unfavourable outcomes are generally avoided. This gives rise to the notion that human behaviour is significantly regulated by its effects and introduces the concept of self-regulation within SCT which is directly linked to Moral Justification.

Self-Regulation

SCT suggests that individuals have control over their thoughts, feelings, motivations and actions. Self-regulation occurs through "the interplay between social standards and moral standards along with self-produced internal influences" (Al-Qeisi, 2009, p. 53).

Self-regulation can, therefore, be considered as an internal capacity that humans are capable of which controls what actions are taken by an individual. According to Bandura (1989, p. 40) "People influence their own motivation and behaviour by the positive and negative consequences they produce for themselves". Self-regulation, therefore, allows an individual to control their response or behaviour when confronted with external stimuli (Bandura, 1991). Feedback is one such externally imposed stimulus that functions together with a person's self-regulatory capability to allow for adjustments to be made in behaviour. However, human behaviour is not only regulated by external stimuli. According to Bandura (1991), internal mechanisms or capabilities such as self-reflectiveness and self-reactiveness enable people to effect some control over their thoughts, feelings, motivation, and action. This is called moral self-regulation. Both social and moral standards can regulate behaviour, with moral standards developing from multiple sources such as direct instructions, feedback from others, and the modelling of other people's moral standards (Al-Qeisi, 2009). Other influences include the media, education, a person's religion, and political parties.

In SCT, moral conduct is said to be regulated by two mechanisms: social sanctions (rules set by society to ensure that what it deems as acceptable behaviour will be followed) and internalised self-sanctions (internal standards of right and wrong that serve as guides and restraints for harmful practices) (Bandura, 1991). Moral self-regulation is based on the idea that people have the tendency to conduct a balancing act by doing something good or moral in one instance to offset doing something wrong (or nothing at all) in another.

However, according to Bandura (1991, p. 64), "self-regulation of moral conduct involves more than moral thought. Moral judgment sets the occasion for self-reactive influence." This is a mechanism by which standards regulate an individual's behaviour or actions. SCT has proposed that self-reactive influences cannot function unless they are activated, and there are various ways in which self-sanction can be disengaged from immoral conduct (Bandura, 1990).

Individuals often experience conflicts in which the behaviours they themselves consider shameful can function as a means of acquiring valued benefits. This occurs when behaviour is consistent with personal standards, in that self-sanctions override the force of external incentives (Bandura, 1991). When confronted with external stimuli, such conflict, it is overcome by the selective disengagement of self-sanctions. This enables otherwise considerate people to perform self-centred activities that have harmful social effects. This refers to Bandura's concept of Moral Disengagement, opertionalised as Moral Justification, an aspect of SCT, and an important variable in this study.

Moral Disengagement operationalized as Moral Justification

This aspect of SCT is used to analyse the means through which individuals justify their unethical or unjust actions (Bandura, 1990). Moral disengagement, as a broader concept, refers to the ability of an individual to morally dissociate from the possible negative impacts of their behaviours on the environment, specifically the use of fossil fuels. Self-sanctions can be disengaged from harmful practices through various mechanisms proposed by this theory, namely, moral justification (reconstruing conduct), euphemistic labelling (linguistic restructuring), advantageous comparison (obscuring causal agency), displacement of responsibility (governmental liability), diffusion of responsibility (cluster dilution), distortion of consequences (minimisation of consequences), dehumanisation, or attribution of blame (circumstantial condemnation). For the purposes of this study, moral justification will be focused on as this is the only mechanism that serves a dual function (Bandura, 2007). Firstly, moral justification sanctifies harmful behaviours as serving worthy purposes to include moral engagement in the activity. Secondly, it causes individuals to believe in the worthiness of the initiative, eliminating self-condemnation from its harmful aspects, engages self-approval and creates social recognition and economic rewards for being successful at it (Bandura, 2007).

Moral justification as technique to sanctify harmful practices by endowing them with worthy purposes allows for individuals to preserve a sense of self-worth while still initiating harm through their activities. (Bandura, 2007). For this study, Moral

Justification was examined due to its nature of tapping into the psyche of individuals and understanding the manner in which people persuade themselves and others that an action is 'right'. In the instance of an individual choosing to adopt a fossil-fuel vehicle over an HEV, their Intention to Adopt an HEV is low, and as such they need to engage in morally justifing their behaviour to avoid punishing themselves or being punished by others for their choice. In other words, individuals would need to have high moral justification in order to protect themselves from the self-sanctions or the sanctions of other (environmentally conscious) people. Moral Justification can, therefore, be seen as a defense mechanism that people engage in and this, together with the above mentioned aspects of moral justification, is reason to this variable being of importance to this study, which was examined in conjunction to the UTAUT model and Aesthetic appeal as a way to determine if it had a buffering effect on the relationship between these main effects.

In terms of the nature and context of this research, not many studies have sought to examine Moral Justification in terms of sustainability, except for Bandura (2007). There have, however, been studies that have assessed the moderating effects of moral Justification such as that by Samnani, Salamon, and Singh (2014), and by Li, Nie, Broadley, Situ, and Dou (2014). To date only one study has examined Moral Justification within the South African context in relation to software piracy on the factors relating to Bandura's Social Cognitive Theory (Thatcher & Matthews, 2012).

Bandura (2007) suggests that when it comes to conserving the environment, there are many reasons that account for humans failing to change their behaviours on the basis of it being the right thing to do. This can be considered as a universal principle of morality. Many see nature as a resource that can be owned and used in pursuit of one's own personal interest (Bandura, 2007). From this perspective, operations should be governed by free-market principles and without governmental interference. Others, according to Bandura (2007), believe that advancements in technology will evidently provide solutions to environmental crises. This is an unrealistic belief as faith in such technologies brings with it the reality that time is running out for people to change their

ways, since technology may be of no use when the entire population's irreversible ecological damage reaches a point of no return.

People are no longer dependent on their immediate habitat for survival due to life in urbanised conditions where harmonisation is sought with the concrete jungle rather than the natural environment (Bandura, 2007). This diminishes the age-old self-interest to protect the natural environment. People are provided with the essentials at their convenience where their daily needs are met. Due to this, consumers may have little regard for the humaneness of working conditions, pollution from production processes, and the costs demanded to procure goods and dispose of waste. Therefore, Bandura (2007, p. 14) captures this despondent reality as: "environmental conservation becomes an abstraction rather than an experienced necessity". These beliefs may impair consumers' intentions to adopt HEVs, since the degree to which people care about the environment, will impact on their willingness to adopt technologies that seek to assist in conserving the natural environment. This is linked to the notion of Environmental Concern, the second moderator in this study.

Environmental Concern

Environmental Concern is seen as an evaluation or an attitude towards a person's behaviour or others' behaviour that has consequences for the environment (Fransson & Garling, 1999). Environmental Concern can be both a specific attitude to determine intentions or a general attitude or value of an individual. Fransson and Garling (1999) suggest that if a person possesses a positive environmental attitude then they will generally engage in environmentally responsible behaviour, such as the adoption of sustainable technologies. For the purposes of this study, it was hypothesised that those who obtain high scores on the Nature Relatedness Scale would have a higher rating on Intention to Adopt HEVs.

It has been proposed by Fransson and Garling (1999) that a lack of knowledge is a key factor that can explain the weak relationship between Environmental Concern and environmentally responsible behaviour. Another factor that could result in a weak relationship between these two measures is that of social norms which prevent people

from acting in an environmentally friendly way. It has been advised by Halford and Sheehan (1991) that social institutions implement two strategies to persuade consumers to act in the interest of the collective: to structure the environment in a way that short-term self-interests corresponds with long-term interests; and to coerce people through group pressure. The latter activates moral norms that play an important role in compelling people to act in an environmentally friendly manner, through viewing it as immoral to use conventionally fuelled vehicles, which make inefficient use of fossil fuels. Here, the link to Moral Justification, and Social Influence from the UTAUT model can be seen. If there is considerable pressure from significant others in one's life to adopt an HEV and/or if a person has a high affiliation towards the environment, Intention to Adopt HEVs will be higher than if these factors were absent. In other words, if individuals have a high concern for the environment, they will already have a high concern for what an HEV stands for and hence are more likely to adopt such a technology. If individuals are not as concerned about the environment then Intention to Adopt HEVs would be low. Hence, the addition of this variable as a second moderator in this study, to test whether a high or low affliation towards nature will strengthen or weaken the relationship between the main effects and result in a either a higher or lower Intention to Adopt HEVs.

Rational Models of Cognition

The UTAUT model was developed on the basis of researchers being confronted with multiple models of technology acceptance to choose from with the possibility of favouring one over another, therefore disregarding the contributions other models could make to their research. Whilst testing the models that constitute the UTAUT model, it was found by Venkatesh et al. (2003) that the predictive validity of all the models, except for the Motivational Model and SCT, increased after they included the moderators of gender, age, experience, and voluntariness of use.

The UTAUT model has received much support since its inception and has been said to account for 70 percent of the variance in usage intention, which is a significant improvement over the individual models from which it is drawn, since the highest

variance in usage intention for such models was approximately 40 percent (Al-Qeisi, 2009). However, the UTAUT has predominately been applied to examine usage intention for Information and Communication Technology in general and not focusing much on Green Information Technology or sustainable technology, therefore falling short in this respect. Some studies that have explored is that by Thatcher et al. (2014) and Barkane & Glinters (2011), in which both studies investigated the impact of the UTAUT model on sustainable technology acceptance.

According to Alwahaishi and Snasel (2013), technology innovation in ICT has grown tremendously over the past few decades and has influenced the manner in which individuals work and where they work from. It has changed the way in which business is conducted and in dealing with daily activities both at work and at home. These researchers have suggested that the acceptance of ICT has become essential for organisations to explore for their continuation, with many researchers choosing to adopt the UTAUT model when conducting research for such organisations. Despite the ongoing technological revolution and the increasing research in the field of ICT and technology acceptance through the utilisation of the UTAUT model, not much focus has been spent on sustainable technologies and its acceptance and adoption.

In his paper on technology and sustainability, Vergragt (2006) looks towards the persisting contradictions present in the world today, where an improved lifestyle is created and supported by technology for those few who are wealthy, and an increase in environmental deterioration and poverty for the mass population. He advocates for a closer examination and understanding of technology and its relationship to society, specifically a sustainable society, as well as for the use of appropriate technology which is energy efficient and environmentally friendly and is thus considered to be another form of sustainable technology.

Reasoning on the basis of a means-end basis is what the UTAUT model is defined upon, as it focuses on a rational cognitive model of reason in that such rational models of cognition "aim to explain human thought and behaviour as an optimal solution to the computational problems that are posed by our environment" (Sanborn, Griffiths, &

Navarro, 2010, p. 1). The UTAUT model follows a logical structure and focuses on means-end and technical aspects of technologies and does not account for assessing people's morals and emotions towards using a specific technology. In other words, the UTAUT model does not allow for people to consciously consider whether a technology would be appropriate to use given the current state of the world's natural environment or whether they would feel good or guilty to use such a technology on the basis of its impact on the wider community and environment. This is made evident by constructs included into the UTAUT (Venkatesh et al., 2003), whereby Performance Expectancy focuses on what the person will gain from using the technology and whether the technology will assist the person in their performance; Effort Expectancy related to how much energy needs to expended to use the technology, and if excessive time and energy is needed to use the technology, then it will not be adopted no matter whether or not it would benefit the individual, community and/or the environment. Social Influences focuses on the reasoning patterns of others close to the person and suggests that individual's externalise their responsibility to others in making decisions that they should internally make. In other words, individuals engage in logical reasoning to adopt a technology or not. Finally, Facilitating Conditions includes the degree to which technical infrastructures such as programmes or smart technology will be used to support the individual in using the technology. Once again, there is the notion of externalising individual responsibility onto others, as well as the notion that if extensive time and resources are needed to utilise the technology, people are more unlikely to adopt such technologies.

An individual who engages in Moral Justification is one who is attempting to survive and prosper to meet their goals and thus decisions on how to act to achieve such goals through validation of their immoral behaviour that is based on feeling or emotion. This is based on a more traditional model of cognition that focuses on psychological processes that are responsible for behaviour (Sanborn et al., 2010). Therefore, Moral Justification within the sphere of moral disengagement is also part of a rational cognitive model as is Social Cognitive Theory. As previously mentioned, in order for a person to act morally, universal standards, as well as thought processes, which may be

based on emotion, are required. Hence, rational cognitive models are those that individuals use in to justify their behaviours either based on reason or on emotion or feeling.

The notion of rational cognitive models is linked to human reasoning as discussed by Kahneman (2011). He speaks of two different kinds of processes called "fast and slow" processes. Type 1 processes, according to Kahneman, are fast and do not require any conscious attention, do not need any input from conscious processes, and can operate in parallel. Type 2 processes, on the other hand, are slow and require conscious effort on the part of the individual and these processes work in sequence. The processes of type 1 provide quick judgements which are often wrong, and sometimes immoral, but can be overridden by the corrective Type 2 processes. This seems to be related to people engaging in Moral Justification, such that when a questionable action is performed, the individual engages in Type 1 reasoning processes, and the "corrective" mechanisms they engage in to disengage from such an action are related to Type 2 processes. Therefore, engaging in moral behaviour can be considered to be based on Type 2 processes.

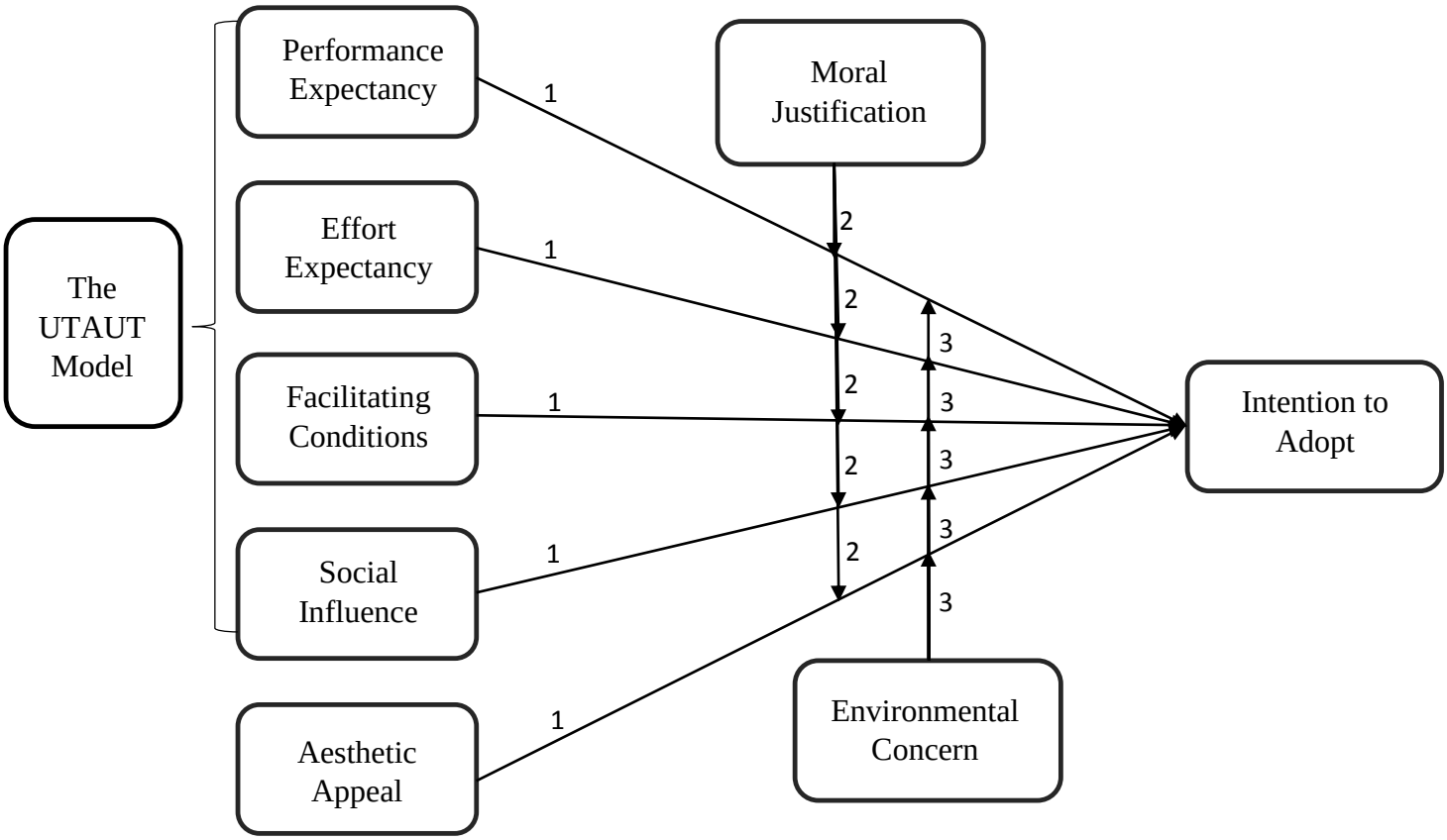
However, Type 2 processes are considered to be computationally expensive, and humans are understood to be cognitive misers, meaning that humans are programmed to default to Type 1 processes whenever possible such that people do not want to spend too much of their mental processes on one problem or thought, and rather thrive on cognitive models that allow for fast and quick-thinking. When individuals do make use of Type 2 processes, they use the least demanding kinds of Type 2 processes so that they reason from the simplest model available rather than considering all the relevant factors. Hence, Kahneman suggests that humans are essentially subjected to confirmation bias, which is people's thoughts focusing on what they already believe (believing that committing an immoral act was for the greater good in a certain situation) and other biases. The result is one of three situations: regressing to Type 1 processes when Type 2 processes are needed (knowing what is the morally correct, yet engaging in immortality); failing to override Type 1 processes with Type 2 processes; and using Type 2 processes with focal bias (Kahneman, 2011).

However, such human reasoning is never as simple as based on either one or another model of rational thinking or human reasoning. There are a multitude of factors that influence thought processes as to the intentions to adopt sustainable technologies. This then brings about the purpose of this study: to examine which factors may influence people's Intention to Adopt sustainable technologies evident through the adapted UTAUT model and research questions proposed below.

Research Questions

1) Is there an impact of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal on Intention to Adopt Hybrid Electric Vehicles?
2) Moral justification will have a moderating effect on the relationship between Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal on Intention to Adopt Hybrid Electric Vehicles.
3) Environmental concern will have a moderating effect on the relationship between Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal on Intention to Adopt Hybrid Electric Vehicles.

Figure 3: Adapted UTAUT Model in Relation to Research Questions



Chapter 3: Method

This chapter is concerned with the methods used to investigate the relationship between the variables that were adressed in the study. This section will first outline issues regarding the research design and secondly the sample and research procedure will be presented. The measuring instruments will be discussed as well as the various analyses that were used to answer the research questions posed. Lastly, ethical considerations will be taken into account.

Research design

A quantitative methodological approach was used for this study as it involved examining the relationship between the various independent variables of Performance Expectancy, Effort Expectancy, Social Influence, facilitating factors, and Aesthetic Appeal and the dependent variable of Intention to Adopt as moderated by Moral Justification and Environmental Concern. The scales utilised in this study make use of a questionnaire-like format, as this is a personal reflection on people's preferences and emotions, and hence the reason for using a self-report quantitative method of analysis. A quantitative methodological approach is concerned with drawing statistical conclusions about the relationships in an objective and quantifiable manner. Statistical methods were utilised to analyse the data obtained using a qualitative method and presented in the form of numbers and measurement. A series of statistical analyses were conducted on the data obtained from students in the Engineering and Psychology departments. Students from both departments were invited to participate in this research on a voluntary basis.

The research design employed in this study was a descriptive, cross sectional, ex-post facto, predictive research design. As such, students completed the questionnaire at one point in time (Rosenthal & Rosnow, 2008). As a result, there was no random selection or random assignment, and the independent variables in the study were not manipulated in anyway. Furthermore, no experimental or control group was present, hence no strong causal conclusions or inferences could be made in this study. The study aimed to

specifically examine the relationships that existed between the variables under investigation.

Sampling and Procedure

Sample

The sample drawn for this study came from two departments at the University of the Witwatersrand and specifically included final year students. The sample secured was for the purpose of both the pilot study and main study, since the pilot study was a representative of the target study population. The sample was quite substantive and diverse, and was composed of students of a small age range, but of different races, genders and course programmes. The sample also included those who have access to motor vehicles, whether these were petrol, diesel and/or HEV compatible. These demographics will be detailed in the preliminary results section.

The initial sample size proposed for the main study was 100 to 150 students from both departments. This was exceeded as a total of 255 responses were obtained, from which 235 were usable for the main study. The same effect was experienced with the pilot study whereby eight to ten participants were proposed to partake, with the resaercher receiving twelve responses, of which six were from the Engineering department and six from the Psychology department. Descriptive statistics revealed that the number of observations per variable did not vary substantially, such that the response for most variables was 100 percent.

There were only two predetermined factors of this study that were necessary to be met for inclusion or exclusion into this study. These included the departments from which the students were drawn and only final year students were approached. Psychology and Engineering were chosen specifically due to the psychological and technical engineering nature of this research that seeks to examine both the internalised moral states of students when making decisions that are influenced by social, emotional and other important facilitating factors, as well as how their technical framework may influence their decisions to adopt HEVs. A student sample had been chosen since these individuals do not yet own vehicles, but may be considering this important purchasing

decision in the very near future (the upcoming year or two). It is likely that currently employed individuals have already purchased their own vehicles, or are guided primarily by the realistic factor of cost rather than aspiration.

The researcher made use of convenience and snowball sampling methods in order to obtain a sufficient number of students from both departments. Convenient sampling involves obtaining samples that are easily accessible to the researcher, with responses were obtained from those participants who were willing and available to respond (Stangor, 2011). For the purposes of this study, the researcher was able to gain access to the students that were situated on the same university grounds that she attends. Students were more willing to participate as final year students in both departments also engage in their own research studies and understand the difficulties in obtaining a relevant sample for research purposes. Snowball sampling was also used as students were approached and requested to either send the link to the questionnaire to their colleagues or pass on hard copies of the questionnaire to others in their respective course as a means of gaining participation for this study.

However, both convenience and snowball sampling are not without their limitations. Convenience sampling often suffers from a number of biases and can lead to under- or over- representation of participants. For example, access to chemical engineering students was dismal, as compared to civil engineering or mechanical engineering students, and this could have missed important differences in perceptions between the different academic courses in the engineering department. Additionally, reasons as to why some students agreed to take part in the study whilst, others did not are unknown. Chemical engineering students were not approached by either their lecturer or fellow students. Some students were not interested and were too busy to complete the questionnaire. They found it a waste of time. Since the sampling frame is known and not chosen at random, the inherent bias in convenience sampling suggests that the sample is unlikely to be a very good representative of the population being studied, and therefore, undermines the ability to make adequate generalisations from the sample to the population under study. Whilst convenience sampling should be treated with

caution, it is the most cost and time efficient, therefore being the preferred choice to gain a significant proportion of participants.

Procedure

This study made use of volunteers from both the Psychology and Engineering departments at the University of the Witwatersrand for both the pilot study and main study. These individuals were willing to participate and had the time to complete the questionnaire, which enhanced this study as individuals were not made to feel obligated to participate in this study. Completion of the questionnaire was considered consent to participate in the study. Permission to conduct this research was obtained by contacting the course coordinators of the Engineering and Psychology departments via email or telephonically. Once permission was obtained, the course coordinators contacted lecturers within the departments to allow the researcher to access the students for both the pilot study and the main study. Upon receiving permission to access students, the researcher commenced with the pilot study.

The pilot study involved a trial of the adapted UTAUT scale, the Semantic Differential Scales pertaining to each HEV tested in this study in relation to the MAYA principle, and the Moral Justification Scale which was conducted using six final year students from each department, to evaluate the reliability and face validity of these scales. In dealing with the sample for each study, the lecturers made the students aware of the research that was to be carried out and requested for their participation and completion. Upon obtaining permission to conduct the study, participants were provided with a participant information sheet (please refer to Appendix B) and the questionnaire upon arrival to participate in the study. Participants were exposed to pictures of three HEVs of differing typicality and novelty to answer the Semantic Differential scale for each HEV. The three HEVs examined in this study were the BMW i8, the Toyota Prius and the Audi Q5 hybrid (please refer to Appendices F, G and H). The process for this section of the questionnaire was conducted through the use of a slide show, where the participants were shown the three vehicle designs to familiarise them with the stimulus set. Thereafter, they were presented with each consecutive design in isolation and were

asked to rate each design on the 7-point rating scales. Each consecutive design was presented after approximately 30 seconds, the time it would take for participants to fill out the three questions for the specific design. Overall, it took approximately a minute and a half to rate all three vehicle designs. The completed questionnaire was then evaluated statistically and the results analysed. These results will be presented in the results section below.

Once the various scales were validated, the main study commenced. Initially the lecturers from each department were provided with an online link to be distributed via email to their students. This link contained the participant information sheet and the finalised questionnaire that included each of the scales, as well as the image of the Audi Q5 hybrid, for which the researcher found had the highest reliability from the pilot study results, and was therefore chosen as the model to be used for the purposes of answering the Semantic Differential scale (please refer to Appendix I). However, the response rate from the online questionnaire was poor with only thirty participants having responded. The researcher then approached the lecturers to gain access into their lecture sessions as a way for students to answer the questionnaire through the pencil-and-paper method. Once the lecturers granted permission, the researcher visited each lecture session and distributed the questionnaire to the students and remained present until all questionnaires (completed or not) were handed back to the researcher. This worked well and the response rate was substantial. The overall time it took for this procedure was thirty minutes with fifteen minutes used to fill out the questionnaire. Completed questionnaires were coded/scored manually, evaluated statistically using the program SPSS, and the results were subsequently analysed.

Figure 4: Picture of the Audi Q5 Hybrid as Presented to the Participants in the Main Study.



Measures

For the purpose of this study, a number of measures were used. Due to the quantitative nature of the research questions and the sample size, a structured questionnaire was considered the most appropriate instrument to use to collect data. Six separate scales were used to collect data on: demographics; factors affecting Intention to Adopt based on the UTAUT model; students' perceptions of the Aesthetic Appeal of the HEV measured through a Semantic Differential scale pertaining to the MAYA principle; the degree to which students are able to morally dissociate from the possible negative effects of fossil fuel use on the environment as measured by a Moral Justification scale; and examing people's affiliation towards nature and the environment through the Nature Relatedness scale. The following measures were used to obtain information about the variables under investigation.

Demographic questionnaire

A demographic questionnaire was designed by the researcher to capture information regarding a number of pertinent demographic variables within the study including age,

gender, race, the academic module participants engaged in, and whether the participants had access to a motor vehicle and if so what type of motor vehicle (petrol, diesel, and/or HEV) (please refer to Appendix D). It consisted of short, closed-ended questions and took most participants approximately five minutes to complete. The demographics obtained were used to describe the sample and for the additional analyses including ANOVAs, t-tests and separate multiple regression for only certain biographical information.

Adapted UTAUT Model

The UTAUT model can be considered as one of the most important models in behavioural psychology consisting of influential constructs and moderators that affect individuals' intention and actual product usage (Genuardi, 2004). According to Oshlyansky, Cairns, and Thimbleby (2007), the UTAUT model is meant to be adjusted to fit the technology under investigation and therefore rewording of the items is essential. As such, items for the UTAUT constructs of interest were adapted from the UTAUT scales used by Venkatesh et al. (2003) and Marchewka et al. (2007) to relate to HEVs. This was achieved through a tense change to future tense ("I will…") and a change in wording from "system" and "Blackboard" to "Hybrid Electric Vehicles" (please refer to Appendix E). The items utilised in the UTAUT model were key predictors of intentions to adopt the proposed sustainable technology.

The final UTAUT model for this study comprises 19 items. The subscales are Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Intention to Adopt. All 19 items are measured on a 5-point Likert scale ranging from 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. Individuals were required to indicate, using the 5-point scale the extent to which they agree or disagree with the statements for each subscale. Sample features for each subscale include, "Using a Hybrid Electric Vehicle will be more cost effective" (Performance Expectancy), "Learning to use a Hybrid Electric Vehicle would be easy for me" (Effort Expectancy), "People who influence my behaviour think that I should use a Hybrid Electric Vehicle" (Social Influence), "I will have the resources necessary

to purchase a Hybrid Electric Vehicle" (Facilitating Conditions), and "My feelings towards using a Hybrid Electric Vehicle are positive" (Intention to Adopt). Higher scores on these subscales indicated high levels of general acceptance and strong intentions to use HEVs if given the opportunity. It was established by the researcher that items 5 of the Facilitating Conditions subscale were reverse scored to avoid response bias.

In consideration of the psychometric properties of the scales, "All constructs with the exception of use, were modelled using reflective indicators. All internal consistency reliabilities were greater than .70", according to Venkatesh et al. (2003, p.457). Reliability scores ranging from 0.7 to 0.8 are generally considered to be acceptable, whereas very high scores imply redundancy (Gravetter & Forzano, 2011). Very low scores on internal consistency indicate that items may be measuring something different. Since the UTAUT model was adapted to fit the purpose of this study, the reliability and validity of this measure are aspects that are addressed in this study. Venkatesh et al. (2003) received reliability scores between 0.7 and 0.9 for the subscales in the preliminary derivation of the original UTAUT model. After the pilot study was conducted, the internal consistency reliabilities of the final UTAUT model ranged between 0.678 for Performance Expectancy, 0.653 for Effort Expectancy, 0.804 for Social Influence, 0.611 for Facilitating Conditions, and 0.879 for Intention to Adopt. This suggests quite acceptable internal consistency reliabilities for the adapted UTAUT scale.

Venkatesh and colleagues' (2003) UTAUT model has been shown to have merit in South Africa. On a sample of 72 physicians operating in South Africa, Cohen, Bancilhon, and Jones (2013), aimed to draw on the UTAUT model to develop a model of physician acceptance of e-prescribing within the South African context. They employed the original model by Venkatesh et al (2003) which demonstrated good reliability. Their reliability scores also ranged from 0.7 to almost 1.0 indicating some redundancy. The current study which was also situated in the South African context, yielded reliability scores between 0.55 and 0.8 and were not as high due to the adaptation of the scale.

Semantic Differential Scale

Visually appealing technologies are said to have a primary influence on people's acceptance and use of technologies (Thatcher, 2012). Aesthetics, or visual appeal, is an emotional state experience by individuals and is an initial reaction or emotion experienced when an individual is exposed to a product. A scale that taps into emotional stimulation is the Semantic Differential scale that is a method used to measure the emotional content of a word objectively as it has been suggested by Osgood, Suci, and Tannenbaum (1957) that an object stimulates an emotional reaction within individuals and the one way to capture this is through the use of emotion-based words. For this reason, the Semantic Differential scale was utilised to measure the aesthetic properties of HEVs, which contained three items pertaining to typicality (Poor example-Good example), novelty (Not original-Original), and aesthetic preference (Ugly-Beautiful), respectively (Diels et al., 2013) (please refer to Appendices F, G, H, and I).

For typicality, participants had to indicate how good an example each design model is as an instance of the category "car". In terms of novelty, students had to indicate the extent to which they found the design of the HEV to be innovative or more traditional. Aesthetic preference simply looked to judge whether students found the HEVs to be visually appealing or not. No internal consistency measures were mentioned by Diels et al. (2013) and Hekkert et al. (2003), however, for this study, reliability measures were calculated. Although the pilot study did not reveal very high internal consistencies for two of the three Semantic Differential scales, the researcher decided to utilise the original bipolars as proposed by Diels et al (2013) as they used the same scale for their research pertaining to HEVs. The reason for the differences in reliability scores may be due to the responses obtained for each design. The reliability scores for the designs were 0.339 for the BMW i8 (SD1), 0.656 for the Toyota Prius (SD2), and 0.884 for the Audi Q5 Hybrid (SD3). Since this technique is used to collect the subjective emotions of consumers to a specific object, product, or word, these scales need to be self-developed for any study utilising this technique (Osgood et al., 1957). From the results obtained from the pilot study, the researcher opted to analyse only one design in the

main study, this being the Audi Q5 Hybrid, which had the highest internal reliability score. The reliability score for this design from the results of the main study were also favourable as that of the pilot study, suggesting a good level of reliability for this scale.

Semantic Differential Scales, according to Stangor (2011), are better able to assess an individual's feelings or attitudes and opinions than any other self-report measure. The way this scale operates is to have the product presented once on the top of the page and then items consisting of bipolar adjectives located at two end points (or emotional extremes) as the basic response format. The function of the scale is to allow the participant to express his or her feelings towards the specific product by marking a point on the dimension. The scale makes use of a 7-point Likert scale ranging from 1 (slightly) to 7 (very), and where 4 would indicate a "neutral" response. A high score on this scale means that the HEV shows a higher level of aesthetic appeal, in other words, the participant has indicated that the motor vehicle has a more favourable appeal, visually, and is a good example of an HEV.

Moral Justification scale

Moral Disengagement, in general, is a means of rationalising one's unethical or unjust actions to avoid shame or guilt. This strategy was measured through a three-item scale of Moral Justification (please refer to Appendix J). Items pertaining to this scale are taken from the Model of Normative Behaviour derived from Social Cognitive Theory and the Theory of Planned Behaviour (LaRose & Kim, 2007), as these were the only items from this model that pertained to this study. The Model of Normative Behaviour utilises a 7-point Likert scale ranging from (1) strongly disagree to (7) strongly agree. A high score on this scale indcates a high level of moral justification. Sample items from this scale include "Everyone else is driving general combustion vehicles, it is OK for me to do it" and "There is nothing wrong with driving general combustion vehicles". LaRose and Kim (2007) reported 0.69 reliability estimate for their moral justification scale, being very similar to that of this study which yielded a Cronbach Alpha of 0.65, which can be can be considered as acceptable. The researcher established after the data was collected that item 4 would need to be reversed scored to avoid response bias.

Nature Relatedness Scale

The Nature Relatedness Scale was utilised as a way to gain an understanding into students' concern towards the environment. The scale was thus used as a general measure of Environmental Concern (please refer to Appendix K). This scale, according to Nisbit, Zelenski, and Murphy (2009), is a self-report measure of the emotional, cognitive, experiential, and physical aspects of individuals' connection to nature. This scale has been constructed for the purposes of measuring these aspects simultaneously and collectively since no existing scale has been found to capture all of these elements related to the person-nature relationship. The notion of *nature relatedness* describes a person's level of association with nature by considering a person's appreciation for and understanding of their interconnectedness, as well as the importance of all living things through their emotions, therefore linking it to the concept of Environmental Concern (Nisbet et al., 2009). This scale has been used by Nisbet and colleagues in other papers (Nisbest, Zelenski, & Murphy, 2011; Nisbest & Zelenski, 2013; Zelenski & Nisbet, 2014) as well as by other researchers such as Karlegger and Cervinka (2009), Tauber (2012), and Keniger, Gaston, Irvine, and Fuller (2013). Within a South African context, the only known published article was by Thatcher et al. (2014).

This scale also measures the degree to which individuals see themselves as part of the natural world, and as such, if a person values and feels a sense of concern for the environment, they would then want to protect it or they will feel an obligation towards the environment. For the purpose of this study, each participant rated each of the 20 candidate Nature Relatedness statements on how well each item describes their level of Environmental Concern using a 5-point Likert scale ranging from 1 (disagree strongly) to 5 (agree strongly), such that higher scores indicate a stronger obligation towards the environment.

This scale has been standardised by Nisbet and colleagues in their use of this scale in much of their research. They have already established that items 2, 3, 10, 11, 13, 14, 15, and 18 are to be reversed scored to avoid response bias. This scale has been tested by Nisbet et al. (2009) who found that the scale yielded a Cronbach's Alpha of .87.

They found that those with higher scores on the scale demonstrate a stronger obligation towards the environment indicating high internal construct validity. The current study yielded a reliability coefficient of 0.83 which is very close to that of the Nisbet et al. (2009) study, indicating a high level of internal consistency.

Data analysis

Pilot Study

Firstly, psychometric tests (Cronbach Alphas) were conducted on the adapted UTAUT scale, the Semantic Differential Scales, and the Moral Justification Scale using data obtained from the pilot study. This allowed the researcher to determine whether these scales were reliable and valid. Results revealed that some scales were more reliable than others. Since the initial reliability scores for the Effort Expectancy subscale (of the adapted UTAUT scale) were low, an exploratory factor analysis was conducted to determine how the items held togther and based on results of this analysis, the scale was re-constructed. The results of the pilot study, in terms of the reliabilities obtained for each scale, together with the changes made to the scales in terms of rewording and the removal and/or additions of items is provided for in the results section of this research report.

Main study

Due to the inherent quantitative nature of the study, it was appropriate to run descriptive statistics and conduct preliminary analyses in order to determine the nature of participant responses and the questionnaire used. These descriptive statistics included obtaining means, frequencies, standard deviations, and Kolmogorov-Smirnoff scores to assess normality. Descriptive statistics were used for classifying, summarizing and describing the quantitative data collected.

Normality for this research was assessed via the Kolmogorov-Smirnoff tests as well as histograms. An assessment of normality of data is a prerequisite for many statistical tests such as linear regressions and multiple moderated linear regression because normal data is an underlying assumption in parametric testing (Howell, 2011). The Kolmogorov-Smirnoff is a statistical test that provides an objective judgement of

normality, but has the disadvantage of sometimes not being sensitive enough to very large or very small sample sizes. Graphical or visual inspection of the data accounts for this disadvantage as it allows good judgements of normality when statistical tests might be over or under sensitive. However, graphical representations lack objectivity.

The p-values of the Kolmogorov-Smirnoff test were calculated, where values indicating $p > 0.05$ were classified as normal (Dancey & Reidy, 2004). It was found that the data in the sample was normally distributed for the majority of the variables for Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and the Semantic Differential scales. Due to the high level of sensitivity of Kolmogorov-Smirnov as a test of normality, an additional evaluation of the histograms was also conducted (Churchill & Iacobucci, 2009). Histograms were assessed in order to determine whether the majority of the scores fell towards the centre of the distribution, which indicated that all variables appeared to be sufficiently normally distributed to allow for certain parametric analyses to be carried out.

After assessing and establishing normality, specific statistical techniques were chosen to investigate the main research questions. To answer the first research question pertaining to the direct impact of the independent variables (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal) on the dependent variable of Intention to Adopt, a multiple linear regression was performed to discover which of the two or more independent variables influenced or predicted the dependent variable. Multiple regression is an analysis technique that allows for patterns of relationships to be examined between multiple predictor variables and a single outcome variable by the researcher (Howell, 2011). The validity of this technique is highly dependent on a range of assumptions which need to be fulfilled, including: normality, interval data, equality of variance, linearity, measurement error, and multicollinearity (Howell, 2011). These assumptions were considered prior to conducting the multiple regression analysis in order to address the first research question in the study. In addition a stepwise regression was performed to determine which of the multiple independent variables would be the best predictor of Intention to

Adopt HEVs. The assumptions of a stepwise regression are the same as multiple regression.

To answer the second and third research questions, multiple moderated linear regressions were carried out to determine the linear equation that produces the most accurate predicted values for *Y* (Intention to Adopt) using multiple predictor variables. In other words, the multiple moderation regression analysis was used to determine whether Moral Justification and Environmental Concern influenced the relationship and strengthened or weakened the relationship between the independent variables of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal and the dependent variable of Intention to Adopt HEVs. The same assumptions of multiple regression applies to this method of analysis which were considered prior to conducting this analyses.

In addition to the analyses conducted to answer the main research questions, further analyses were performed to determine whether any biographical variables had an impact on Intention to Adopt HEVs. Firstly, the researcher ran ANOVAs and t-tests for each biographical variable to determine which of these variables might possibly provide different predictor inputs. Secondly, based on the results of the ANOVAs and t-tests and the discretion of the researcher, separate multiple regressions on the variables of interest were conducted. The results of all the above analyses will be presented in the following section.

Ethical considerations

The researcher obtained ethical clearance from the Human Research Ethics Committee of the University of the Witwatersrand in order to ensure that the study met strict ethical standards (please refer to Appendix A).

There are various ethical issues which have to be taken into account throughout the research process. One particulary important consideration that was accounted for was the issue of confidentiality and anonymity. According to Babbie and Mouton (2001), confidentiality is the ability of the researcher to identify the participants' response but makes the active promise not to do so publically. Anonymity is the opposite where the

researcher does not have the ability to identify a response of a particular participant. Confidentiality was maintained throughout the research process , for both the pilot study and main study, with participants only providing demographic information excluding their names. Anonymity was guaranteed only to a certain extent due to the researcher being aware of those participants who participated in the pilot study.

For the main study, the participants remained anonymous to the researcher since a reference number for each questionnaire was used for identification and data analytic purposes. Once the research process had been completed, the data, from both the pilot study and main study, was stored in a password protected excel document, which only the researcher and her supervisor were aware of for the online data. The hardcopy data in the form of questionnaires were stored in a sealed box while this study was in progress and after this study had been completed.

Participants were not harmed physically or psychologically in any way during the data collection process. The entire questionnaire comprised closed-ended questions, and therefore there were no probing questions which could psychologically harm the participant (Babbie & Mouton, 2001). Participants were given a participant information sheet for both the pilot study and main study explaining the purpose of the research; the voluntary nature of participation; its expected duration; and participants' right to decline participation in the study or to withdraw from the study once it has begun, but not once it has been completed due to the anonymity of responses. Those who completed the questionnaire volunteered and simultaneously provided their consent to participate. Therefore, voluntary participation as well as informed consent was achieved. Participants were also informed that the results of this study would be reported as part of the research report. Participants were also made aware that the data collected may be used for further research activities, and/or for publication purposes or in conference presentations.

Participants were also informed who they could contact the researcher about any questions pertaining to the research, and would be given the opportunity to contact the researcher for queries pertaining to the results and nature of the research. If participants

would like to access this report in future, access would be granted to students via library services following final submission and completion of the marked report.

Chapter 4: Results

The following chapter presents a comprehensive analysis of the statistical results. This chapter begins with a summary of the findings from the pilot study with an examination of the change in the internal consistency reliabilities from the pilot study data to the results obtained in the main study and the reasons behind such differences. The reliability coefficient for the Nature Relatedness scale will be provided in the same table, although was not piloted. A brief examination of the descriptive statistics from the main study will follow in order to describe the sample. Demographic information obtained was used to describe the sample of this study, as well as for running the additional analyses of ANOVAs, t-tests, and addional multiple moderated regressions. The results of analyses assessing the relationship between the variables in the main study – a multiple regression analysis and multiple moderated regression analyses are also provided for in this section.

It must be noted that all statistical analyses conducted were carried out using the SPSS statistical analysis package, version 22.

Statistical Abbreviations

For ease of reference, a key of the abbreviations is utilised in certain parts of the results section where the size of tables is insufficient to hold lengthy information. Table 1 provided below can be referred to when necessary.

Table 1: Summary of Abbreviations for Key Variables

Variable	**Abbreviation**
Performance Expectancy	PE
Effort Expectancy	EE
Social Influence	SI
Facilitating Conditions	FC
Intention to Adopt	IA
Moral Justification	MJ
Environmental Concern	EC
Semantic Differential scale	SD

Pilot Study

The following table provides changes in the internal reliabilities obtained between the pilot study and main study for the adapted UTAUT model, the Semantic Differential scales, and the Moral Justification scale. The reliability coefficient for the Nature Relatedness scale will also be provided that was utilised in the main study. According to the theory of reliability, the Cronbach's alpha is used to measure internal consistency or reliability in a versatile way, as it can measure items scored with three or more possible values (Huck, 2012). According to Gravetter and Forzano, (2011), a Cronbach alpha ranges from 0.00 to +1.00, with anything above 0.7 being deemed as acceptable and anything below 0.4 as poor and unacceptable.

Table 2: Cronbach's Alpha for All Scales and Subscales in the Pilot Study and Main Study

Name of scale or subscale	**N**	**Cronbach's Alpha - Pilot Study**	**N**	**Cronbach's Alpha – Main Study**
PE	4	0.558	3	0.678
EE	4	0.593	2	0.653
SI	6	0.611	5	0.804
FC	6	0.777	6	0.611
IA	5	0.913	5	0.879
SD1	3	0.339		
SD2	3	0.581		
SD	3	0.884	3	0.671
MJ	5	-0.499	4	0.649
NR			20	0.828

The pilot study was used solely to determine whether the above mentioned scales, because they were adapted for this study, would be reliable to use in the main study. Some changes were made to the different subscales which could account for the changes in reliability estimates as seen from the table above. The following changes were made after the pilot study: the removal of item 4 from the Performance

Expectancy subscale, therefore resulting in a higher reliability coefficient from 0.558 to 0.678, with three items remaining. This suggests that reliability of this subscale falls within the acceptable range. There was an addition of item 5 to the Effort Expectancy subscale, as well as the removal of items 1, 3, and 4 from the scale after consideration of the exploratory factor analysis results. The results of this analysis revealed that items 2 and 5 of the existing scale formed part of factor 1 and items 3 and 4 formed part of factor 2. Reliability analyses of these two factors were conducted, with factor 1 generating the higher measure of internal consistency, therefore the scale was re-constructed and resulted in a two-item subscale generating an acceptable Cronbach Alpha of 0.653 (for further information of these results, please refer to Appendix L). Item 3 was removed from the Social Influence subscale of six items, resulting in a five-item scale, changing the reliability from acceptable (0.611) to highly acceptable (0.804). There was a change in reliability estimates from 0.777 to 0.611 between the pilot study and main study for the Facilitating Conditions subscale with the removal of two items (items 1 and 6) resulting in a four-item scale . The Intention to Adopt subscale reliability coefficient went down from 0.913 to 0.879 with no changes made to this subscale, yet remained within the acceptable range. The reliability coefficient decreased for the Semantic Differential scale of the Audi Q5 hybrid from 0.88 to 0.67, yet still remained within the acceptable range without any changes made to the scale.

The changes in relialibility coefficients may be due to the nature of the responses at the time of the pilot study and main study, as well as the sample size at both times. The reliability coefficient of the Moral Justification scale in the pilot study resulted in a negative number due to a negative average covariance among the items which violates reliability model assumptions. For the main study, the item codings were checked, and item 1 was removed resulting in a three-item scale, which allowed for a higher and positive reliability coefficient of 0.649, making for an acceptable and reliable scale. . The Nature Relatedness scale yielded a Cronbach alpha of 0.828 and therefore reliability for this scale falls within the acceptable range, indicating good internal consistency.

Descriptive Statistics

It is common practice to conduct basic descriptive analysis in order to describe the characteristics of a given sample (Stangor, 2011). In line with this practice, a complete representation of the demographic characteristics of the sample, including frequencies and percentages, means, standard deviations, minimum scores, maximum scores, Kolmogorov-Smirnov p-values is presented below.

The only biographical information attained was for age, which ranged from 20 to 44 years with a mean of 22.12 and a standard deviation of 2.739 as seen in Table 3 below.

Table 3: Descriptive Statistics for Age

Mean	**Std Dev.**	**Minimum**	**Maximum**	**K-S p-value**
22.12	2.739	20	44	> 0.05

Table 4: Descriptive Statistics for Gender

	N	**%**	**K-S p-value**
Male	115	48.9	> 0.05
Female	120	51.1	
Total	235	100	

As depicted above, 115 were male (48.9%) and 120 female (51.1%).

Table 5: Descriptive Statistics for Race

	N	**%**
Black	87	37.0
Coloured	11	4.7
Asian	3	1.3
Indian	37	15.7
White	90	38.3
Other	6	2.6
Total	234	100

The majority of participants were White (38.3%) and Black (37%), followed by Indians (15.7%). There was relatively a small number of Coloureds (4.7%) and Asians (1.3%). Six individuals classified themselves as a member of a racial category entitled "other", pointing to the widespread acceptance amongst participants of the chosen racial categories.

Table 6: Descriptive Statistics for the Academic Course

	N	**%**
Organisational Psychology	34	14.6
General Psychology	64	27.5
Industrial Engineering	13	5.6
Civil Engineering	63	27.0
Mechanical Engineering	33	14.2
Chemical Engineering	1	0.4
Aeronautical Engineering	12	5.2
Electrical Engineering	13	5.6
Total	233	100

The majority of participants came from General Psychology (N=64) and Civil Engineering (N=63). The response rate from Chemical Engineering students was very poor with only student competing the questionnaire from that academic programme.

Table 7: Descriptive Statistics for Self-owning A Motor Vehicle

	N	**%**	**K-S p-value**
Yes	112	47.9	> 0.05
No	122	52.1	
Total	234	100	

52.1 % of the sample did not own their own motor vehicle which is more than half the sample. 47.9% did own their own motor vehicle and thus could answer the question on what type of motor vehicle they owned.

Table 8: Descriptive Statistics for Driving A Motor Vehicle Owned by the Family

	N	**%**	**K-S p-value**
Yes	150	63.8	> 0.05
No	85	36.2	
Total	235	100	

150 students (63.8%) stated that they drove a motor vehicle that was not their own but rather one owned by their family. This is a considerable amount of students compared to those who stated they did not drive a motor vehicle owned by parents or guardians (36.2%).

Table 9: Descriptive Statistics for Having Access to a Motor Vehicle

	N	**%**	**K-S p-value**
Yes	192	81.7	> 0.05
No	43	18.3	
Total	235	100	

Based on the previous two questions, 192 participants suggested that they have access to a motor vehicle, with only a small percentage stating otherwise (18.3%).

Table 10: Descriptive Statistics for the Type of Motor Vehicle

	N	%	K-S p-value
Petrol	181	77.0	> 0.05
Diesel	13	5.5	
Total	194	82.6	

Based on the previous three questions, those who drove their own motor vehicle or one owned by family and thus having access to one, stated the type of motor vehicle they had access to. The majority of students had access to a petrol-based motor vehicle (77%). Thirteen students also stated that in additional to petrol-based motor vehicles, they also had access to diesel-based motor vehicles. One student stated that they had access to all three types of motor vehicles including an HEV.

Multiple Regression and Multiple Moderated Regression

Before selecting which test to analyse the data, the nature if the data was assessed in order to decide whether certain assumptions for parametric tests were fulfilled such as interval data and normality (Dancey & Reidy, 2004). The data was interval for the different sections of the questionnaire. The first research question attempted to establish the extent to which Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal could be used to predict Intention to Adopt HEVs.

Assumptions of Multiple Regression and Multiple Moderated Regression

Basic Assumptions

Firstly, normality was established via a close inspection of the histograms which were deemed to be sufficiently symmetrical to allow for multiple regression and multiple moderated regressions to be conducted. The data was interval for all parts and scales of the questionnaire (Dancey & Reidy, 2004).

Homoscedasticity

Homoscedasticity can be seen as the equivalent to establishing equality or homogeneity of variance. This assumption is based on ensuring the predictability in scores for one

variable is approximately the same as all values of another variable (Howell, 2011). In a multiple regression and multiple moderated regression analysis, differences between values can be detected via the assessment of the shape of the residuals scatterplot. The patterns appeared to be mainly rectangular in the residuals plot with the majority of the scores concerned around the centre, and points falling predominantly between -2.00 and +2.00 standard deviations. The points were thus evenly distributed which meant that the assumption of equality of variance could be established in this research (Dancey & Reidy, 2004).

Multicollinearity

Multicollinearity can be defined as the extent to which independent or predictor variables are highly correlated or related to one another (Howell, 2011). When the correlations between the independent variables are very high then the variables can be considered to be multi-collinear. For moderation analyses, when two or more predictor variables are quantitative, it is necessary to centre the scores on each of the predictors before computing the product term that represents the interaction (Whisman & McClellend, 2005). The reason behind centring, which is also called a mean deviation, is to reduce the correlation between the product term and the predictor scores, so that the effects of the predictor variables are distinct from the interaction. The scores of this study's predictor variables and moderator variables were centred by subtracting the sample means from the scores on each predictor and moderator. Below are the results of the correaltions between the predictor variables.

Table 11: Pearson's Correlation Coefficients for Intention to Adopt, Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal

		IA	PE	EE	SI	FC	SD3
Pearson Correlation	IA	.					
	PE	.395*	.				
	EE	.276*	.270*	.			
	SI	.486*	.281*	.038	.		
	FC	.552*	.309*	.191*	.346*	.	
	SD	.162*	.142*	.146*	.115*	.121*	.

* $p < 0.05$

Multiple Regressions and Multiple Moderated Regressions Results

Based on the establishment of all the assumptions, a multiple regression analysis was used to understand which of the multiple independent variables would be the best predictors of Intention to Adopt HEVs to answer question one. A multiple moderated regression model was tested in order to answer the second research question which sought to investigate whether the association between all the independent variables of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal, and the dependent variable on Intention to Adopt depends on the extent to which people morally dissociate from the possible negative effects of their behaviour, in other words Moral Justification. To avoid potentially problematic high multicollinearity with the interaction term, the independent variables and the moderator variables were centred and the interaction terms were created (Aiken & West, 1991). After computing the multiple interaction terms for this research question, the predictor variables and interactions were entered into a simultaneous regression model.

A multiple moderated regression model was also tested in order to answer the third research question which investigated whether the association between all the independent variables, and the dependent variable depends on the extent to which people have an affiliation with nature, in other words the extent to which people are concerned about the environment. Below are the results presented for each moderator variable, including the results for the first research question.

Table 12: Moderated Linear Regression for Moral Justification

Variables	**Model 1**	**Model 2**	**Model 3**
PE	0.150*	0.135*	0.135*
EE	0.148*	0.140*	0.140*
SI	0.307*	0.311*	0.311*
FC	0.367*	0.381*	0.381*
SD	0.040	0.039	0.039
MJ		-0.164*	-0.164*
PE*MJ			0.840*
EE*MJ			-0.537
SI*MJ			0.315
FC*MJ			-0.125
SD*MJ			0.064
$\mathbf{R^2}$	0.446	0.470	0.495
$\mathbf{\Delta R^2}$		0.024	0.025

* $p < 0.05$

Table 13: Moderated Linear Regression for Environmental Concern

Variables	Model 1	Model 2	Model 3
PE	0.150*	0.150*	0.150*
EE	0.148*	0.148*	0.148*
SI	0.307*	0.307*	0.307*
FC	0.367*	0.367*	0.367*
SD	0.040	0.040	0.040
NR		0.040*	0.040*
PE*NR			0.227
EE*NR			-0.480
SI*NR			-0.404
FC*NR			0.066
SD*NR			0.733
$\mathbf{R^2}$	0.446	0.445	0.444
$\mathbf{\Delta R^2}$		0.001	0.001

* $p < 0.05$

The results above revealed a significant relationship between Performance Expectancy ($\beta = 0.150$, $p < 0.05$), Effort Expectancy ($\beta = 0.148$, $p < 0.05$), Social Influence ($\beta = 0.307$, $p < 0.05$), Facilitating Conditions ($\beta = 0.367$, $p < 0.05$) and Intention to Adopt (R-square = 0.446; $F_{5,229} = 38.674$; $p < 0.05$) for model 1. The adjusted R-square value showed that 45.1% of the variance in Intention to Adopt was explained by four of the five predictor variables, and hence a strong positive relationship was established.

Furthermore, a forward stepwise multiple regression was performed in order to assess which of the four independent variables were the strongest predictors. The analysis revealed that Facilitating Conditions was the best predictor of Intention to Adopt ($\beta = 0.551$, $p < 0.05$), accounting for 30.1% of the variance in Intention to Adopt. With Facilitating Conditions and Social Influence, 39.7% of the variance in Intention to Adopt was accounted for. Together Facilitating Conditions, Social Influence, and Effort Expectancy accounted for 42.8% of the variance in Intention to Adopt. With all four

predictor variable (Facilitating Conditions, Social Influence, Effort Expectancy, and Performance Expectancy), 44.6% of the variance was accounted for. Finally, the Semantic Differential scale had no predictive validity ($p > 0.05$) and hence no relationship was evident between this scale and Intention to Adopt.

For model 2, the results of table 12 indicate that the interaction term (Moral Justification) has some sort of influence over the relationship between the independent variables of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating conditions and Aesthetic Appeal, and the dependent variable of Intention to Adopt ($p < 0.05$). This result is made evident from the results of model 3 in table 12, where a significant interaction term was present between Performance Expectancy and Moral Justification accounted for a significant proportion of variance in Intention to Adopt ($\beta = 0.840$; $p < 0.05$).

The results of model 2 from table 13, show no influence of Environmental Concern over the relationship between the independent and dependent variables ($p > 0.05$). As such, the results revealed no significant interaction effects of Environmental Concern for the interaction term between Performance Expectancy and Environmental Concern ($\beta = 0.227$; $p > 0.05$), Effort Expectancy and Environmental Concern ($\beta = -0.480$; $p > 0.05$), Social Influence and Environmental Concern ($\beta = -0.404$; $p > 0.05$), Facilitating Conditions and Environmental Concern ($\beta = 0.066$; $p > 0.05$) and, Aesthetic Appeal and Environmental Concern ($\beta = 0.733$; $p > 0.05$) on Intention to Adopt.

Multiple Regressions – Biographical Information

Additional multiple moderated regressions were computed using the biographical data as grouping variables. Only three biographical data questions were used to test the interaction effects of Moral Justification and Environmental Concern, being the academic course that students were registered under, their gender and the type of motor vehicle they had access to (petrol, diesel and/or HEV). This was based on the discretion of the researcher as well as the results of the ANOVA and t-test results conducted for each biographical variable to determine where differences lie. The results of the ANOVA and t-test analyses revealed that differences only occurred among the different

academic courses that the students studied within. Therefore the researcher chose two other variables to examine being gender and what type of automobiles students' had access to.

After it was determined which variables would be analysed, the multiple moderated regressions were conducted on such variables. The results suggested that the interaction term between Performance Expectancy and Moral Justification accounted for a significant proportion of variance in Intention to Adopt for those within General Psychology ($\beta = 1.547$; $p < 0.05$); The interaction term between Social Influence and Moral Disengagement accounted for a significant proportion of variance in Intention to Adopt for those within Mechanical Engineering ($\beta = 1.113$; $p < 0.05$).

For Environmental Concern, the interaction term between Performance Expectancy and Environmental Concern accounted for a significant proportion of variance in Intention to Adopt HEVs for those within General Psychology ($\beta = -9.986$; $p < 0.05$). A significant interaction between Social Influence and Environmental Concern was found that accounted for a significant amount of variance in Intention to Adopt for those in General Psychology ($\beta = -0.033$; $p < 0.05$). A significant amount of variance in Intention to Adopt for those in Civil Engineering was accounted for by the interaction between SD and Environmental Concern ($\beta = 1.934$; $p < 0.05$).

A significant interaction was found between Effort Expectancy and Moral Justification for females; ($\beta = -1.238$; $p < 0.05$). A significant interaction was also found between SD and Moral Justification for females ($\beta = -1.059$; $p < 0.05$).

A significant interaction between Performance Expectancy and Moral Justification was found that accounted for a significant amount of variance in Intention to Adopt for those who had access to petrol motor vehicles ($\beta = 0.875$; $p < 0.05$). A significant amount of variance in Intention to Adopt for those with access to petrol vehicles was accounted for by the interaction between for Effort Expectancy and Moral Justification ($\beta = -0.863$; $p < 0.05$).

Chapter 5: Discussion

This section aims to critically address the results of this study with regard to the conceptual framework explored earlier in the research. The main objectives of this study was to firstly investigate whether the factors or subscales of the adapted UTAUT model (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions) and the affective design of sustainable technologies, specifically HEVs, would explain Intention to Adopt HEVs. Secondly this study sought to assess the moderating effects of Moral Justification and Environmental Concern. Additional multiple moderated regressions were used to test whether any differences in the moderating effects of Moral Justification and Environmental Concern existed between the genders, the different academic courses that students studied within, the type of motor vehicles students had access to. For the purpose of this chapter a discussion of the results obtained from the pilot study's reliability coefficients will be carried out, followed by a discussion of the main study multiple regression and multiple moderated regression analyses; all of which in some way address the overarching research questions which were laid out earlier.

Discussion of Research Questions, Findings and Practical Limitations

Reliability Scores - Pilot Study and Main Study

A key element in the design of a research project is the use of a pilot study that informs both the process and the outcome of research (Kilanowski, 2011). Pilot studies are utilised to represent different choices including representing a feasibility study to prepare for the main study, or acting as part of the research plan to develop or refine the methodology. For the purposes of this research, the pilot study shared similar aims and research questions and was used solely to determine the adequacy of using the adapted UTAUT model, the Semantic Differential scales and the Moral Justification scale through testing the internal consistency estimates of these measures.

When examining the internal consistency estimates for the different UTAUT subscales including, Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Intention to Adopt; for the three Semantic Differential scales; and for

the Moral Justification scale from the pilot study, it was found that internal consistency reliability coefficients ranged from poor to highly acceptable (-0.4 to 0.9) for both the pilot study and main study. The reasons behind this range is due to some factors as specified by Hertzog (2008) that were evident in this study. Hertzog mentions that the pilot sample, being twelve in this case, exhibits variability in terms of being a representative of the study's population. When a pilot study sample is too homogenous, it can result in low estimated alphas. The sample for both the pilot study and main study made use of both Engineering and Psychology students mainly from General Psychology and Civil engineering and thus could have been a reason as to why some reliabilities were poor. Hertzog (2008, p. 183) also suggests that the Cronbach Alpha of a scale is likely to be more precise with length such that there is "a twofold change in length changing interval limits by approximately 0.1". Measurement errors are smaller in the measurement values obtained from longer scales than from shorter scales. The length of the subscales of the UTAUT and the Moral Justification scale may have been a determining factor for the reliability scores obtained, such that they consisted of less than ten items each which suggests a very short scale (Hertzog, 2009). In addition to this, the range in reliability scores may also be due to the expression or wording of the items in each scale and/or subscale, as well as a misinterpretation of the meaning of the items (Ercan, Yazici, Ocakoglu, Sigirli, & Kan, 2007). In terms of the expression of the items in the scales and/or subscales, and the misintepretation of the items, the way an item is phrased is important, because if it is not expressed in the manner as required, different interpretations may occur at each administarion of the scale and/or subscale resulting in different answers being given. This infers that items need to be prepared on the basis of there being item-answer relations (Ercan et al., 2007). This means that items need to be phrased in such a manner to coincide with the experiences and knowledge of the respondents; to include only one meaning; and to be arranged appropriately in order to ensure that the item is expressed in a manner in which the researcher intended, and does not lead to misunderstanding through misinterpretation (Ercan et al., 2007). The researcher had made an active effort to take into consideration such factors. However, after the data was analysed, the results revealed that there was a

wide range of reliability coefficients from poor to highly acceptable, and non-significant results for both the pilot study and main study.

The majority of the scales and subscales used in this study comprised of items ranging from two items (Effort Expectancy subscale), to twenty items for the Nature Relatedness scale. Poor to moderate reliabilities for the Semantic Differential scales may possibly be due to the length of the scales, consisting of only three items each for both the pilot study and main study, and/or due the poor formulation of the items. The reason behind poor reliability coefficients may also be due to Semantic Differential scales being ordinal in nature and are generally not converted into continuous scales as was the case in this study. This study chose to combine the items of each Semantic Differential scale since it was used as an independent variable and had to meet certain assumptions for the chosen analyses, as mentioned previously. In addition, all other independent variables in the study were converted to continuous variables by calculating the total and average score for each scale for these same purposes. Together with such tranformations, all independent variables and moderator variables were centred for the purposes of the multiple regression analyses in an attempt to reduce the correlation between the product term and the predictor scores, so that the effects of the predictor variables are distinct from the interaction.

The researcher made use of the MAYA technique to analyse Aesthetic Appeal based on its use in another study by Diels et al. (2013) and was not specially formulated for this study. In the original study by Diels et al. (2013), the researchers made use of the specific bipolars as utilised in this study. The differences in means of the each bipolar was calculated for the two samples in their study since it was a comparative study that focused on the differences in perception between the two groups of participants, and, therefore each were analysed separately, which resulted in fairly acceptable reliability scores. As such, the low to moderate reliability scores of the Semantic Differential scales for this study where possibly due to the nature of this study (converting the independent variables to continious variables) and as such, future research should possibly utilise another scale that can measure aesthetic appeal more effectively and reliably with the variable being continious in nature.

Independent Variables Predicting Intention to Adopt

In order to answer the first research question of prediction and whether the independent variables of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Aesthetic Appeal can predict Intention to Adopt, a multiple regression analysis was conducted. In addition, a stepwise multiple regression analysis was conducted to determine which of the independent variables would be the best predictor of Intention to Adopt.

In terms of the results of these regression analyses, it was found that the four subscales of the UTAUT (Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions) were significantly and positively related to Intention to Adopt HEVs. The results of this study are in line with the majority of studies mentioned throughout this report, whereby the factors of the UTAUT have shown to predict Intention to Adopt information and communication technologies (Alwahaishi, & Snasel, 2013; Brown et al., 2010; Venkatesh et al., 2003; Dillon & Morris, 1996; Dlodlo & Mafini, 2013). This study has provided evidence that the UTAUT model can also be applied within the realm of sustainable technologies and the factors that influence the adoption intention of these technologies (Thatcher et al., 2014; Barkane & Glinters, 2011). Within the framework of this study these results mean that students pay close attention to the logical reasons behind technology adoption, such as whether such technologies will serve a means-ends purpose, the amount of effort that needs to be exerted, the reasons behind others views about adopting such technologies, as well as the technical qualities of the technology. Therefore students tend to make decisions based on a logical rational model rather than one based on feelings or emotions.

A stepwise multiple regression was performed, additionally, as a means of determining which of the significant predictors would be the best predictor of Intention to Adopt. With a close examination of the standardised parameter estimates (where values can be interpreted similarly to a correlation), it was evident which independent variables were the most predictive of Intention to Adopt. Facilitating Conditions was the strongest positive determinant of Intention to Adopt such that those who perceive that they will

have the neccesary resources to purchase an HEV in the future, that adopting an HEV will be compatible with their lifestyle, and feel that it is not very costly would have a higher intention to purchase an HEV. However, this relationship proved to be moderate (0.301). This result was followed by Social Influence as the second best predictor of Intention to Adopt and then Effort Expectancy and Performance Expectancy which all appeared to be weak predictors. In relation to examining which of the UTAUT subscales is the best predictor of Intention to Adopt, Jambulingam (2013) found that Performance Expectancy was the best positive predictor of behavioural intention that influences Mobile Technology in the Learning Environment (MTLE) adoption, with Effort Expectancy having no effect, which indicates that Effort Expectancy is not a significant predictor of Intention to Adopt MTLE.

In line with this study, Jeon, Yoo, and Choi (2012) found that social factors, such as image benefits, which refers to expressing an innovative green personality to others; and subjective norms,have been used as a way to measure the concept of Social Influence (comply with what others believe is right to do such as act pro-environmentally through adopting sustainable technologies) and has a powerful effect on people's Intention to Adopt HEVs. Karahanna et al. (1999) also found that normative pressures such as pressure from friends, family and supervisors and colleagues dominates prediction of behavioural Intention to Adopt information and communication technology, which is a similar result found in this study in terms of sustainable technologies.

Moderating Effects of Moral Disengagement and Environmental Concern

To test the second and third research questions, multiple moderated regressions were conducted to determine whether Moral Justification and Environmental Concern alter the strength of the causal relationship between the independent variables of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Aesthetic Appeal and the dependent variable of Intention to Adopt. To avoid potentially problematic high multicollinearity with the interaction term, the independent variables and the moderator variables were centred and the interaction terms were created (Aiken & West, 1991). After computing the multiple interaction terms for this

research question, the predictor variables and interactions were entered into a simultaneous regression model.

The model that was significant and positive occurred for the interaction between Performance Expectancy and Moral Justification. This result suggests that when Performance Expectancy is high, in terms of being positive, people's intention to adopt an HEV will be high when the motor vehicle meets expectations in terms of its performance. As such people will be more likely to adopt an HEV because they perceive that it would help them get to their destination effectively; that it would be more cost effective, as they would not need to spend as much on fuel than if they drove a petrol or diesel motor vehicle; and that HEVs are better alternatives to conventionally fuelled vehicles. In this case, the product speaks for itself in terms people intending to adopt the technology based on its performance, and therefore do not need to engage in Moral Justification. Moral Justification, therefore weakens the relationship between Performance Expectancy and Intention to Adopt HEVs.

In relation to Environmental Concern, no significant interaction effects were evident from the results ($p > 0.05$). This result suggests that rather than having a moderating effect whereby a variable will either strengthen or weaken the relationship between the independent and dependent the variables, this variable has a main effect on the dependent variable (i.e. has a direct effect on Intention to Adopt HEVs). According to Baron and Kenny (1986) this can occur, but does not provide any information on the moderating effects of the variable. They also suggest that for one to determine the effects of moderator variable, it should be uncorrelated with the predictor variable, but would still have a direct impact on the dependent variable, which is what the results revealed for this study.

A study, very similar to this study, was conducted by Hong, Khan, and Abdulla (2013) on the factors that affect the adoption of HEVs, and the relationship between demographics and Intention to Adopt HEVs in Malaysia. The researchers also adopted regression analyses to determine the patterns in their data and found that relative advantage, compatibility, pro-environmental, and perceived behavioural control were

positively related to the adoption of HEVs. Their results revealed a nonsignificant relationship between Social Influences and adoption of HEVs. Environmental Concern was treated as a main effect, and the results revealed that it is positively related to adoption of HEVs in Malaysia. The results of that study provide some grounding for Environmental Concern as having a main effect rather than having an interactional effect, which the results of this study yielded (Environmental Concern having a direct impact on Intention to Adopt HEVs). To date no studies have examined Moral Justification in terms of its effects on Intention to Adopt sustainable technologies, which this study has provided some evidence for.

Biographical Data as Influencing Factor

Lastly, additional multiple regressions were conducted to assess the relationships between the biographical data and the moderator relationships. Not all biographical data was used to examine these relationships, since ANOVAs and t-tests were run to determine where differences would lie for the biographical variables. Based on the results and on the discretion of the researcher, the different academic courses students studied within, the gender of the students, and the type of motor vehicle students had access to was assessed through separate multiple regressions. The results revealed significant positive relationships between some academic courses such as General Psychology and Mechanical Engineering when Moral Justification was added into the regression equation as the moderator. These significant results indicate that when the HEV meets their performance expectations from a psychological perspective for General Psychology students, their intention to adopt an HEV, and therefore will not need to morally justify their behaviour. Students will also adopt HEVs when significant others in the lives of students believe that they should adopt HEVs (Social Influence) based on the technical qualities of the HEV for Mechanical Engineering students, and therefore will not need to sanctify their behaviours. These results relate to the notion of externalising responsibility onto other people or things. In other words, people will adopt a certain technology, not based on it being “the right thing to do”, but rather based on the performance of the technology and/or the opinions of others.

When Environmental Concern and Performance Expectancy was added to the regression equation, the negative relationship accounted for a significant amount of variance in Intention to Adopt HEVs for those in General Psychology. Therefore, those with a high affliation towards nature believe that an HEV will not help them in achieving performance goals from a psychological perspective. Significant relationships also resulted for the relationship between Social Influence and Environmental Concern for those studying General Psychology. For those in General Psychology, concern for nature weakens the relationship between Social Influence and Intention to Adopt HEVs. A positive relationship was found for those in Civil Engineering between the aesthetic appeal of the Audi Q5 Hybrid and Intention to Adopt HEVs when Environmental Concern was added to the regression equation. This means that a higher level of attractiveness of this HEV suggested a higher Intention to Adopt HEVs, which was intensified by a high affiliation towards nature and the environment.

Females were found to morally dissociate from the consequences of their actions to a greater extent than males when they perceived that the technology would help them attain gains in their personal lives and to explain their intentions. Surprisingly, males were found to participate less in Moral Justification when they perceived the HEV to be more attractive. Therefore apart from the technical aspects, males tend to steer towards the physical properties of a vehicle when making their decision to adopt it.

In the study by Kassie et al. (2009), they found that the impact of gender on sustainable technology adoption is technology-specific, such that males and females will look towards different qualities of the technology to determine whether adoption of such a technology will take place. In the case of this study, it was found that females look more towards means-end purposes of the technology, whereas males find the technical aspects, such as battery life, the actual operation of the vehicle and the attractive qualities (how alluring the vehicle is) of an HEV to be important.

In terms of the vehicles students had access to, whether self-owned or a family vehicle, it was found that students who use petroleum fuelled vehicles were more likely to adopt an HEV when they believed that it would perform better in terms of fuel costs, where

only a fraction would need to be paid for petrol due the mechanics of the HEV (i.e. HEVs save more fuel than conventional automobiles). As a result, students do not engage in Moral Justification if they felt that HEVs would meet their performance expectations. However, if students who drive petroleum fuelled vehicles felt that much effort was needed to make use of and maintain an HEV, they were less likely to adopt an HEV, and hence engage in Moral Justification.

Practical Implications

The results obtained in this study have both practical and theoretical implications. The results have implications for those who require to replicate this study and to further the research in the sphere of sustainable technology adoption, as well as for the motor industry. The study's finding show that the factors of the UTAUT model are important to consider in sustainable technology adoption and as such so are the different rational models of cognition. The UTAUT model is an aggregation of technology acceptance models that have been developed over many decades and provides a comprehensive analysis of the logical reasons behind technology adoption. However, emotional aspects of decision making such as the investigation into the affective or visually appealing aspects of sustainable technologies is also important, especially when it comes to differences in gender. The role of aesthetic appeal should therefore be assessed together with the factors that comprise the UTAUT model when examining behavioural Intention to Adopt sustainable technologies. This would allow for a broader view of the factors that may affect technology adoption and is an important consideration for automobile manufacturers and retailers to take account of as this could increase demand and sales of such technologies.

In relation to Intention to Adopt sustainable technologies, specifically low carbon technologies such as HEVs, important concepts such as morals in terms of Moral Justification and Environmental Concern about the environment also need to be included when assessing technology adoption and acceptance. The important role that these constructs play in influencing students' decisions to adopt HEVs can be seen from the findings of this study. Both these constructs played a significant role in changing

the dynamics of the relationship between the main factors, with Environmental Concern having a main effect on Intention to Adopt HEVs. This indicates that not only does examining people's relationship to the environment have an important role in regulating an individual's behaviour, but is also a main reason to why people may or may not adopt a certain technology.

Moral Justification, as Bandura (2007) puts it, is the ability of individuals to validate unjust behaviour as a way for them to safeguard themselves from any scrutiny or criticism. In other words, it is a way to justify why certain actions were performed and to turn it into a morally just action. From the responses received, it is evident that students also engage in Moral Justification from a pre-adoption perspective, through indicating that if others use conventionally powered vehicles it is acceptable for them to do the same; and that there is nothing immoral with driving conventionally fuelled vehicles if it serves their purposes. Such decisions are in itself an action, an action to externalise their responsibility onto others and things, and therefore not making an active effort based on internal drive to change circumstances such as climate change. These decisions are based upon the morals and values of the individual and their beliefs as to what they deem important.

The results obtained in this study with respect to Intention to Adopt HEVs and the independent variables of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal, with the moderator variables of Moral Justification and Environmental Concern can, however, have implications for the motor industry in South Africa. With the slow rate of adoption of HEVs, motor industries need to actively look into the factors that may persuade people to purchase HEVs, not just on the basis of business, but more importantly to assist with climate change and control. South Africa, as part of Sub-Saharan Africa and a developing country, focuses more on other pressing issues that the country faces in terms of socio-economic and cultural factors and thus the government does not actively involve itself in the promotion of such sustainable technologies, since it is seen as more of a luxury than a necessity (Musa et al., 2005). The adoption of sustainable technologies is to a large extent seen as something for the wealthy but this should not be the case. Motor

industries need to take heed of findings from studies such as this since it provides valuable insight into what people deem the most important factors they consider when intending to purchase HEVs. Students that were utilised in the study are those who will be heading into the corporate sphere with the attainment of assets in mind, such as a motor vehicle and therefore more advertising of HEVs and sustainable technologies should occur to encourage them to purchase such technologies. If the motor industry can adapt existing models to fit the needs of the South African population and actively promote the great benefits of HEVs, students may be more willing to purchase such vehicles when the time arises.

Limitations

As with all studies, this study had a number of limitations which needs to be acknowledged. First and foremost, this study was cross-sectional in nature which means that no causal conclusions could be drawn from the result obtained. Decisions made about Intention to Adopt HEVs on the basis of the main variables of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Aesthetic Appeal, and the moderator variables of Moral Justification, and Environmental Concern could have merely reflected current perceptions at the time of completing the questionnaire. The aim of this study, however was not to establish causal links between the variables (i.e. high or low levels of the main variables cause students to have a higher disposition towards Intention to Adopt HEVs) but rather to determine whether there was in fact a relationship between the variables under investigation. However, according to Al-Qeisi (2009), technology acceptance studies are best carried out in a longitudinal study since perceptions change over time between the introduction to the technology and actual usage.

Another limitation was the use of students as the sample. According to Al-Qeisi (2009), studies conducted with a convenience sample of students, is far from being representative of a real workplace or those people who work. The UTAUT was designed as a way to counteract this and is meant to only be used with a sample of working individuals sample. However, the results obtained in this study show how the UTAUT model can still yield significant results with the use of a student population.

This study made use of student to gain a prospective view on what factors might affect Intention to Adopt HEVs and not on the basis of actual usage.

In relation to the sample, there could potentially be an issue with ecological validity, since the sample may not in actuality be representative of the classes that it was drawn from or the population. The results are based on self-report measures and self-preference. Preferences are most likely to change over time, and hence a wider sample including other students from more departments engaging in a wide range of academic courses is required for it to be representative of a student population.

The scale used to assess Aesthetic Appeal may not have been the most appropriate measure for this study. The low reliabilities for both the pilot study and main study give such evidence and suggest that the items may be too ambigious in this setting of the group of participants utilised, as well as the method of analysis used (converting this Aesthetic Appeal into a continuous variable). As such this scale should be revised or a completely different scale should be used to assess such preferences.

Although the UTAUT has been utilised to examine other sustainable technologies, this study was the first to examine the relationship between the UTAUT factors, Aesthetic Appeal, Moral Justification, Environmental Concern and Intention to Adopt HEVs. Therefore it was difficult for the researcher to make conceptual and theoretical links between the variables and the type of sample that was used in this study because no previous research has been conducted around these variables in this context by researchers. Therefore, it was difficult to draw definite conclusions about the relationship amongst the variables in relation to previous research in this study in addition to the sample that was used.

Directions for Future Research

The following recommendations are proposed for future research. Future Research should consider examining the applicability of sustainable technology adoption in South Africa on other samples of students. This will assist in reinforcing the results of this study. In addition, new research within this area should seek to use a sample of a wider range of individuals, such as including individuals who work who have more access or

better access to HEVs since they may be able to afford such technologies. This would allow for better external validity of the results and be a more representative sample of the population who are most likely to adopt and use HEVs. This means using an array of individuals from numerous demographic backgrounds and organisational institutions in order to ensure that the sample is more representative and hence the results of such studies having greater generalizability.

Future studies should consider making use of a longitudinal approach with the use of students in their final year and then examine the changes that occur when they become part of those people who work in terms of their intentions and actual usage of HEVs. Hence future studies should move beyond pre-adoption perceptions and should investigate actual usage behaviour which would be an extension of this study. This will not only add to the growing body of research in sustainable technology adoption, but consider the factors affecting actual adoption and usage.

Future research should further adapt the UTAUT scale, and the Semantic Differential scale utilised in this study so as to obtain more significant results. In terms of the assessing Aesthetic Appeal, a single item scale directly asking participants if the technology is appealing may prove to be a better measurement of such a concept. As such, future research should use this study as a basis from which researchers can adapt if this study were to be replicated or built on.

In terms of the factors that may influence Intention to Adopt HEVs, a closer examination of the CO_2 emissions tax levy may be necessary by incorporating it into the UTAUT scale under Facilitating Conditions. This may be a very significant factor to consider as consumers are likely to pay less tax if they adopt an HEV or any other alternative fuel vehicle thus decreasing the cost in purchase price of such a technology, thereby promoting the adoption of this sustainable technology.

Another factor that should be explored in future research is the influence of celebrity stars since Social Influence is one of the factors that was found to have a significant impact. For some people the influence of celebrities, who have purchased HEVs, may have as a significant impact in their Intention to Adopt HEVs in the same manner as the

influence of family, friends and colleagues. This factor has not been examined in previous research and may prove to yield interesting findings.

Chapter 6: Conclusion

The current study sought to examine the relationship between the independent variables of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Aesthetic Appeal, the moderator variables of Moral Justification and Environmental Concern, and Intention to Adopt HEVs. Research on Intention to Adopt sustainable technologies and the factors that may affect such intentions have been limited particularly within a South African context. Research examining the relationships between all variables mentioned in this study have not been looked at before, therefore this study provides a basis for future research to build on.

Significant results were obtained for the relationship between the UTAUT factors and Intention to Adopt HEVs in this study. Significant results also occurred for the moderating effects of Moral Justification on the relationship between the independent variables and Intention to Adopt HEVs. These findings show the importance of the UTAUT model in explaining not only conventional technology acceptance but also the acceptation and strong Intention to Adopt sustainable technologies. This study has also demonstrated the importance of aesthetic appeal or the affective design of HEVs in perceptions around Intention to Adopt such technologies and how affective design is a more prominent factor of consideration among males than females. This study has also proved the important moderating effect of Moral Justification and how people's morals and standings impact on their decisions when it comes to technology acceptance and adoption.

This study found that the other moderator variable of interest in this study, Environmental Concern, had a main effect on Intention to Adopt HEVs and should be considered as an independent variable that has a direct influence on the dependent variable, rather than an influencing effect on the relationship between Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Aesthetic Appeal and Intention to Adopt. This was made evident through the nonsignificant effects of this variable as a moderator identified in the results.

This study was conducted on a one time basis and as such this may have affected the results as it was looking at students' intention at the time of answering the questionnaire. Essentially, future research should opt for a longitudinal study that is able to follow up on and determine where changes in perceptions around intentions lie over a time lapse. Since little, if any, research has been conducted before, it was difficult to make strong conclusions with respect to the results found in this study. In general, more research needs to be conducted in relation to Intention to Adopt sustainable technologies, specifically HEVs, as there is insufficient research at present, particulary within a South African context.

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Appendices

Appendix A: Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (SCHOOL OF HUMAN & COMMUNITY DEVELOPMENT

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: MORG/14/003 IH**
PROJECT TITLE:	Electric hybrid vehicles: Driving towards sustainability.
INVESTIGATORS	Riga Divia Madan
DEPARTMENT	Psychology
DATE CONSIDERED	05/05/13
DECISION OF COMMITTEE*	Approved

This ethical clearance is valid for 2 years and may be renewed upon application

DATE: 19 June 2014

CHAIRPERSON _____
(Professor M. Nduna)

cc Supervisor: Prof. A Thatcher
Psychology

DECLARATION OF INVESTIGATOR (S)

To be completed in duplicate and **one copy** returned to the Secretary, Room 100015, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure, as approved, I/we undertake to submit a revised protocol to the Committee.

This ethical clearance will expire on 31 December 2016

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix B: Participant Information sheet – Pilot Study

Psychology
School of Human & Community Development

University of the
Witwatersrand
Private Bag 3, WITS, 2050

Tel: (011) 717 4500 Fax: (011) 717 4559

Good day

My name is Divia Riga, and I am conducting research for the purpose of obtaining a Masters degree at the University of Witwatersrand. My research focus is in the area of technology adoption and its possible relation to the environment and one's values. The main aim of this study is to find out what factors are most likely to impact on people's intention to adopt Hybrid Electric Vehicles (HEVs). These factors could be social, emotional, relative advantage, cost, and how easy this type of technology would be to use in everyday life. I would like to invite you to participate in my research study.

Participation in this research will require you to answer a questionnaire consisting of five subscales while viewing a PowerPoint presentation of different HEVs. The questionnaire will take no longer than 15 minutes to complete. I understand that this is a substantial investment of your time. However, your response is valuable as it will contribute towards a South African understanding of what factors impact on people's intention to adopt HEVs.

Participation in this study is completely voluntary. You will not be advantaged or disadvantaged in any way should you choose to complete the questionnaire or not. Your responses will remain confidential. In addition, the data from completed questionnaires will only be seen by me and my supervisor. The results will be reported as part of a research report, and the data collected may be used for future publication purposes or in conference presentations. There are no foreseeable risks or benefits to taking part in this study.

If you are willing to participate please complete the following questionnaire. Completion and return of the questionnaire will be regarded as consent to participate in this study. If you have any further questions or require feedback on the progress of the research, please feel free to contact me. My contact details appear below my signature.

Thank you for taking the time to read this letter.

Should you have any queries, please do not hesitate to contact either myself, or my supervisor, Prof. Andrew Thatcher.

Yours Sincerely,

Divia Riga	Prof. Andrew Thatcher
Organisational Psychology Masters Student Psychology Dept.	Supervisor: Organisational
diviariga@gmail.com	Andrew.Thatcher@wits.ac.za

Appendix C: Participant Information sheet – Main Study

Psychology
School of Human & Community Development

University of the
Witwatersrand
Private Bag 3, WITS, 2050

Tel: (011) 717 4500 Fax: (011) 717 4559

Good day

My name is Divia Riga and I am currently conducting research for the purpose of obtaining a Masters degree at the University of Witwatersrand. My research focus is in the area of technology adoption and its possible relation to the environment and one's values. The main aim of this study is to find out what factors are most likely to impact on people's intention to adopt Hybrid Electric Vehicles (HEVs). These factors could be social, emotional, relative advantage, cost, and how easy this type of technology would be to use in everyday life. I would like to invite you to participate in my research study.

Participation in this research will require you to answer a questionnaire consisting of five parts while viewing pictures of different HEVs contained within the questionnaire. The questionnaire will take no longer than 15 minutes to complete. I understand that this is a substantial investment of your time. However, your response is valuable as it will contribute towards a South African understanding of what factors impact on people's intention to adopt HEVs.

Participation in this study is completely voluntary. You will not be advantaged or disadvantaged in any way should you choose to complete the questionnaire or not. Your responses will remain confidential and anonymity is guaranteed. At no time will I know who you are since the questionnaire requires no identifying information. In addition, the data from the completed questionnaire will only be seen by me and my supervisor. The results will be reported as part of a research report, and the data collected may be used for future publication purposes or in conference presentations. There are no foreseeable risks or benefits to taking part in this study.

If you are willing to participate please complete the following questionnaire. Completion and return of the questionnaire will be regarded as consent to participate in this study. If you have any further questions or require feedback on the progress of the research, please feel free to contact me. My contact details appear below my signature.

Thank you for taking the time to read this letter.

Should you have any queries, please do not hesitate to contact either myself, or my supervisor, Prof. Andrew Thatcher.

Yours Sincerely,

Divia Riga	Prof. Andrew Thatcher
Organisational Psychology Masters Student Psychology Dept.	Supervisor: Organisational
diviariga@gmail.com	Andrew.Thatcher@wits.ac.za

Appendix D: Demographic Questionnaire

1. What is your gender?

Male	Female

2. What is your race?

Black	Coloured	Asian	Indian	White	Other

3. What is your age? _____

4. What course are you currently completing? (Please tick the most appropriate one)

Organisational Psychology	
General Psychology	
Industrial Engineering	
Civil Engineering	
Mechanical Engineering	
Chemical Engineering	
Aeronautical Engineering	
Environmental Engineering	
Electrical Engineering	
Mining Engineering	

5. Do you own a car?

Yes	No

6. Do you drive a car owned by your family?

Yes	No

7. Do you have access to a car?

Yes	No

8. If you have access to a car, what type of car? (You may choose more than 1)

Petrol	Diesel	HEV

Appendix E: The Adapted UTAUT Model

Performance Expectancy

I expect that...

Questionnaire Item	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Using a Hybrid Electric Vehicle will help me get to my destination on time					
Using a Hybrid Electric Vehicle will be more cost effective					
Using a Hybrid Electric Vehicle serves as a good alternative to general combustion vehicles					

Effort Expectancy

I expect that...

Questionnaire item	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Learning to use a Hybrid Electric Vehicle would be easy for me					
My interaction with a Hybrid Electric Vehicle would be clear and understandable					

Social Influence

I believe that...

Questionnaire Item	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
People who influence my behaviour think that I should use a Hybrid Electric Vehicle					

People who are important to me would think that I should use a Hybrid Electric Vehicle					
I would use a Hybrid Electric Vehicle if a number of other students use it					
My friends and family would be upset if I did not adopt a Hybrid Electric Vehicle					
I would receive recognition from others if I adopted a Hybrid Electric Vehicle					

Facilitating Conditions

I believe that...

Questionnaire Item	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
I will have the resources necessary to purchase a Hybrid Electric Vehicle					
Using a Hybrid Electric Vehicle will be compatible with other aspects of my life					
Using a Hybrid Electric Vehicle fits well with the way I like to live					
I would not adopt a Hybrid Electric Vehicle because it is expensive					

Intention to Adopt

Questionnaire Item	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
My feelings towards using a Hybrid Electric Vehicle are positive					

I like the idea of using a Hybrid Electric Vehicle					
Using a Hybrid Electric Vehicle will make driving pleasant					
I would enjoy using a Hybrid Electric Vehicle					
I feel that Hybrid Electric Vehicles are a waste of time and I will not purchase one					

Appendix F: Semantic Differential Scale 1 – Pilot Study

For each set of words, please circle the number that is the closest to how you feel about each Hybrid Electric Vehicle (HEV) in the slide show on a scale from -3 to +3 with 0 being the neutral point:

Poor example	-3	-2	-1	0	+1	+2	+3	Good example
Not original	-3	-2	-1	0	+1	+2	+3	Original
Ugly	-3	-2	-1	0	+1	+2	+3	Beautiful



Appendix G: Semantic Differential Scale 2

For each set of words, please circle the number that is the closest to how you feel about each Hybrid Electric Vehicle (HEV) in the slide show on a scale from -3 to +3 with 0 being the neutral point:

Poor example	-3	-2	-1	0	+1	+2	+3	Good example
Not original	-3	-2	-1	0	+1	+2	+3	Original
Ugly	-3	-2	-1	0	+1	+2	+3	Beautiful



Appendix H: Semantic Differential Scale 3 – Pilot Study

For each set of words, please circle the number that is the closest to how you feel about each Hybrid Electric Vehicle (HEV) in the slide show on a scale from -3 to +3 with 0 being the neutral point:

Poor example	-3	-2	-1	0	+1	+2	+3	Good example
Not original	-3	-2	-1	0	+1	+2	+3	Original
Ugly	-3	-2	-1	0	+1	+2	+3	Beautiful



Appendix I: Semantic Differential Scale – Main Study

For each set of words, please circle the number that is the closest to how you feel about the Hybrid Electric Vehicle (HEV) shown below, on a scale from -3 to +3 with 0 being the neutral point:

Poor example	-3	-2	-1	0	+1	+2	+3	Good example
Not original	-3	-2	-1	0	+1	+2	+3	Original
Ugly	-3	-2	-1	0	+1	+2	+3	Beautiful



Appendix J: Moral Justification Scale

Moral Justification

I believe that...

Questionnaire Item	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Everyone else is driving general combustion vehicles, it is OK for me to do it					
There is nothing wrong with driving general combustion vehicles					
I would feel guilty if I did not adopt a Hybrid Electric Vehicle					

Appendix K: Nature Relatedness Scale

For each of the following, please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please respond as you really feel, rather than how you think "most people" feel.

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

1. Some species are just meant to die out or become extinct.	1	2	3	4	5
2. Humans have the right to use natural resources anyway we want.	1	2	3	4	5
3. My ideal vacation spot would be a remote, wilderness area.	1	2	3	4	5
4. I always think about how my actions affect the environment.	1	2	3	4	5
5. I enjoy digging in the earth and getting dirt on my hands.	1	2	3	4	5
6. My connection to nature and the environment is a part of my spirituality.	1	2	3	4	5
7. I am very aware of environmental issues.	1	2	3	4	5
8. I take notice of wildlife wherever I am.	1	2	3	4	5
9. I don't often go out in nature.	1	2	3	4	5
10. Nothing I do will change problems in other places on the planet.	1	2	3	4	5
11. I am not separate from nature, but a part of nature.	1	2	3	4	5
12. The thought of being deep in the woods, away from civilization, is frightening.	1	2	3	4	5
13. My feelings about nature do not affect how I live my life.	1	2	3	4	5
14. Animals, birds, and plants should have fewer rights than humans.	1	2	3	4	5
15. Even in the middle of the city, I notice nature around me.	1	2	3	4	5
16. My relationship to nature is an important part of who I am.	1	2	3	4	5
17. Conservation is unnecessary because nature is strong enough to recover from any human impact.	1	2	3	4	5
18. The state of non-human species is an indicator of the future for humans.	1	2	3	4	5
19. I think a lot about the suffering of animals	1	2	3	4	5
20. I feel very connected to all living things and the earth.	1	2	3	4	5

Appendix L: Exploratory Factor Analysis Results

Table 14: Rotated Factor Matrix for Effort Expectancy

	Component	
	1	2
EE1	.299	.491
EE2	.874	
EE3		.720
EE4		.843
EE5	.818	.164

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.