A Multi-Analytical Approach to Studying Customers Motivations to Use Innovative Totally Autonomous Vehicles

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Abstract

Increasing technological innovation means level 5 fully autonomous vehicle pods (AVPs) that do not require a human driver are approaching reality. However, the adoption of AVPs continues to lag behind predictions. In this paper, we draw on Mowen's (2000) 3M model taking a multi-analytical approach utilising PLS-SEM and fuzzy set qualitative comparative analysis, to investigate how personality trait sets motivate consumers to adopt AVPs. Based on a survey of 551 US respondents, we identify four necessary traits and five combinations of traits that predict adoption. We contribute to consumer psychology theory by advancing the understanding of the motivational mechanisms of consumers' adoption of autonomous vehicles that are triggered and operationalised by personality traits and conceptualising innovativeness as a complex multidimensional construct. From a managerial perspective, our findings highlight the significance of incorporating elements that are congruent with target customers' personality traits, when designing, manufacturing and commercializing innovative products.

Keywords: Autonomous Vehicle; Driverless Car; Personality Traits; Necessity and Sufficiency; Innovativeness; Adoption Intention.

1. Introduction

Innovations and developments in technology such as those associated with driverless cars are having a profound effect on society and marketing, transforming consumer behaviour and future consumption (Kamolsook, Badir, and Frank, 2019; Manika, Papagiannidis, and Bourlakis, 2015). Autonomous vehicle pods (AVPs), also known as driverless cars, are likely to revolutionize travel for people who cannot drive, including the elderly, the disabled and the young (Cohen, Jones and Cavoli, 2017), fundamentally changing the 'driverscape' for everybody (Pel et al., 2020; Marletto, 2019). AVPs have particular benefits in light of the increasing vulnerability of populations to global pandemics such as COVID 19 (current at the time of writing), particularly for vulnerable groups who otherwise cannot socially distance in taxis or on public transport, and seek to avoid the need for human couriers in lockdown and highly infected areas (Wong, 2020). Despite all these positive attributes of AVPs and their desirability in general, adoption appears to lag behind predictions by a significant margin (Acheampong and Cugurollo, 2019; Rubio, Llopis-Albert, Valero and Besa, 2019).

Technology management research reveals that one of the biggest challenges is the gap between the maturity of the technology and the readiness of consumers to adopt new products or services (Hickey, Davis and Kaiser, 2003; Rinne, 2004). This gap impedes the commercialization and popularization of a given technology, reduces returns on investment, and delays the sustainable development of related products (Dhewanto and Sohal, 2015; Miller, McAdam and McAdam, 2018). Scholars point out the urgent need to better understand the impact of consumer characteristics on technology acceptance and the psychological mechanisms behind technology adoption, particularly in the development phase of product introduction such as in the case of AVPs (Charness, Yoon, Souders, Stothart and Yehnert, 2018; Hegner, Beldad and Brunswick, 2019).

Extant literature suggests that consumers' personal characteristics influence the acceptance and adoption of new technologies and that their personality traits (the characteristics of an individual that exert a pervasive influence on a broad range of attitudinal and behavioural responses) drive decision making (Acheampong and Cugurollo, 2019). As autonomous driving technology continues to develop, consumers' perceptions of such technologies are expected to change over time (Cash and Kreye, 2018; Saeed Burris, Labi, and Sinha, 2020). In contrast to perceptions, personality traits are inherent and have profound implications for consumers' intentions to adopt technology (Allport, 1961; Lin, 2013). Therefore, a better understanding of the personalities of target consumers would enable manufacturers to capture consumer traits when developing new products and commercializing relevant technology. An informed approach will enable a personality congruence between products and consumers, and consumers' acceptance of new technology-enhanced products (Govers and Schoormans, 2005) as customers are ultimately responsible for the success of an innovation (Kunz, Schmitt and Meyer, 2011).

Our primary inquiry is therefore to explore the personality traits that influence consumers' adoption of AVPs by responding to two specific research questions: i) what are the sufficient and necessary antecedents to predict new product adoption intention? and ii) what are the sufficient recipes that lead to new product adoption intention? Our approach is important because necessity and sufficiency are terms that explain different conditional associations between two factors[1]. To the best of our knowledge, previous research on the 3M model and autonomous vehicles has relied on investigating sufficient factors using only

[1] A sufficient antecedent is a factor or a combination of factors that will produce an outcome (e.g. new product adoption intention). A necessary antecedent is a factor that must be present for adoption to take place. To predict new product adoption intention, an antecedent can be sufficient but unnecessary and vice versa. In logic, sufficiency means that a certain level of X (the causal condition) is sufficient to reach a certain level of Y (the outcome), and necessity means a certain level of X is necessary to reach a certain level of Y (Olya and Han, 2020). For example, a specific level of quality is necessary for repeat purchasing of a product, but quality alone is insufficient to recommend the product to others (Olya and Al-ansi, 2018).

symmetrical analyses (e.g. Kang and Johnson, 2015; Mowen et al., 2014; Schneider and Vogt, 2012). This study deepens our understanding of adoption intentions of AVPs by exploring both sufficient recipes and necessary traits, proposing conditional assumptions that are tested using multi-analysis approaches including both symmetrical and asymmetrical methods. Following Han, Al-Ansi, Olya and Kim (2019), we represent our objectives as research questions, rather than the hypotheses that are mainly used in symmetrical studies (Han, Al-Ansi, Olya and Kim, 2019).

We make several important contributions. First, in contrast to previous research that has considered lower-level autonomous vehicles (level 2 and especially level 3) that require human input while driving) and have mostly been focused on the implications for transport and policy, we take a consumer perspective and model customers' personality traits in adopting futuristic highly innovative level 5 AVPs. Our approach offers important first-hand customer-centric insights. Second, from a theoretical perspective, we draw upon the 3M model to advance the understanding of interactions of personality traits that influence consumers' adoption of innovative driverless technology. More specifically, through the lens of consumer psychology, we go beyond identifying the (single) sufficient traits and employ fsQCA and NCA to explore the trait sets and necessary traits that influence consumers' adoption decisions. By doing so, we reveal new dynamics and mechanisms in how personality traits motivate and predict consumer behaviour. Additionally, our approach extends the boundaries of the hierarchical order suggested in the 3M Model, offering a new theoretical lens of personality-elicited motivating mechanisms (e.g. trait sets and necessary traits in predicting consumer behaviour) that incorporates innovation as a multi-dimensional construct. Finally, from a managerial perspective, we also provide practical implications by identifying customer personas of potential AVP adopters which may better enable design, production and commercialization practices to target specific segments of the market. This approach advances the understanding of the motivation mechanism of personality traits and provides important insights for technology developers and carmakers seeking to understand the key drivers of adoption, from a perspective of AVPs' functionality.

This paper is organised as follows. First, extant literature is presented to develop the theoretical background and the conceptual framework for the study. In this section, we explore studies of autonomous vehicles and introduce the 3M model. We then describe the methodology used in the study, including the experimental methods, measures and scales. We also present the subsequent analysis and results in this section. Next, we discuss the findings of the research in terms of both theoretical and practical implications. Finally, we present directions for future researchers to consider, along with the limitations of this study.

2. Literature Review and Theoretical Framework

Autonomous vehicles are generally classified by The National Highway Traffic Safety Administration and others according to their degree of autonomy between level 1 and level 5 (Saeed, 2020). Extant research has primarily focused on level 3 semi-autonomous conditional AVs (e.g. Bansal and Kockelman, 2017; Montoro et al., 2019) rather than technologically enhanced level 5 autonomous unconditional self-driving AVPs (SAE International, 2018; Skeete, 2018). The context of this paper is level 5 unconditional self-driving cars which we refer to as AVPs, which may not have a steering wheel, brakes or a driver and may look like the pods illustrated in Figure A1 in the Appendices.

From a technical viewpoint, autonomous vehicles are superior to traditional cars on a number of fronts. For example, they are safer (Cohen and Hopkins, 2019), more efficient and less polluting (Fleetwood, 2017). In spite of the technical superiority of AVPs, consumers have many unresolved concerns relating to AVPs including ethical and societal considerations (Bonnefon, Shariff and Rahwan, 2016), safety (Coca-Vila, 2018; Levin and

Carrie, 2018), as well as confusion over legal responsibility in the case of an accident (König and Neumayr, 2017). A summary of recent literature is presented in Table 1, which provides an overview of the emerging body of research dedicated to exploring consumers' acceptance of autonomous vehicle driving technology. Information presented in Table 1 suggests that from a theoretical perspective, the seminal work of Rogers (1962) and Rogers and Shoemaker (1971) has been widely used to explain how some consumers are likely to adopt new products and services more quickly than others. We also observe that theories such as the Technology Acceptance Model (TAM: Davis, Bagozzi and Warshaw, 1989), Technology Adoption Lifecycle Model (Moore, 1991) and the Unified Theory of Acceptance and Use of Technology Model (UTAUT: Venkatesh, Morris, Davis and Davis, 2003) have been used to describe the success or failure of AVPs. However, none of these theories specifically focus on the role that personality traits can play in influencing the adoption of new technology such as AVPs.

Insert Table 1 here

We can draw a number of general conclusions from the extant research summarised in Table 1. Specifically: a) scholars have focused primarily on level 3 autonomous vehicles, rather than on the adoption of radical complex disruptive innovations such as those related to level 5 AVPs; b) studies of AVPs have largely contributed to the transportation and engineering literature, and consequently lack a marketing perspective; c) some research is conceptual (e.g. Cohen and Hopkins, 2019) and therefore lacks a nuanced understanding of the specific benefits of AVPs that inform consumers' adoption decision-making; d) these studies collectively show how adoption is influenced by culture, socio-economic trends, and political decisions; e) most extant literature has focussed on technological perspectives. However, over-emphasis on technical innovation and capabilities does not necessarily result in an enhanced customer-centric understanding of other factors that influence adoption, or enable manufacturers to refine their product-service offerings so they better satisfy future consumer needs and wants.

It is important to understand the personas of segments of potential consumers when developing innovative products and services (Un and Price, 2007). Therefore, it is crucial to identify and appreciate the personas of potential users of AVPs and incorporate their preferences into product designs. Personality traits represent constant and stable intrinsic attributes that influence consumers' adoption decisions (Ali, Bowen and Deininger, 2020; He and Veronesi, 2017; Junglas, Johnson and Spitzmüller, 2008), particularly for innovative new products. In contrast to other autonomous vehicle research that adopts technology-based theoretical underpinnings (e.g. TAM) to predict adoption tendencies, we draw upon Mowen's (2000) 3M model to explore the role that personality traits play in influencing the adoption and to develop personas of potential AVP users.

2.1. The 3M Model

Drawing upon Allport's work (1961), the 3M model was initially developed by Mowen (2000) and illustrates four hierarchical levels of personality that jointly influence individual behaviour: 1. elemental traits; 2. compound traits; 3. situational traits; and 4. surface traits. The 3M model elaborates the motivational mechanism of personality traits in affecting individuals' behaviour and has been widely used in consumer research to predict consumer behaviour in different contexts (e.g. Dinsmore, Swani and Dugan, 2017; Flynn, Goldsmith and Pollitte, 2016; Roberts, Pullig and Manolis, 2015; Schneider and Vogt, 2012). The 3M model is a useful theoretical framework to profile consumers by comprehensively examining the context-specific traits (Kang and Johnson, 2015; Mowen, Park and Zablah, 2007; Sun, Tai and Tsai, 2010).

As illustrated in the conceptual framework presented in Figure 1, we extend the 3M model to explore the innovative nature of AVPs. We use fsQCA to explain the complex interactions among three levels of the model and predict AVP adoption. Previous research on the 3M model applied symmetrical modelling (e.g. regression and SEM) (e.g. Kang and Johnson, 2015; Mowen et al., 2014; Schneider and Vogt, 2012) and indicated that it is difficult to demonstrate the full dynamics of how different personality traits jointly shape consumers' decision-making (Şahin, Karadağ and Tuncer, 2019; Timmer and Kaufmann, 2019). Therefore, this study conducts asymmetrical modelling using configurational analysis to explore recipes (i.e. combination of factors) associated with the expected behavioural intentions of AVP users. To the best of our knowledge, this is the first empirical study to identify necessary antecedents from the 3M model to achieve an expected surface trait in the AVP context. Each level of the motivational traits and the associations between the trait and AVP adoption are discussed below.

Insert Figure 1 here

2.1.1. Elemental traits

Elemental traits reflect the primary level in the hierarchy of the 3M model and are the basic predispositions arising from an individual's genetic endowment and early learning history. The 3M model initially proposed eight elemental traits that influence an individual's behaviour: the big five (agreeableness, conscientiousness, emotional stability, extroversion and openness to experience); and an additional three basic traits (need for arousal, need for material resources and need for body resources; Mowen, 2000). The later theoretical development of the 3M Model suggests that elemental traits can be selectively included in the model, depending on the potential association between the elemental traits and outcome behaviour (Chang et al., 2013; Kang and Johnson, 2015). Therefore, based on the previous research on personality traits and technology adoption and use, we propose five elemental traits that are expected to affect consumers' adoption intention of AVPs. Table 2 summarizes the conceptualization of each one, with supporting empirical evidence and the potential valence of association with AVP adoption intention.

Insert Table 2 here

2.1.2. Compound traits

Compound traits are cross-situational predispositions that emerge from the interplay of elemental traits, culture and the learning history of an individual (Mowen et al., 2004). Research suggests that reflecting and expressing self-identity is a key motivation in the process of adopting new products and technology (Shaw, Ellis, Kendrick, Ziegler and Wiseman, 2016; Shaw, Ellis and Ziegler, 2018). In consumer research, self-identification expressiveness is a trait or enduring desire drawn from social learning and refers to the extent to which an individual expresses his/her identity to themselves and others through using particular products or technology (Pagani, Hofacker and Goldsmith, 2011; Thorbjørnsen, Pedersen and Nyseveen, 2007). More recent research suggests self-identity expressiveness plays an increasingly important role in consumers' technology adoption and consumption (e.g. Bai, Wang and Gong, 2019; Mishra, Malhotra, Chatterjee, Sanatkumar and Shukla, 2021; Hsieh and Tseng, 2017; including autonomous vehicles (Wang, Wong, Li and Yuen, 2020), as consumers continuously differentiate themselves from others through consumption. AVPs are expected to differentiate from conventional vehicles in terms of operating mechanism, riding experience and even look, which allows consumers to express their unique self-identification through adoption (Fagnant and Kockelman, 2015). There is also evidence that elementary personality traits influence one's identity formation along with social learning (Klimstra, 2013). We therefore postulate that self-identification expressiveness captures consumers' tendency to express their personal identity through adopting AVPs and linking elemental and situational traits.

2.1.3. Situational traits

The level of situational traits in the 3M hierarchy represents enduring dispositions to behave within a general situational context, affected by the pressure of the contextual environment and by the joint effects of elemental and compound traits (Mowen, 2000). In the context of technology adoption, consumer innovativeness (innovativeness) has been seen as a fundamental trait that influences their behaviour (Hwang, Kim and Lee, 2021; Li, Zhang and Wang, 2015; Pagani, Hofacker and Goldsmith, 2011). Therefore, to predict consumers' adoption decisions of AVPs, innovativeness is identified at the situation level. Innovativeness refers to "the degree to which an individual is relatively earlier in adopting new ideas than the average members in [their] social system" (Rogers and Shoemaker, 1971, p. 27). Vandecasteele and Geuens (2010) recognize the significance of innovativeness as an essential situational trait in shaping consumers' behaviour and categorize the underlying motivation into four dimensions: functional, hedonic, social and cognitive. Scholars identify a positive association between innovativeness and technology adoption intention in various contexts, ranging from online shopping to augmented reality (Rauschnabel and Ro, 2016; Thakur and Srivastava, 2015). Moreover, we incorporate innovativeness as a multi-dimensional higher-order situational trait as it consists of four first-order components (i.e. functional, hedonic, social and cognitive dimensions each consisting of multiple items) that are uncorrelated and non-interchangeable (Henseler, Hubona and Ray, 2016; Hernández-Perlines, 2016). By doing so, we answer calls to explore innovativeness as a multi-dimensional higher order construct, as research in this area is lacking (e.g. Calabrò et al., 2016). In summary, we consider that innovativeness is a situational trait that predicts consumers' adoption of AVPs.

2.1.4. Surface traits

Surface traits reflect the immediate determinants of behaviour (Bosnjak, Galesic and Tuten, 2007). In our context, surface traits refer to consumers' intention to adopt AVPs. Surface traits represent the final level of the 3M model hierarchy. Previous studies suggest elemental, compound and situational traits affect consumers' technology acceptance and adoption behaviour at the surface level. For example, Guadagno, Okdie and Eno (2008) assert the elemental traits predict individuals' online blogging behaviour. Self-identification expressiveness (a compound trait) influences consumers' multimedia messaging adoption (Thorbjørnsen, et al., 2007). Innovativeness (a situational trait) accelerates the adoption of internet shopping (Citrin, Sprott, Silverman and Stem, 2000), online banking (Lassar, Manolis and Lassar, 2005) and new technology products (Hirunyawipada and Paswan, 2006). Therefore, we postulate that elemental, compound and situational traits predict consumers' intentions to adopt AVPs.

2.2. Model testing using a multi-analytical approach (PLS-SEM, fsQCA and NCA)

Given that most previous 3M model studies have used either symmetrical or asymmetrical approaches, we have elected to use both, for the reasons outlined below. Using symmetrical analysis, we test customer innovativeness as a higher-order trait of the 3M model to predict intentions to adopt AVPs. Specifically, PLS-SEM is an iterative technique that maximizes the R^2 values of the outcome variable; it is used to test hierarchical component models including higher-order variables (Hair et al., 2016). PLS-SEM is conducted to investigate the sufficiency of traits (distinct effect, not configuration/recipe: a combination of traits). Asymmetrical modelling has recently been applied in psychology studies (Duarte and Pinho, 2019). For example, López-Cabarcos, Vázquez-Rodríguez and Gieure (2017) used fsQCA and NCA to assess the role of risk factors in predicting bullying behaviour among prison employees. fsQCA is recognized as a powerful analytical approach to justify heterogeneous results on household pro-environmental behaviour (Schmitt, Grawe, and Woodside, 2017). Saridakis, Baltas, Oghazi and Hultman (2016) indicated different roles of predictors (positive and or negative contribution) depending on the attributes of other predictors in a causal recipe leading to the outcome. fsQCA helps explore sufficient combinations of the traits (i.e. recipe/configuration). NCA identifies necessary traits of the 3M model to predict new product adoption intentions. Our unique approach enriches the understanding of adoption intentions of AVPs by exploring sufficient recipes and necessary traits using fsQCA and NCA, respectively. We extend knowledge of the 3M model by using the asymmetrical approach to explore sufficient configuration of elemental, compound and situational traits (causal recipes) to formulate the 3M model outcome (i.e. consumers' intention to adopt AVPs as a surface trait), to provide empirical evidence that multiple personality traits function simultaneously to predict intentions to adopt AVPs. fsQCA is recognized as a set-theoretic analytical approach that generates knowledge by exploring algorithms leading to the given outcomes (Kan, Adegbite, El Omari and Abdellatif, 2016; Llopis-Albert, Rubio and Valero, 2019). A multi-analytical approach provides deeper insight into consumer behaviour by advising sufficient and necessary conditions for the adoption of AVPs. The results from PLS-SEM, fsQCA, and NCA help marketers to identify and satisfy sufficient and necessary conditions and by doing so may increase consumers' intentions to adopt AVPs.

3. Method

3.1 Survey development and data collection procedure

A survey was developed utilising existing scales. The elemental traits of conscientiousness, openness to experience, agreeableness, need for material resources and need for arousal, were each measured, using a 4-item scale adapted from Mowen et al. (2004). To operationalize self-identification expressiveness, we adapted a 3-item scale developed by Thorbjørnsen et al. (2007). Innovativeness had four dimensions: functional (5 items); hedonic (5 items); social (3 items) and cognitive (4 items) that were captured using scales developed by Vandecasteele and Guens (2010). These scales have been widely used in other studies of consumer innovativeness. New product adoption attention was measured using a 3-item scale adapted from Li, Zhang and Wang (2015).

Respondents were initially asked to answer a series of questions regarding their personality traits before watching a two-minute video that was specifically developed for this study, illustrating the attributes of AVPs. Additional questions were asked regarding respondents' potential adoption intentions. A number of attention checking questions (e.g. please select neither agree nor disagree) and comprehension questions (e.g. which city is the capital of England) were randomly inserted throughout the survey to ensure respondents were concentrating. Prior to the main data collection, following Liu et al. (2019), we initially ran a pilot with 21 respondents in a lab setting to test the readability and accuracy of the survey, and to estimate the duration of the study. The identified issues, including the wording and the difficulty level of some questions, were discussed. We then revised the survey design by incorporating the suggestions drawn from the pilot.

For the main study, 805 US-based participants using Mechanical Turk attempted to complete the online survey. 88 participants waived their participation in the middle of the survey, representing incomplete responses. Additionally, 137 were filtered out due to failure to correctly answer one or more of the comprehension and attention-checking questions. Furthermore, using the quickest case in the pilot as a benchmark (10 min), we eliminated 29 responses that were completed within 9 min (the participants were still paid). After the elimination, the average completion time was 12 min 47s, which is close to the estimated time from the pilot (i.e. 16 min, including note-making). The final sample was therefore 551 participants. In terms of geographical location, data was obtained from respondents from 17 states (Washington, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Illinois, Indiana, Minnesota, Ohio, Wisconsin, New Mexico, Iowa, California, and New York). We performed ANOVA analysis to confirm that respondents' views did not vary significantly based on their locations. The results of ANOVA showed that the model outcome (NDPI: as a sample variable) did not significantly differ among respondents from 17 states ($F(16, 534) = .684$, $p>.05$). Over a third were aged 31-40 (36.3%) and just under a third were 21-30 (32.3%), with a gender mix of 49% female. Respondents' socio-demographic information is summarized in Table A1 in the appendices. The study variables did not significantly vary across the gender and age of the respondents.

3.2. Measurement and research models testing

The psychometric characteristics of the measurement model were assessed using rigorous analysis. Cronbach's alpha (α), composite reliability (CR) and Dijkstra-Henseler's rho (ρA) were used to check internal consistency among items for each scale. Construct validity and fit validity were evaluated using confirmatory factor analysis. A proposed structural 3M model was used to investigate the sufficient effects of antecedents using Smart-PLS 3 and a configurational model for exploring sufficient causal recipes was tested using fsQCA 3.0 (www.fsQCA.com). fsQCA includes three steps of calibration, calculation of truth tables, and counterfactual analysis. In calibration crisp set data is transformed to fuzzy set value (0: non full membership and 1: full membership). The Truth table is calculated based on Boolean Algebra which provides a list of all possible conditions leading to the desired outcome. In the final step, possible conditions are refined to sufficient recipes that consistently explain conditions for achieving the outcome model. Measures of coverage (>1) and consistency (.85) were used to select the recipes (Olya, Lee, Lee and Reisinger, 2019). Necessary antecedents for achieving AVPs adoption were identified using NCA.

4. Results

4.1. Psychometrics properties

Following Hair, Hult, Ringle and Sarstedt (2016), Cronbach's alpha, composite reliability (CR) and Dijkstra-Henseler's rho (ρA) were used to check the reliability of the measures. All three values were above 0.7, a commonly accepted cut-off point, confirming the reliability of the scales (Table 3). Construct validity, both convergent and discriminant, were evaluated using a set of metrics. First, all items were significantly and sufficiently loaded under the assigned scale (loading value > 0.5, $p < 0.001$) that confirmed the proposed scale composition of the items. Second, values of average variance extracted (AVE) for all scales were greater than 0.5, confirming the convergent validity of the measures.

Insert Table 3 here

The Fornell Larcker criteria and the heterotrait-monotrait ratio of correlation (HTMT) were used to evaluate discriminant validity. As shown in Table 4, the square root of AVE for each construct is larger than its highest correlation coefficient with other constructs. The HTMT for all constructs was lower than the recommended cut-off of 0.85 (Henseler et al., 2016). These results indicate the discriminate validity of the study measures. We calculated weights of four first-order constructs (cognitive, functional, hedonic, social innovativeness) on the respective second order constructs. The weights for cognitive, functional, hedonic, social innovativeness were 0.852, 0.803, 0.830, and 0.844 with t-values of 28.701, 33.519, 39.097, and 35.652, respectively. Magnitude of the VIFs (variance inflation factors) for cognitive, functional, hedonic, social innovativeness were 2.088, 2.652, 2.914, and 2.118, which all were below 5, recommended cut-off for multicollinearity. In terms of fit validity, SRMR was 0.047, which is less than the 0.08, recommended maximum, further indicating the goodness of fit of our model (Hair et al., 2016).

Insert Table 4 here

4.2. Sufficient and necessary antecedents: PLS-SEM and NCA results

To examine the relationships between components, we ran a structural model using PLS-SEM (Table 5). We found that conscientiousness is sufficient to stimulating AVP adoption intention ($\beta = 0.105$, $p < 0.001$) as well as innovativeness ($\beta = 0.067$, $p < 0.05$). However, conscientiousness does not have a direct effect on self-identification expressiveness. Openness to experience increases innovativeness ($\beta = 0.207$, $p< .001$), but does not affect new product adoption intentions. Agreeableness plays a significant role in stimulating AVP adoption intention ($\beta= - 0.070$, $p < 0.05$) and self-identification expressiveness ($\beta = 0.100$, $p < 0.05$). While need for material resources boosts self-identification expressiveness ($\beta= 0.346$, $p < 0.001$) and innovativeness ($\beta = 0.400$, $p< 0.001$), it is not sufficient to stimulate adoption intention. Need for arousal is sufficient to stimulate self-identification expressiveness ($\beta = 0.178$, $p < 0.001$), but not innovativeness or adoption intention. According to the SEM results, self-identification expressiveness increases innovativeness ($\beta = 0.371$, $p < 0.001$). AVP adoption intention is significantly and positively influenced by self-identification expressiveness ($\beta = 0.595$, $p < 0.001$) and innovativeness ($\beta = 0.136$, $p < 0.001$) (see Table 5).

NCA was used to identify necessary antecedents, as without them, expected outcomes are unlikely to be achieved (Olya, 2021). According to NCA, intentions to adopt AVPs are dependent on the existence of conscientiousness (consistency: 0.939), openness to experience (consistency: 0.892), agreeableness (consistency: 0.932), and self-identification expressiveness (consistency: 0.809). Similarly, conscientiousness, openness to experience and agreeableness appeared as necessary antecedents for self-identification expressiveness and innovativeness (consistency > 0.85). The results of NCA also reveal that needs for material resources and arousal and innovativeness are not necessary antecedents for AVP adoption (consistency < 0.85).

Insert Table 5 here

Conscientiousness is insufficient to predict self-identification expressiveness, but sufficient for innovativeness and intention to adopt AVPs. On the other hand, conscientiousness is necessary to achieve self-identification expressiveness, innovativeness, and intentions to adopt AVPs. Openness to experience is sufficient for innovativeness, but not self-identification expressiveness or adoption intention for AVPs. Like conscientiousness, openness to experience is necessary for self-identification expressiveness, innovativeness, and consumers' adoption of AVPs. The agreeableness trait is sufficient for increasing self-identification expressiveness but decreases consumers' intentions to adopt AVPs. Similar to conscientiousness, openness to experience and agreeableness are necessary to attain three outcomes of the proposed model (self-identification expressiveness, innovativeness and AVP adoption intention). Need for materials sufficiently contributes to enhancing self-identification expressiveness and innovativeness, but is not necessary to achieve these three outcomes. Similarly, need for arousal is not necessary for AVP adoption, but is sufficient to formulate self-identification expressiveness. Self-identification expressiveness is sufficient and necessary to increase innovativeness, whereas it is sufficient but not necessary to encourage adoption. At the situational trait level, innovativeness is sufficient but unnecessary to achieve consumers' adoption of AVPs.

4.2. Sufficient recipes: fsQCA results

Results from fsQCA identify four recipes from a combination of elemental (conscientiousness, openness to experience, agreeableness, need for material resources), compound and situational traits that drive new product adoption intention (coverage: 0.545, consistency: 0.893). The first recipe indicates that a combination of high conscientiousness, openness to experience and need for arousal, combined with low agreeableness leads to a high degree of adoption intention. The second recipe demonstrates that high levels of conscientiousness, agreeableness, and need for arousal, combined with low levels of openness to experience result in a high degree of AVP adoption intention. The third recipe reveals that high adoption intention results from high levels of conscientiousness, openness to experience, need for material resources and arousal. According to the fourth recipe, high levels of conscientiousness, agreeableness, needs for material resources and arousal, are conditions that drive AVP adoption intention (see Table 6).

Insert Table 6 here

fsQCA results for combinations of elemental traits with self-identification expressiveness reveal that four recipes describe conditions where high levels of AVP adoption intention can be achieved (coverage: 0.762, consistency: 0.885). Recipe 1 demonstrates that high levels of conscientiousness, openness to experience, agreeableness and self-identification expressiveness lead to high levels of AVP adoption intention. Alternatively, recipe 2 indicates that high levels of conscientiousness, agreeableness and self-identification expressiveness together with low need for material resources and arousal increase consumers' intention to adopt AVPs. According to recipe 3, high levels of adoption intention are obtained when consumers have high levels of conscientiousness, openness to experience, agreeableness, need for material resources and arousal. Recipe 4 describes another condition leading to high levels of AVP adoption intention where levels of openness to experience, need for arousal and self-identification expressiveness are low and levels of conscientiousness, agreeableness, and need for material resources are high (see Table 7).

Insert Table 7 here

Configurational modelling of the element traits with self-identification expressiveness and innovativeness suggest five causal recipes (coverage: 0.762, consistency: 0.885). According to recipe 1, the combination of a high level of conscientiousness, agreeableness and self-identification expressiveness with low levels of need for material resources sufficiently explains conditions for high AVP adoption intention. Recipe 2 demonstrates that adoption intention is increased with high levels of conscientiousness, openness to experience, agreeableness, self-identification expressiveness and innovativeness. Recipe 3 reveals that high levels of conscientiousness, agreeableness, and self-identification expressiveness with low levels of need for material resources and arousal and innovativeness, result in high levels of adoption intention. According to recipe 4, high levels of conscientiousness, openness to experience, agreeableness, need for material resources and innovativeness, with low levels of need for arousal, result in a high level of adoption intention. Recipe 5 indicates that a high degree of AVP adoption intention is obtained where consumers indicate high levels of conscientiousness, openness to experience, agreeableness, need for arousal and innovativeness, although they have low levels of need for material resources (see Table 8). As innovativeness is a multidimensional variable, we conducted fsQCA to explore recipes from four sub-dimensions of innovativeness in stimulating consumers' adoption of AVPs (Table A2, appendices). A list of all recipes for predicting consumers' adoption of AVPs is presented in Table A3 in the appendices.

Insert Table 8 here

5. Discussion and Conclusion

We set out to explore the impact of personality traits on consumers' adoption intention for future AVPs, based on the foundations of Mowen's 3M model. We observe how traits can play different roles in terms of sufficiency and necessity when predicting consumers' intentions to adopt AVPs. Modelling consumers' adoption of AVPs is complex because of the heterogeneous effects of personality traits. Our results extend current knowledge of the role that elemental, compound and situational traits can play in influencing consumers' intentions, by showing how combinations of these traits (sufficient recipes) explain conditions that lead to the adoption of AVPs. The recipes for predicting consumers' adoption of AVPs can be used as a guideline for marketers and managers seeking to combine personality traits from the three hierarchies of the 3M model and therefore to stimulate consumers' intentions to adopt AVPs. Armed with such recipes, manufacturers could develop a line-up of various car models that emphasise different features that reflect consumers' preferences revealed by the personality trait sets. The results highlight five causal recipes, in which conscientiousness, openness to experience, agreeableness and expressiveness will drive consumers' intentions to adopt AVPs.

Need for materials and need for arousal play negative roles in most of the recipes. Although consumer innovativeness positively influences the adoption intention in most cases, it works in a negative way when combined with high conscientiousness, agreeableness and self-identification expressiveness, and low need for arousal and need for materials. Alternatively, when a consumer is highly conscientious and agreeable but has a low need for materials, arousal and a low level of innovativeness, there is a higher likelihood of such a consumer adopting AVPs. On the other hand, when a consumer is highly conscientious and agreeable but has a low need for materials and arousal and level of innovativeness, this results in intention to adopt AVPs. The roles of innovativeness and need for materials and arousal in predicting the expected outcome (consumers' adoption of AVPs) varies according to the attributes of other traits in a given recipe. In sum, our results highlight the importance of personalities in the adoption of AVPs by consumers and provide additional insights to extant studies that suggested attitudinal components such as fear, freedom and convenience (Bennett, Vijaygopal and Kottasz, 2019; Ro and Ha, 2019) influence consumers' perceptions of AVPs. These findings are further interpreted in the theoretical contributions and managerial implications sections below.

5.1. Theoretical contributions

Through our inquiries, we make three specific theoretical contributions. First, we advance the understanding of autonomous driving technology by profiling the personas of prospective consumers. Specifically, we take a consumer psychology perspective to identify consumer personality traits that are sufficiently and conditionally associated with the adoption of innovative level 5 autonomous driving technology (Charness et al., 2018; Hegner et al., 2019). This contributes to the ever-growing research field of totally autonomous vehicles by taking a customer-centric approach.

Second, we develop a novel framework for studying consumers' adoption of innovative new technologies. Extant work exploring the factors that drive or inhibit the uptake of autonomous vehicles has drawn heavily upon TAM, UTAUT and related theories of innovation diffusion to explore consumers' perceptions and beliefs. However, in an environment where the driverless technology is still continuously developed, consumers' perceptions vary over time and may provide a temporary snapshot. However, personality traits are inherent and have a permanent impact on consumers' perception development and behavioural intentions. Therefore, by extending the 3M model to focus on the impact of personality on futuristic technology adoption, we uncover the significant roles that elemental, compound and situational personality traits play in influencing the adoption of futuristic technology, developing specific consumer personas of level 5 AVP users and illustrating the potential customer base. The employment of the 3M model in a futuristic context in a manner that conceptualised innovation as a multi-dimensional construct provides empirical evidence for predicting individual behaviour through a comprehensive theoretical framework that advances our understanding of personality-elicited motivational mechanisms.

Third, we offer a path and guidance through combining analytical approaches (PLS-SEM, fsQCA, and NCA) to 3M model studies. fsQCA is a set-theoretic method that is not only recognized as a powerful and programmatic analytical approach, but also demonstrates new personality-based motivating mechanisms through exploring causal recipes leading to an outcome model. The application of fsQCA enables us to calculate the causal recipes from a combination of personality traits at different levels of the 3M model to predict consumers' adoption of AVPs. fsQCA also helps in explaining the heterogeneous role that personality traits play in formulating consumers' intentions to adopt AVPs. We therefore contribute to the current knowledge of consumer psychology and AVP nexus by identifying the necessary factors of the 3M model that will drive consumers' adoption of AVPs. We found traits that are sufficient but unnecessary to predict consumers' adoption of AVPs and vice versa. Specifically, of the elemental traits of the 3M model, openness to experience is a necessary but insufficient antecedent of adoption intention. On the other hand, innovativeness at the situational trait level appears as a sufficient but unnecessary factor to predict consumers' adoption of AVPs. Our approach uniquely specifies the 'must have' intrinsic characteristics of prospective consumers of AVPs. NCA results highlighted the significance of elemental traits which, through the 3M hierarchy, stimulate consumers' adoption of AVPs. This improves our understanding of consumers' internal personality motivating mechanisms in the modern world of complex and novel technologies such as AVPs.

5.2. Managerial implications

Our study provides practical insights for the developers and manufacturers of driverless vehicles who are seeking to tailor autonomous driving technology to potential consumers' needs and wants, thereby enhancing the market readiness of AVPs. First, we identify the key personality traits that could motivate consumers to adopt AVPs and develop initial profiles of consumer personas of AVP. Subsequent investigation of causal recipes further specifies personas of potential users by demonstrating their multidimensional personality traits. Such information will help manufacturers to design and develop distinctive models of AVPs that fit the personalities of specific consumer groups and therefore overcome the confusion the consumers seeking to adopt AVPs are currently facing (König and Neumayr, 2017; Taylor-West, Saker and Champion, 2018). For example, when integrating traits at the elemental, compound and situational levels (see Table 8), Recipes R1 and R2 have in common conscientiousness, openness to experience, agreeableness and self-identification expressiveness. However, they can be differentiated with regard to negative need for material resources and (positive) for innovativeness, respectively. In such circumstances, we show how a manufacturer could benefit from developing an AVP model that fulfils the needs of customers who express high levels of common traits (i.e., conscientiousness, openness to experience, agreeableness and self-identification expressiveness) between those two recipes. Similarly, recipes 4 and 5 share common traits of conscientiousness, openness to experience, agreeableness and innovativeness, which suggests that manufacturers should focus on designing their products to accommodate those common traits of consumers. Meanwhile, needs for material resources and arousal go against each other in R4 and R5. This indicates that when manufacturers decide to emphasise the materialistic nature of the AVP (e.g. luxuriousness) to please materialistic consumers, they should tone down the features that act as psychological and affective stimuli (R4). The alternative condition is recipe 5 where consumers would rather prefer psychological and affective stimuli than the materialistic nature of the AVP (R5).

Our findings add to and complement the work of other scholars who have explored the preference of autonomous vehicle users (Saeed et al., 2020). There is merit in manufacturers tailoring their designs to satisfy consumers' preferences based on the differences in the recipes that are presented in Table 8. Beyond using common traits in these recipes that inform the generic features that should be included in the AVP design discussed above, each recipe also helps the manufacturer to further customize the product design that decodes the complexity of consumer psychology to encourage adoption intention. More precisely, drawing on recipe R1 where the need for materials is low, manufacturers could further develop a '*utilitarian*' model that plays down luxury. An efficient car with imaginative design may satisfy conscientiousness, openness to experience, agreeableness and self-identification expressiveness of potential customers. To address recipe R2, a manufacturer could design cars that consumers perceive innovative from a functional, hedonic, social and cognitive perspective (Vandecasteele and Geuens, 2010). We opine that they could design a '*pioneer*' model that follows in the steps of successful innovations in conventional cars, taking inspiration from pioneering examples in the automotive sector, such as Volvo's active seat belts or Mercedes Benz's anti-lock braking system. Recipe R3 suggests that there is a group of consumers who would adopt AVP if a car is efficient and expresses their identity, even if it is not luxurious, imaginative, innovative or arousing. An "*expressive*" model that allows a customer to implement some customizations and express themselves will be welcomed. Recipes R4 and R5 highlight that there is a segment of consumers demanding efficient, imaginative, and innovative AVP. However, recipe R4 consumers prefer to be aroused rather than have material resources and would appreciate an "*experiential*" model of AVP. While recipe R4 consumers would prefer a "luxury" modelled AVP considering the high level of their materialistic personality. This level of granularity may be instrumental for manufacturers interested in maintaining high-growth strategies based on customer segmentation. Our identification of the most important features of AVPs taken in tandem with an exploration of the perceptions and expectations of AVPs from the view of road users (Penmetsa et al., 2019) will be invaluable for firms seeking to invest in features that enable greater adoption.

Furthermore, the identification of necessary antecedents will help manufacturers to allocate resources in a manner that best accommodates the needs of consumers. This is important because adoption intention would not occur without these necessary antecedents. In other words, it is important to acknowledge that antecedents that are sufficient might not necessarily enable AVP adoption. Technology developers and AVP manufacturers should be encouraged to invest valuable resources into designing the product features associated with the most important personality traits of different segments of customers. For example, consumer innovativeness, which is measured and used as a multi-dimensional higher-order component, is sufficient, but unnecessary for consumer adoption. Therefore, contrary to popular belief, incorporating extensive innovation and creativity into AVP designs (at very significant costs) may not necessarily result in adoption, especially in the initial stage of market development (unless it is combined with other personality traits as discussed above).

Meanwhile, a focus on the necessary antecedents (conscientiousness, openness to experience, agreeableness and self-identification expressiveness) is likely to lead to higher sales as these are the 'must have' traits of prospective customers. New product development activities should be aligned with the preferences and needs of consumers who have such traits. More precisely, for example, conscientious consumers usually like using sophisticated technology with high levels of efficiency, and a wish to understand how the technology operates (Willems, Swinnen, Jassens and Brengman, 2011). To satisfy such preferences AVP manufacturers could focus on improving efficiency as well as training salespeople, and developing manuals and online support provisions that will simplify the complex nature of AVPs.

Moreover, we show that the design functions and look of AVPs should be novel and creative to accommodate the preference of consumers who are open to experiences and provide them with a distinct riding experience in multiple senses. Our work complements extant work suggesting that AI interaction systems should be presented in a friendly and simple way (Mulyanegara, Tsarenko and Anderson, 2009). We show that the design and functionality of AVPs should be visually distinctive, in order to enable consumers to reflect their self-identity when adopting them; this is consistent with recommendations made by Carter (2015) for technology in general. The development of an initial understanding of sufficient antecedents and profiles of the personas of potential customers will enable technology developers to present prototype AVPs that satisfy consumer needs and wants. Additionally, AVP manufacturers should be aware that customers expect cars to represent their personality, as self-identification expressiveness is a necessary factor in their future adoption intentions. Manufacturers and designers are advised to carry out in-depth market research to classify target customers based on their personality traits and personal values. It is essential to integrate these potential traits in the design of AVPs, allowing consumers' adoption of AVPs to contribute to their social identity and develop their self-image (Berger and Heath, 2007).

As AVPs move ever closer to introduction in the marketplace, it is suggested that developers and manufacturers design and tailor their products based on the necessary antecedents of consumers' adoption, accommodating the preferences of customers who have these necessary personality traits. As the AVP market matures, manufacturers could adopt product-growth and diversification strategies based on sufficient recipes to produce various models in order to satisfy different types of customers. The results of our study should help technology developers in matching the personalities of products and consumers.

In sum, our recipes guide AVP designers in matching products to consumer segments. By way of examples, we draw parallels with cars. An AVP targeting the R4 materialistic personality might focus on the comfort, luxury and prestige offered by brand cachet such as "Mercedes-Benz" (Bartikowski, Fastoso and Gierl, 2019), with a top-quality leather interior and "carpeting rivaling … a Plaza Hotel suite" (Perlas, 2017), packed with mobile office technology and infotainment (Autocar, 2021). On the other hand, good value, efficient, quality "economy" models, typically small, lightweight and cheap to run (Rosecky and Kin., 1996), the "Nissan Micra" of AVPs, might suit R1, where the need for materials is low. Higher technical specification versions might suit the R2 need for innovativeness. An AVP with sporty styling could be the "Porsche" that appeals to R5. R3 looks to AVPs for self expression, which axiomatically, covers a wide range but we illustrate with the "Mini Cooper", with quirky styling and a price premium. Of course, all these suggestions are speculative, whilst we await the consumer-ready technologies.

5.3. Limitations and Research Directions

While we expand our understanding of the motivational personality traits in predicting consumers' adoption of AVPs, in common with any empirical study, our work has some limitations. First, although autonomous technology is being developed around the world our sample consisted of only US participants. Examining consumer traits in a variety of cultural backgrounds may yield different results (Costa, Terracciano and McCrae, 2001). In addition, as autonomous driving technology is being developed at different rates across the world, individuals in different regions may have different perceptions of driverless vehicles (Kyriakidis, Happee and De Winter, 2015). Future research could benefit from a larger and more diverse sample and be undertaken across different countries. As national cultures affect consumers' technology adoption (e.g. Alsaleh, Elliott, Fu and Thakur, 2019; Wong, Liu, Meng-Lewis, Sun and Zhang, 2021), a comparative study with other countries with cultural differences would be valuable. Second, given its complexity, we encourage scholars to subject the 3M model to different methodological or research approaches. For example, experiments could help with further validating the model and testing the cause-effect relationships (Kang and Johnson, 2015). Third, we focus on the motivating power of personality traits in predicting adoption behaviour. Future research could further explore how personality traits affect consumers' perceptions and evaluations (e.g. perceived usefulness), thereby influencing adoption behaviour. Fourth, our study focused on pod-shaped AVPs, while the steering wheel-free feature allows different designs and looks of future autonomous vehicles. That is, future research could examine the impact of personality traits on consumers' acceptance of different designs and visualizations of AVPs. (Celhay and Tringuecoste, 2015; Mugge and Dahl, 2013).

In addition, as autonomous vehicles become more widespread new ownership models based on driverless car sharing are likely to evolve. More research that extends our understanding of consumers' perceptions of shared ownership (Gurumurthy and Kockelman, 2020; Merfeld et al., 2019) and its interactions with motivational personality traits would be valuable. In the current study, we did not focus on consumers' perceptions of specific potential benefits of AVPs associated with safety, increased time to play or work, reduced congestion, sustainability or AVPs ability to assist the young, old or physically impaired to overcome transportation difficulties. These areas warrant further academic attention, as does a better understanding of the barriers to adoption. For example, do consumer concerns about range anxiety relating to electric AVPs, the creepiness of not having a driver, or taxi drivers losing jobs as they are replaced by robot drivers act as barriers? Factors such as trust in AVPs and ethics could also be explored in more detail. Additional research that focuses on stakeholders perceptions of how AVPs create or destroy value from the perspective of multiple actors in the servicescape (e.g. transportation companies, consumers, policymakers, manufacturers, designers) would also be useful. Finally, a longitudinal study could provide insights into how consumers' perceptions of nascent innovative technologies evolve over time.

References

Acheampong, R.A., Cugurullo, F., 2019. Capturing the behavioural determinants behind the adoption of autonomous vehicles: Conceptual frameworks and measurement models to predict public transport, sharing and ownership trends of self-driving cars. Transp. Res. Part F Traffic Psychol. Behav. 62, 349–375. https://doi.org/10.1016/j.trf.2019.01.009

Ali, D.A., Bowen, D., Deininger, K., 2020. Personality Traits, Technology Adoption, and Technical Efficiency: Evidence from Smallholder Rice Farms in Ghana. J. Dev. Stud. 56(7), 1330-1348. https://doi.org/10.1080/00220388.2019.1666978

Allport, G.W., 1961. Pattern and growth in personality. Holt, Rinehart, & Winston, New York.

Alsaleh, D.A., Elliott, M.T., Fu, F.Q., Thakur, R., 2019. Cross-cultural differences in the adoption of social media. J. Res. Interact. Mark. 13, 119–140. https://doi.org/10.1108/JRIM-10-2017-0092

Anania, E.C., Rice, S., Walters, N.W., Pierce, M., Winter, S.R., Milner, M.N., 2018. The effects of positive and negative information on consumers' willingness to ride in a driverless vehicle. Transp. Policy 72, 218-224. https://doi.org/10.1016/j.tranpol.2018.04.002

Autocar, 2021. Top 10 best luxury cars 2021 [WWW Document]. URL https://www.autocar.co.uk/car-news/best-cars/top-10-best-luxury-cars

Bai, L., Wang, M., Gong, S., 2019. Understanding the antecedents of organic food purchases: The important roles of beliefs, subjective norms, and identity expressiveness. Sustain. 11. https://doi.org/10.3390/su11113045

Bansal, P., Kockelman, K.M., 2017. Forecasting Americans' long-term adoption of connected and autonomous vehicle technologies. Transp. Res. Part A Policy Pract. 95, 49-63. https://doi.org/10.1016/j.tra.2016.10.013

Bartikowski, B., Fastoso, F., Gierl, H., 2019. Luxury cars Made-in-China: Consequences for brand positioning. J. Bus. Res. 102, 288–297. doi:10.1016/j.jbusres.2019.01.072

Bennett, R., Vijaygopal, R., Kottasz, R., 2019. Willingness of people with mental health disabilities to travel in driverless vehicles. J. Transp. Heal. 12, 1–12. https://doi.org/10.1016/j.jth.2018.11.005

Berger, J., Heath, C., 2007. Where Consumers Diverge from Others: Identity Signaling and Product Domains. J. Consum. Res. 34, 121–134. https://doi.org/10.1086/519142

Bonnefon, J.F., Shariff, A., Rahwan, I., 2016. The social dilemma of autonomous vehicles. Science (80-.). 352, 1573–1576. https://doi.org/10.1126/science.aaf2654

Bosnjak, M., Galesic, M., Tuten, T., 2007. Personality determinants of online shopping: Explaining online purchase intentions using a hierarchical approach. J. Bus. Res. 60, 597–605. https://doi.org/10.1016/j.jbusres.2006.06.008

Calabrò, A., Minola, T., Campopiano, G., Pukall, T., 2016. Turning innovativeness into domestic and international corporate venturing: The moderating effect of high family ownership and influence. Eur. J. Int. Manag. 10(5), 505-533. https://doi.org/10.1504/EJIM.2016.078789

Carter, M., Grover, V., 2017. Me, My Self, and I(T): Conceptualizing Information Technology Identity and its Implications. MIS Q. 39, 931–957. https://doi.org/10.25300/misq/2015/39.4.9

Cash, P., Kreye, M., 2018. Exploring uncertainty perception as a driver of design activity. Des. Stud. *54*, 50-79. https://doi.org/10.1016/j.destud.2017.10.004

Celhay, F., Trinquecoste, J.F., 2014. Package Graphic Design: Investigating the Variables that Moderate Consumer Response to Atypical Designs. J. Prod. Innov. Manag. 32, 1014–1032. https://doi.org/10.1111/jpim.12212

Chang, A., Tseng, C.H., Chu, M. yeh, 2013. Value creation from a food traceability system based on a hierarchical model of consumer personality traits. Br. Food J. 115(9), 1361-1380. https://doi.org/10.1108/BFJ-11-2011-0286

Charness, N., Yoon, J.S., Souders, D., Stothart, C., Yehnert, C., 2018. Predictors of attitudes toward autonomous vehicles: The roles of age, gender, prior knowledge, and personality. Front. Psychol. 9, 2589. https://doi.org/10.3389/fpsyg.2018.02589

Citrin, A.V., Sprott, D.E., Silverman, S.N., Stem, D.E., 2000. Adoption of Internet shopping: The role of consumer innovativeness. Ind. Manag. Data Syst. 100, 294–300. https://doi.org/10.1108/02635570010304806

Coca-Vila, I., 2018. Self-driving Cars in Dilemmatic Situations: An Approach Based on the Theory of Justification in Criminal Law. Crim. Law Philos. 12, 59–82. https://doi.org/10.1007/s11572-017-9411-3

Cohen, S.A., Hopkins, D., 2019. Autonomous vehicles and the future of urban tourism. Ann. Tour. Res. 74, 33–42. https://doi.org/10.1016/j.annals.2018.10.009

Cohen, T., Jones, P., Cavoli, C., 2017. Social and behavioural questions associated with automated vehicles. Scoping study by UCL Transport Institute. Final report. London.

Costa, P.T., Terracciano, A., McCrae, R.R., 2001. Gender differences in personality traits across cultures: Robust and surprising findings. J. Pers. Soc. Psychol. 81, 322–331. https://doi.org/10.1037/0022-3514.81.2.322

Davis, F.D., Bagozzi, R.P., Warshaw, P.R., 1989. User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. Manage. Sci. 35, 982–1003. https://doi.org/10.1287/mnsc.35.8.982

Devaraj, U.S., Easley, R.F., Crant, J.M., 2008. How does personality matter? Relating the five-factor model to technology acceptance and use. Inf. Syst. Res. 19, 93–105. https://doi.org/10.1287/isre.1070.0153

Dhewanto, W., Sohal, A.S., 2015. The relationship between organisational orientation and research and development/technology commercialisation performance. R&D Manag. 45, 339–360. https://doi.org/10.1111/radm.12073

Dinsmore, J.B., Swani, K., Dugan, R.G., 2017. To "Free" or Not to "Free": Trait Predictors of Mobile App Purchasing Tendencies. Psychol. Mark. 34, 227–244. https://doi.org/10.1002/mar.20985

Duarte, P., Pinho, J.C., 2019. A mixed methods UTAUT2-based approach to assess mobile health adoption. J. Bus. Res. 102, 140-150. https://doi.org/10.1016/j.jbusres.2019.05.022

Fagnant, D.J., Kockelman, K., 2015. Preparing a nation for autonomous vehicles: Opportunities, barriers and policy recommendations. Transp. Res. Part A Policy Pract. *77*, 167-181. https://doi.org/10.1016/j.tra.2015.04.003

Fleetwood, J., 2017. Public health, ethics, and autonomous vehicles. Am. J. Public Health 107, 532–537. https://doi.org/10.2105/AJPH.2016.303628

Flynn, L.R., Goldsmith, R.E., Pollitte, W., 2016. Materialism, Status Consumption, and Market Involved Consumers. Psychol. Mark. 33, 761–776. https://doi.org/10.1002/mar.20915

Govers, P.C.M., Schoormans, J.P.L., 2005. Product personality and its influence on consumer preference. J. Consum. Mark. 22, 189–197. https://doi.org/10.1108/07363760510605308

Guadagno, R.E., Okdie, B.M., Eno, C.A., 2008. Who blogs? Personality predictors of blogging. Comput. Human Behav. 24, 1993–2004. https://doi.org/10.1016/j.chb.2007.09.001

Gurumurthy, K.M., Kockelman, K.M., 2020. Modeling Americans' autonomous vehicle preferences: A focus on dynamic ride-sharing, privacy & long-distance mode choices. Technol. Forecast. Soc. Change. 150, 119792. https://doi.org/10.1016/j.techfore.2019.119792

Hair, J.F.J., Hult, G.T.M., Ringle, C., Sarstedt, M., 2016. A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) 2nd Ed, SAGE Publications. https://doi.org/10.1016/j.lrp.2013.01.002

Han, H., Al-Ansi, A., Olya, H.G.T., Kim, W., 2019. Exploring halal-friendly destination attributes in South Korea: Perceptions and behaviors of Muslim travelers toward a non-Muslim destination. Tour. Manag. 71, 151–164. https://doi.org/10.1016/j.tourman.2018.10.010

He, P., Veronesi, M., 2017. Personality traits and renewable energy technology adoption: A policy case study from China. Energy Policy. 107, 472-479. https://doi.org/10.1016/j.enpol.2017.05.017

Hegner, S.M., Beldad, A.D., Brunswick, G.J., 2019. In Automatic We Trust: Investigating the Impact of Trust, Control, Personality Characteristics, and Extrinsic and Intrinsic Motivations on the Acceptance of Autonomous Vehicles. Int. J. Hum. Comput. Interact. 1–12. https://doi.org/10.1080/10447318.2019.1572353

Henseler, J., Ringle, C.M., Sarstedt, M., 2014. A new criterion for assessing discriminant validity in variance-based structural equation modeling. J. Acad. Mark. Sci. 43, 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hickey, A.M., Davis, A.M. (Alan M., Kaiser, D., 2007. Requirements Elicitation Techniques: Analyzing the Gap between Technology Availability and Technology Use. Comp. Technol. Transf. Soc. 1, 279–302. https://doi.org/10.1353/ctt.2003.0026

Hirunyawipada, T., Paswan, A.K., 2006. Consumer innovativeness and perceived risk: Implications for high technology product adoption. J. Consum. Mark. 23, 182–198. https://doi.org/10.1108/07363760610674310

Hsiao, K.L., 2017. Compulsive mobile application usage and technostress: The role of personality traits. Online Inf. Rev. 41, 272–295. https://doi.org/10.1108/OIR-03-2016-0091

Hsieh, S.H., Tseng, T.H., 2015. The effects of emoticons and text-messaging on social interaction: Playfulness in mobile instant messaging, in: Pacific Asia Conference on Information Systems, PACIS 2015 - Proceedings.

Hwang, J., Kim, J.J., Lee, K.W., 2021. Investigating consumer innovativeness in the context of drone food delivery services: Its impact on attitude and behavioral intentions. Technol. Forecast. Soc. Change 163. https://doi.org/10.1016/j.techfore.2020.120433

Junglas, I.A., Johnson, N.A., Spitzmüller, C., 2008. Personality traits and concern for privacy: An empirical study in the context of location-based services. Eur. J. Inf. Syst. *17*(4), 387-402. https://doi.org/10.1057/ejis.2008.29

Kamolsook, A., Badir, Y.F., Frank, B., 2019. Consumers' switching to disruptive technology products: The roles of comparative economic value and technology type. Technol. Forecast. Soc. Change. 140, 328–340. https://doi.org/10.1016/j.techfore.2018.12.023

Kan, A.K.S., Adegbite, E., El Omari, S., Abdellatif, M., 2016. On the use of qualitative comparative analysis in management. J. Bus. Res. 69, 1458–1463. https://doi.org/10.1016/j.jbusres.2015.10.125

Kang, J.Y.M., Johnson, K.K.P., 2015. F-Commerce platform for apparel online social shopping: Testing a Mowen's 3M model. Int. J. Inf. Manage. 35, 691–701. https://doi.org/10.1016/j.ijinfomgt.2015.07.004

Kaur, K., Rampersad, G., 2018. Trust in driverless cars: Investigating key factors influencing the adoption of driverless cars. J. Eng. Technol. Manag. 48, 87–96. https://doi.org/10.1016/J.JENGTECMAN.2018.04.006

Klimstra, T., 2013. Adolescent Personality Development and Identity Formation. Child Dev. Perspect. 7, 80–84. https://doi.org/10.1111/cdep.12017

Kohl, C., Knigge, M., Baader, G., Böhm, M., Krcmar, H., 2018. Anticipating acceptance of emerging technologies using twitter: the case of self-driving cars. J. Bus. Econ. 88 (5), 617-642. https://doi.org/10.1007/s11573-018-0897-5

König, M., Neumayr, L., 2017. Users' resistance towards radical innovations: The case of the self-driving car. Transp. Res. Part F Traffic Psychol. Behav. 44, 42–52. https://doi.org/10.1016/j.trf.2016.10.013

Kunz, W., Schmitt, B., Meyer, A., 2011. How does perceived firm innovativeness affect the consumer? J. Bus. Res. 64(8), 816-822. https://doi.org/10.1016/j.jbusres.2010.10.005

Kyriakidis, M., Happee, R., De Winter, J.C.F., 2015. Public opinion on automated driving: Results of an international questionnaire among 5000 respondents. Transp. Res. Part F Traffic Psychol. Behav. 32, 127–140. https://doi.org/10.1016/j.trf.2015.04.014

Lassar, W.M., Manolis, C., Lassar, S.S., 2005. The relationship between consumer innovativeness, personal characteristics, and online banking adoption. Int. J. Bank Mark. 23, 176–199. https://doi.org/10.1108/02652320510584403

Levin, S., Carrie, J., 2018. Self-driving Uber kills Arizona woman in first fatal crash involving pedestrian [WWW Document]. Guard. URL https://www.theguardian.com/technology/2018/mar/19/uber-self-driving-car-kills-woman-arizona-tempe (accessed 4.9.19).

Li, G., Zhang, R., Wang, C., 2015. The Role of Product Originality, Usefulness and Motivated Consumer Innovativeness in New Product Adoption Intentions. J. Prod. Innov. Manag. 32, 214–223. https://doi.org/10.1111/jpim.12169

Lin, C.A., 2003. An interactive communication technology adoption model. Commun. Theory. https://doi.org/10.1111/j.1468-2885.2003.tb00296.x

Llopis-Albert, C., Rubio, F., Valero, F., 2019. Fuzzy-set qualitative comparative analysis applied to the design of a network flow of automated guided vehicles for improving business productivity. J. Bus. Res. 101, 737-742. https://doi.org/10.1016/j.jbusres.2018.12.076

López-Cabarcos, M.Á., Vázquez-Rodríguez, P., Gieure, C., 2017. Gender and age differences in the psychosocial risk factors of workplace bullying. Psychol. Mark. 34, 1023–1030. https://doi.org/10.1002/mar.21041

Manika, D., Papagiannidis, S., Bourlakis, M., 2015. Can a CEO's YouTube apology following a service failure win customers' hearts? Technol. Forecast. Soc. Change. 95, 87–95. https://doi.org/10.1016/j.techfore.2013.12.021

Marletto, G., 2019. Who will drive the transition to self-driving? A socio-technical analysis of the future impact of automated vehicles. Technol. Forecast. Soc. Change. 139, 221-234. https://doi.org/10.1016/j.techfore.2018.10.023

Merfeld, K., Wilhelms, M.P., Henkel, S., Kreutzer, K., 2019. Carsharing with shared autonomous vehicles: Uncovering drivers, barriers and future developments – A four-stage Delphi study. Technol. Forecast. Soc. Change. *144*, 66-81. https://doi.org/10.1016/j.techfore.2019.03.012

Miller, K., McAdam, R., McAdam, M., 2018. A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda. R D Manag. 48, 7–24. https://doi.org/10.1111/radm.12228

Mishra, S., Malhotra, G., Chatterjee, R., Sanatkumar Shukla, Y., 2021. Impact of self-expressiveness and environmental commitment on sustainable consumption behavior: the moderating role of fashion consciousness. J. Strateg. Mark. 1–23. https://doi.org/10.1080/0965254x.2021.1892162

Montoro, L., Useche, S.A., Alonso, F., Lijarcio, I., Bosó-Seguí, P., Martí-Belda, A., 2019. Perceived safety and attributed value as predictors of the intention to use autonomous vehicles: A national study with Spanish drivers. Saf. Sci. 120, 865-876. https://doi.org/10.1016/j.ssci.2019.07.041

Moore, G.A., 1991. Crossing the Chasm - Marketing and Selling High-Tech Products to Mainstream Customers. Harper Business, New York.

Mowen, J.C., 2000. The 3M model of motivation and personality : theory and empirical applications to consumer behavior. Kluwer Academic Publishers, Boston.

Mowen, J.C., 2004. Exploring the Trait of Competitiveness and Its Consumer Behavior Consequences. J. Consum. Psychol. 14(1-2), 52-63. https://doi.org/10.1207/s15327663jcp1401&2_7

Mowen, J.C., Harris, E.G., Bone, S.A., 2004. Personality traits and fear response to print advertisements: Theory and an empirical study. Psychol. Mark. 21, 927–943. https://doi.org/10.1002/mar.20040

Mugge, R., Dahl, D.W., 2013. Seeking the ideal level of design newness: Consumer response to radical and incremental product design. J. Prod. Innov. Manag. 30, 34–47. https://doi.org/10.1111/jpim.12062

Mulyanegara, R.C., Tsarenko, Y., Anderson, A., 2009. The Big Five and brand personality: Investigating the impact of consumer personality on preferences towards particular brand personality. J. Brand Manag. 16, 234–247. https://doi.org/10.1057/palgrave.bm.2550093

Olya, H., Al-ansi, A., 2018. Risk assessment of halal products and services: Implication for tourism industry. Tour. Manag. 65, 279–291. https://doi.org/10.1016/j.tourman.2017.10.015

Olya, H., Lee, C.K., Lee, Y.K., Reisinger, Y., 2019. What are the triggers of Asian visitor satisfaction and loyalty in the Korean heritage site? J. Retail. Consum. Serv. 47, 195–205. https://doi.org/10.1016/j.jretconser.2018.11.002

Olya, H. (2021). Towards advancing theory and methods on tourism development from residents' perspectives: Developing a framework on the pathway to impact. *Journal of Sustainable Tourism*, https://doi.org/10.1080/09669582.2020.1843046

Pagani, M., Hofacker, C.F., Goldsmith, R.E., 2011. The influence of personality on active and passive use of social networking sites. Psychol. Mark. 28, 441–456. https://doi.org/10.1002/mar.20395

Pel, B., Raven, R., van Est, R., 2020. Transitions governance with a sense of direction: synchronization challenges in the case of the dutch 'Driverless Car' transition. Technol. Forecast. Soc. Change. https://doi.org/10.1016/j.techfore.2020.120244

Penmetsa, P., Adanu, E.K., Wood, D., Wang, T., Jones, S.L., 2019. Perceptions and expectations of autonomous vehicles – A snapshot of vulnerable road user opinion. Technol. Forecast. Soc. Change. 143, 9-13. https://doi.org/10.1016/j.techfore.2019.02.010

Perlas, G., 2017. What Makes a Mercedes-Benz Special? [WWW Document]. URL https://www.benzinsider.com/2017/11/what-makes-a-mercedes-benz-special/

Rauschnabel, P.A., Ro, Y.K., 2016. Augmented reality smart glasses: an investigation of technology acceptance drivers. Int. J. Technol. Mark. 11, 123–148. https://doi.org/10.1504/ijtmkt.2016.075690

Rinne, M., 2004. Technology roadmaps: Infrastructure for innovation. Technol. Forecast. Soc. Change 71, 67–80. https://doi.org/10.1016/J.TECHFORE.2003.10.002

Ro, Y., Ha, Y., 2019. A Factor Analysis of Consumer Expectations for Autonomous Cars. J. Comput. Inf. Syst. 51, 52–60. https://doi.org/10.1080/08874417.2017.1295791

Roberts, J.A., Pullig, C., Manolis, C., 2015. I need my smartphone: A hierarchical model of personality and cell-phone addiction. Pers. Individ. Dif. 79, 13–19. https://doi.org/10.1016/j.paid.2015.01.049

Rogers, E., 1962. Diffusion of innovations. Free Press of Glencoe, Macmillan Company, New York.

Rogers, E.M., Shoemaker, F.F., 1971. Communication of innovations: A cross-cultural approach, 2nd ed., Communication of innovations: A cross-cultural approach, 2nd ed. The Free Press, New York.

Rosecky, R.B., King, A.B., 1996. Perceptual differences among owners of luxury cars: strategic marketing implications. The Mid-Atlantic Journal of Business, 32(3), 221-241.

Rubio, F., Llopis-Albert, C., Valero, F., Besa, A.J., 2020. Sustainability and optimization in the automotive sector for adaptation to government vehicle pollutant emission regulations. J. Bus. Res. https://doi.org/10.1016/j.jbusres.2019.10.050

Ruggeri, K., Kácha, O., Menezes, I.G., Kos, M., Franklin, M., Parma, L., Langdon, P., Matthews, B., Miles, J., 2018. In with the new? Generational differences shape population technology adoption patterns in the age of self-driving vehicles. J. Eng. Technol. Manag. - JET-M 50, 39–44. https://doi.org/10.1016/j.jengtecman.2018.09.001

SAE International, 2018. International Releases Updated Visual Chart for Its “Levels of Driving Automation” Standard for Self-Driving Vehicles [WWW Document]. URL https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-”levels-of-driving-automation”-standard-for-self-driving-vehicles (accessed 4.9.19).

Saeed, T.U., Burris, M.W., Labi, S., Sinha, K.C., 2020. An empirical discourse on forecasting the use of autonomous vehicles using consumers’ preferences. Technol. Forecast. Soc. Change. https://doi.org/10.1016/j.techfore.2020.120130

Şahin, F., Karadağ, H., Tuncer, B., 2019. Big five personality traits, entrepreneurial self-efficacy and entrepreneurial intention: A configurational approach. Int. J. Entrep. Behav. Res. 25(6), 1188-1211. https://doi.org/10.1108/IJEBR-07-2018-0466

Saridakis, C., Baltas, G., Oghazi, P., Hultman, M., 2016. Motivation Recipes for Brand-Related Social Media Use: A Boolean—fsQCA Approach. Psychol. Mark. 33, 1062–1070. https://doi.org/10.1002/mar.20940

Schmitt, A.K., Grawe, A., Woodside, A.G., 2017. Illustrating the Power of fsQCA in Explaining Paradoxical Consumer Environmental Orientations. Psychol. Mark. 34, 323–334. https://doi.org/10.1002/mar.20991

Schneider, P.P., Vogt, C.A., 2012. Applying the 3M Model of Personality and Motivation to Adventure Travelers. J. Travel Res. 51, 704–716. https://doi.org/10.1177/0047287512451134

Shaw, H., Ellis, D.A., Kendrick, L.-R., Ziegler, F., Wiseman, R., 2016. Predicting Smartphone Operating System from Personality and Individual Differences. Cyberpsychology, Behav. Soc. Netw. 19, 727–732. https://doi.org/10.1089/cyber.2016.0324

Shaw, H., Ellis, D.A., Ziegler, F. V., 2018. The Technology Integration Model (TIM). Predicting the continued use of technology. Comput. Human Behav. 83, 204–214. https://doi.org/10.1016/j.chb.2018.02.001

Skeete, J.P., 2018. Level 5 autonomy: The new face of disruption in road transport. Technol. Forecast. Soc. Change. 134, 22-34. https://doi.org/10.1016/j.techfore.2018.05.003

Sun, T., Tai, Z., Tsai, K.C., 2010. Perceived ease of use in prior e-commerce experiences: A hierarchical model for its motivational antecedents. Psychol. Mark. 27, 874–886. https://doi.org/10.1002/mar.20362

Tabacchi, M.E., Caci, B., Cardaci, M., Perticone, V., 2017. Early usage of Pokémon Go and its personality correlates. Comput. Human Behav. 72, 163-169 https://doi.org/10.1016/j.chb.2017.02.047

Talebian, A., Mishra, S., 2018. Predicting the adoption of connected autonomous vehicles: A new approach based on the theory of diffusion of innovations. Transp. Res. Part C Emerg. Technol. 95, 363–380. https://doi.org/10.1016/j.trc.2018.06.005

Taylor-West, P., Saker, J., Champion, D., 2018. Market segmentation strategies for complex automotive products. J. Strateg. Mark. 1–18. https://doi.org/10.1080/0965254X.2018.1555548

Terzis, V., Moridis, C.N., Economides, A.A., 2012. How student's personality traits affect Computer Based Assessment Acceptance: Integrating BFI with CBAAM. Comput. Human Behav. 28, 1985–1996. https://doi.org/10.1016/j.chb.2012.05.019

Thakur, R., Srivastava, M., 2015. A study on the impact of consumer risk perception and innovativeness on online shopping in India. Int. J. Retail Distrib. Manag. 43, 148–166. https://doi.org/10.1108/IJRDM-06-2013-0128

Thorbjørnsen, H., Pedersen, P.E., Nysveen, H., 2007. "This is who I am": Identity expressiveness and the theory of planned behavior. Psychol. Mark. 24, 763–785. https://doi.org/10.1002/mar.20183

Timmer, S., Kaufmann, L., 2019. Do Managers' Dark Personality Traits Help Firms in Coping with Adverse Supply Chain Events? J. Supply Chain Manag. 55(4), 67-97. https://doi.org/10.1111/jscm.12212

Un, S., Price, N., 2007. Bridging the gap between technological possibilities and people:. Involving people in the early phases of technology development. Technol. Forecast. Soc. Change. 74(9), 1758-1772. https://doi.org/10.1016/j.techfore.2007.05.008

Vandecasteele, B., Geuens, M., 2010. Motivated consumer innovativeness: Concept, measurement, and validation. Int. J. Res. Mark. 27, 308–318. https://doi.org/10.1016/j.ijresmar.2010.08.004

Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D., 2003. User Acceptance of Information Technology: Toward a Unified View. MIS Q. 27, 425-478. https://doi.org/10.2307/30036540

Wang, X., Wong, Y.D., Li, K.X., Yuen, K.F., 2020. This is not me! Technology-identity concerns in consumers' acceptance of autonomous vehicle technology. Transp. Res. Part F Traffic Psychol. Behav. 74, 345–360. https://doi.org/10.1016/j.trf.2020.06.005

Willems, K., Swinnen, G., Janssens, W., Brengman, M., 2011. Fashion store personality: Scale development and relation to self-congruity theory. J. Glob. Fash. Mark. 2, 55–65. https://doi.org/10.1080/20932685.2011.10593083

Wong, D., Liu, H., Meng-Lewis, Y., Sun, Y., Zhang, Y., 2021. Gamified money: exploring the effectiveness of gamification in mobile payment adoption among the silver generation in China. Inf. Technol. People.

Wong, E., n.d. Autonomous vehicles could help us weather the coronavirus [WWW Document]. TechWire. URL https://techwireasia.com/2020/02/autonomous-vehicles-could-help-us-weather-the-coronavirus (accessed 10.27.20).

Wu, J., Liao, H., Wang, J.W., Chen, T., 2019. The role of environmental concern in the public acceptance of autonomous electric vehicles: A survey from China. Transp. Res. Part F Traffic Psychol. Behav. 60, 37–46. https://doi.org/10.1016/j.trf.2018.09.029

Xu, R., Frey, R.M., Fleisch, E., Ilic, A., 2016. Understanding the impact of personality traits on mobile app adoption - Insights from a large-scale field study. Comput. Human Behav. 62, 244-256. https://doi.org/10.1016/j.chb.2016.04.011

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Tables and Figures

Table 1. Summary of relevant literature on autonomous vehicles (AVs)

Authors & Journal	Theoretical Underpinning	Method & Analysis	Core findings
Acheampong & Cugurullo (2019) *Transportation Research Part F*	Modified TAM, Technology Diffusion Theory, Theory of Planned Behaviour	Survey 507 Irish respondents Structural equation modelling	Social psychological factors influence individuals' perceptions and adoption of autonomous vehicles. Sociodemographic factors, such as education, age and gender, also influence the psychological mechanism towards adoption.
Anania et al. (2018) *Transport Policy*	Not specifically stated	Two experiments: 63 US, and 922 Indian and American respondents Multivariate analysis	Consumers are more willing to ride in AVs after hearing positive information about them and less willing after being subject to negative information. Nationality and gender differences exist.
Bennett et al. (2019) *Journal of Transport & Health*	Not specifically stated	Survey of 177 people with mental health disabilities Structural topical modelling and regression analysis	Identified three categories of attitude (freedom, fear and curiosity) which are influenced by internal locus of control and generalized anxiety. Freedom and fear predict respondents' willingness to use AVs.
Kaur & Rampersad (2018) *Journal of Engineering and Technology Management*	TAM & UTAUT	Embedded quantitative case study & survey of 101 Australian Uni. Staff & Students SEM	Reliability, security and privacy concerns influence trust. Adoption is driven by the ability of AV to meet performance expectations and trust.
Kohl, Knigge, Baader, Böhm & Krcmar (2018) *Journal of Business Economics*	TAM	Twitter mining of 1.9 million tweets Supervised machine learning using risk and benefit ratios	News of AVs is reflected in tweets, therefore the promotion of the benefits, as well as the risks of AVs. must be carefully managed.
Ro & Ha (2019) *Journal of Computer Information Systems*	TRA & UTUAT	4 stage study including blog analysis, survey of expectations and analysis of 1,500 Korean respondents Big data mining to search for keywords, EFA, CFA & SEM	Convenience, safety, ethics, licensing, and monetary costs influence attitudes while convenience, safety, and monetary costs influence purchasing intentions for AVs.
Ruggeri et al. (2018) *Journal of Engineering and Technology Management*	Roger's diffusion of innovation	Survey of 2,850 UK consumers Chi Square analysis	Adoption of AVs reflects patterns of adoption of previous technologies. Older consumers are likely to be later adopters
Talebian & Mishra (2018) *Transportation Research Part C*	Resistance theory and Roger's diffusion of innovation	Survey of US University Staff (n=327) Synthetic reconstruction employing agent-based algorithm modelling	Measures willingness to pay for AVs and highlights how marketing and customer satisfaction will influence rates of adoption
Wu et al. (2019) *Transportation Research Part F*	Technology Acceptance Model	Survey 490 Chinese Consumers SEM	Environmental concerns, green perceived usefulness, and perceived ease of use have a positive influence on behavioural intention

Table 2. 3M Elemental traits

Elemental trait	Conceptualization	Empirical Evidence	Rationale of the possible association
Agreeableness	The degree of compassion and cooperativeness towards others	Tabacchi, Caci, Cardaci and Perticone, 2017; Terzis, Moridis and Economides, 2012	Customers who are agreeable perceive that technology is more useful and they better appreciate the social value of the technology.
Conscientiousness	The tendency of being self-organized and self-disciplined	Barnett, Pearson, Pearson and Kellermanns, 2015; Devaraj, Easley and Crant, 2008; Xu, Frey, Fleisch and Ilic, 2016	Conscientious customers appreciate hi-tech products and are interested in using technology to manage their life and well-being.
Openness to experience	The degree of intellectual curiosity and creativity including preferences for novelty and variety	Charness et al., 2018; He and Veronesi, 2017	Customers who are open to experiences are more likely to try out new technologies to satisfy their curiosity as well as experience the sense of excitement brought by such technology.
Need for arousal	An enduring desire for stimulation	Bosnjak, Galesic and Tuten, 2007; Sun, Tai and Tsai, 2010	Consumers who have high levels of need for arousal are more sensitive to psychological and affective stimuli, seek for novelty and are more likely to use new technologies.
Need for material resources	An enduring desire to enhance/protect material items	Hsiao, 2017; Roberts et al., 2015	Materialistic consumers have more positive attitudes and stronger behavioural intention towards technology use. New technologies with high materialistic value are preferred by materialistic consumers.

Table 3. Results of factor analysis, reliability, and convergent validity

Scale item	Factor loading	t-value	α	rho_A	CR	AVE
New product adoption intention (Li et al., 2015)			*0.818*	*0.836*	*0.823*	*0.611*
I'd love to adopt the new autonomous car.	0.848***	17.369				
I'll adopt the new autonomous car soon.	0.838***	32.655				
I can afford to accrue some costs to adopt the new autonomous car.	0.843***	24.908				
Functional innovativeness (Vandecasteele & Geuens, 2010)			*0.895*	*0.898*	*0.893*	*0.628*
If a new time-saving product is launched, I will buy it right away	0.897***	39.678				
If a new product gives me more comfort than my current product, I would not hesitate to buy it.	0.816***	30.755				
If an innovation is more functional, then I usually buy it.	0.733***	23.220				
If I discover a new product in a more convenient size, I am very inclined to buy this.	0.724***	22.804				
If a new product makes my work easier, then this new product is a "must" for me.	0.780***	29.898				
Hedonic innovativeness (Vandecasteele & Geuens, 2010)			*0.922*	*0.924*	*0.923*	*0.705*
Using novelties gives me a sense of personal enjoyment.	0.861***	40.454				
It gives me a good feeling to acquire new products	0.770***	28.530				
Innovations make my life exciting and stimulating.	0.868***	43.472				
Acquiring an innovation makes me happier.	0.871***	34.494				
The discovery of novelties makes me playful and cheerful.	0.820***	30.803				
Social innovativeness (Vandecasteele & Geuens, 2010)			*0.903*	*0.904*	*0.904*	*0.758*
I like to own a new product that distinguishes me from others who do not own this new product.	0.896***	56.606				
I prefer to try new products with which I can present myself to my friends and neighbours	0.873***	46.173				
I like to outdo others, and I prefer to do this by buying new products which my friends do not have	0.842***	38.607				
Cognitive innovativeness (Vandecasteele & Geuens, 2010)			*0.941*	*0.941*	*0.941*	*0.800*
I find innovations that need a lot of thinking intellectually challenging and therefore I buy them instantly.	0.897***	34.304				
I often buy new products that make me think logically.	0.906***	58.668				
I often buy innovative products that challenge the strengths and weaknesses of my intellectual skills.	0.895***	56.054				
I am an intellectual thinker who buys new products because they set my brain to work.	0.877***	54.408				

Self-identification expressiveness (Thorbjørnsen et al., 2007)			*0.936*	*0.937*	*0.935*	*0.828*
Using technologies like autonomous vehicles is part of how I express my personality	0.960***	62.521				
Using autonomous vehicles could express my personal values	0.879***	47.881				
Using autonomous vehicles could express who I want to be	0.890***	49.485				
Conscientiousness (Mowen et al., 2004)			*0.851*	*0.857*	*0.839*	*0.572*
Precise	0.870***	12.118				
Efficient	0.795***	11.042				
Organised	0.739***	9.953				
Orderly	0.726***	7.407				
Openness to experience (Mowen et al., 2004)			*0.899*	*0.905*	*0.898*	*0.689*
Frequently feel highly creative	0.820***	22.976				
Imaginative	0.706***	14.987				
Find novel solutions	0.868***	22.658				
More original than others	0.909***	19.960				
Agreeableness (Mowen et al., 2004)			*0.878*	*0.881*	*0.875*	*0.638*
Tender hearted with others	0.743***	9.205				
Agreeable with others	0.892***	11.488				
Kind to others	0.773***	8.220				
Soft hearted	0.761***	9.589				
Need for material resources (Mowen et al., 2004)			*0.937*	*0.940*	*0.938*	*0.790*
Enjoy buying expensive things	0.881***	42.191				
Like to own nice things more than most people	0.889***	41.089				
Acquiring valuable things is important to me	0.958***	59.227				
Enjoy owning luxurious things	0.821***	33.448				
Need for arousal (Mowen et al., 2004)			*.906*	*.914*	*.909*	*.714*
Drawn to experiences with an element of danger	.809***	22.120				
Seek an adrenaline rush	.898***	26.892				
Actively seek out new experiences	.751***	14.572				
Enjoy taking more risks than others	.907***	28.164				

Note: *** < 0.001, α: Cronbach's Alpha, CR: Composite Reliability, AVE: Average Variance Extracted.

Table 4. Results of discriminant validity based on Fornell Larcker criteria and HTMT measures

Fornell Larcker criteria	1	2	3	4	5	6	7	8	9	10	11
1:Agreeableness	**.798**										
2: Cognitive innovativeness	.134(.018)	**.895**									
3: Conscientiousness	.276(.076)	.307(.094)	**.755**								
4: Functional innovativeness	.155(.024)	.711(.506)	.214(.046)	**.793**							
5: Hedonic innovativeness	.225(.051)	.693(.480)	.182(.033)	.829(.687)	**.840**						
6: Need for material resources	.025(.001)	.520(.270)	.131(.017)	.541(.293)	.604(.365)	**.889**					
7: Product adoption intention	.084(.007)	.586(.343)	.232(.054)	.581(.338)	.518(.268)	.430(.185)	**.782**				
8: Need for arousal	.021(.000)	.428(.183)	.076(.006)	.379(.144)	.354(.125)	.469(.220)	.389(.151)	**.845**			
9: Openness to experience	.290(.084)	.389(.151)	.316(.100)	.413(.171)	.402(.162)	.216(.047)	.291(.085)	.329(.108)	**.830**		
10: Self-identification expressiveness	.142(.020)	.595(.354)	.111(.012)	.540(.292)	.586(.343)	.459(.211)	.801(.642)	.376(.141)	.214(.046)	**.910**	
11: Social innovativeness	.051(.003)	.675(.456)	.158(.025)	.688(.473)	.645(.416)	.657(.432)	.521(.271)	.484(.234)	.299(.089)	.589(.347)	**.871**
Heterotrait-Monotrait Ratio of correlation (HTMT)											
1: Agreeableness											
2: Cognitive innovativeness	.130										
3: Conscientiousness	.277	.299									
4: Functional innovativeness	.154	.709	.208								
5: Hedonic innovativeness	.224	.692	.175	.830							
6: Need for material resources	.044	.518	.123	.537	.669						
7: New product adoption intention	.092	.583	.228	.579	.623	.422					
8: Need for arousal	.058	.429	.092	.377	.454	.467	.388				
9: Openness to experience	.293	.387	.300	.416	.432	.214	.286	.334			
10: Self-identification expressiveness	.139	.594	.111	.534	.647	.456	.812	.373	.211		
11: Social innovativeness	.079	.675	.152	.681	.875	.758	.514	.484	.295	.589	-

Note: Square root of correlation coefficients are presented within the parentheses. Bolded values are square root for the AVEs.

Table 5. Results of SEM and NCA

Antecedent	PLS-SEM: sufficient antecedent on the below outcomes			NCA: necessary antecedent on the below outcomes		
	Self-identification expressiveness	Innovativeness	New product adoption intention	Self-identification expressiveness	Innovativeness	New product adoption intention
Level	β	β	β	Consistency	Consistency	Consistency
Elemental traits						
Conscientiousness	.011	.067*	.105***	.929	.954	.939
Openness to experience	.045	0.207***	.056	.884	.919	.892
Agreeableness	.100*	.030	-.070*	.935	.945	.932
Need for material resources	.346***	.400***	-.005	.674	.702	.640
Need for arousal	.178***	.057	.055	.648	.657	.630
Compound trait						
Self-identification expressiveness		.371***	.595***		.781	.890
Situational trait						
Innovativeness			.136**			.816

Note: *: p<.05, **: p< .01, ***: p< .001. Necessary received consistency above .85.

Table 6. Results of fsQCA from elemental traits configuration

Causal recipes for predicting (arrow A in configurational model)	Raw coverage	Unique coverage	Consistency
npaint = f(consc, opex, agree, needm, needars)			
R1.consc*opex*~agree*needars	0.298	0.013	0.921
R2.consc~opex*agree*needars*	0.315	0.019	0.902
*R3.consc*opex*needm*needars*	0.487	0.001	0.930
*R4.consc*agree*needm*needars*	0.486	0.001	0.926
Solution consistency: 0.545			
Solution coverage: 0.893			

Note: R stands for recipe, *npaint:* new product adoption intention, consc: conscientiousness, *opex:* openness to experience, *agree:* agreeableness, *needm:* need for material resources, *needars:* need for arousal.

Table 7. Results of fsQCA from combination of elemental traits configuration with self-identification expressiveness

Causal recipes for predicting new product adoption intention (arrow B in configurational model)	Raw coverage	Unique coverage	Consistency
npaint = f(consc, opex, agree, needm, needars, expresiv)			
*R1. consc*opex*agree*expresiv*	0.700	0.081	0.922
*R2. consc*agree*~needm*~needars*expresiv*	0.466	0.020	0.920
*R3. consc*opex*agree*needm*needars*	0.478	0.016	0.935
R4.consc~opex*agree*needm*~needars*~expresiv*	0.280	0.012	0.903
Solution consistency: .762			
Solution coverage: .885			

Note: R stands for recipe. npaint: new product adoption intention, consc: conscientiousness, opex: openness to experience, agree: agreeableness, needm: need for material resources, needars: need for arousal. expresiv: self-identification expressiveness.

Table 8. Results of fsQCA from combination of elemental traits configuration with self-identification expressiveness and innovativeness

Causal recipes for predicting new product adoption intention (arrow C in configurational model)	Raw coverage	Unique coverage	Consistency
NPAInt = f(Consc, Opex, Agree, Needm, Needars, expresiv, Inov)			
*R1.consc*opex*agree*~needm*expresiv*	0.498	0.014	0.931
*R2.consc*opex*agree*expresiv*inov*	0.653	0.130	0.940
*R3.consc*agree*~needm*~needars*expresiv*~inov*	0.410	0.017	0.923
*R4.consc*opex*agree*needm*~needars*inov*	0.402	0.012	0.895
*R5. consc*opex*agree*~needm*needars*inov*	0.939	0.018	0.913
Solution consistency: .751			
Solution coverage: .876			

Note: R stands for recipe. npaint: new product adoption intention, consc: conscientiousness, opex: openness to experience, agree: agreeableness, needm: need for material resources, needars: need for arousal. expresiv: self-identification expressiveness, inov: innovativeness.

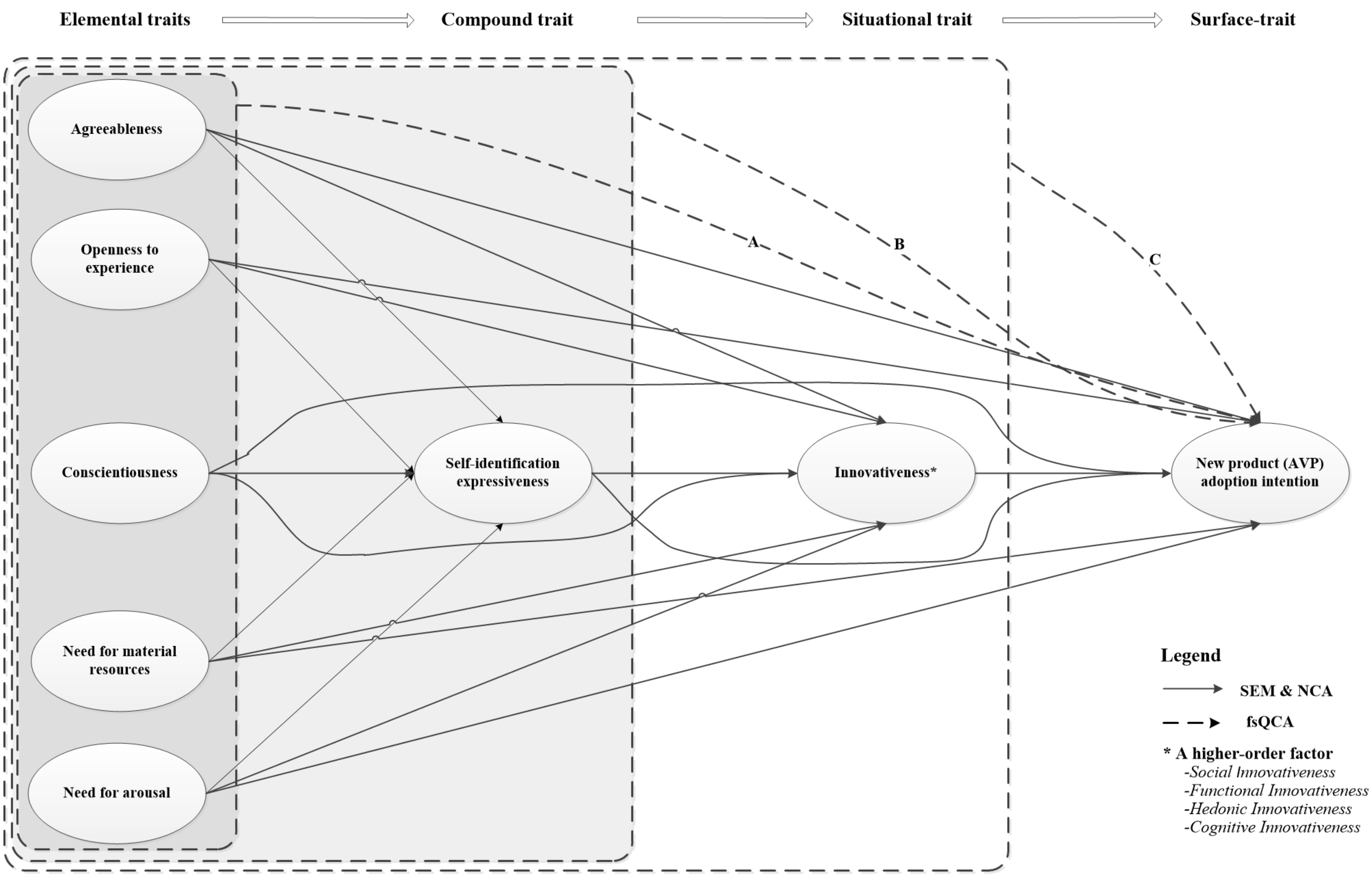

Figure 1. Research model