

# The Personal Autonomous Car: Personality and the Driverless Car

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## Abstract

Road traffic accidents, congestion and their ensuing issues are of international concern. A recent technological development to alleviate this situation is the autonomic car. A driverless vehicle will transport its passengers to their destinations. User experience would be enhanced by adapting the workings of the vehicle in line with the personality of its user. An autonomic car information system preference questionnaire was designed, focusing on different components of a futuristic information system. Participants comprised 155 students. The results demonstrated two factors: willingness to share information and need for control. A regression analysis on the automatic car preferences, personality (the Big 5), gender, and age showed that openness, consciences, and age were related to different preferences. The results are assessed, followed by a discussion on personality in relation to the autonomic car.

**Keywords:** autonomous car, information system, personality, well-being

## Introduction

THE AUTONOMOUS CAR (AC) appears to offer a solution to major issues including traffic jams and accidents.<sup>1</sup> However, before such a solution can be implemented, a psychological barrier of trust has to be overcome. For example, in a survey carried out in the United States, 78 percent of Americans reported that they are afraid of traveling in an autonomous vehicle.<sup>2</sup> This fear led to the suggestion that designing the car's components around the personality of the user will significantly assist in the integration of the driverless car.

Amichai-Hamburger suggested that an individual's personality affects how they use technology.<sup>3</sup> Indeed, many personality theories were shown as being relevant to Internet use.<sup>4-6</sup> Studying how the personality of users impacts their preferences regarding the information exchange system of the AC will assist in developing the vehicle around the needs of the individual, leading to consumer satisfaction and trust.

## Methods

### Participants

Participants were 155 students (BA in the faculty of social science): 100 females and 55 males (mean age = 25.35 years,  $SD = 4.3$ ). Participants answered questionnaires online.

### Tools

**The Big 5 Questionnaire.** The Hebrew version<sup>7</sup> of the Big 5 Questionnaire,<sup>8</sup> comprising 44 items examining 5 personality traits: extroversion/introversion, neuroticism, agreeableness, conscientiousness, and openness to experience. After the negatively phrased items were reversed, Cronbach's alphas were openness:  $\alpha = 0.76$ ; conscientiousness:  $\alpha = 0.75$ ; extraversion:  $\alpha = 0.78$ ; agreeableness:  $\alpha = 0.79$ ; neuroticism:  $\alpha = 0.82$ .

**The AC Questionnaire.** The questionnaire initially comprised 48 questions, based on information acquired from the study of three websites on current and future developments of the information exchange system of the AC (Emerj, Wired and A automotive technologies—HERE). Following the advice given by experts in the field of technological development, this was reduced to 18.

An exploratory factor analysis was carried out on the items. Both the eigenvalues that were greater than 1 and the scree plot were tested to decide on the number of factors to extract. The eigenvalues yielded by the factor analysis were compared with those estimated by a parallel analysis. Only those factors with eigenvalues greater than the values derived by the parallel analysis were extracted.<sup>9</sup> Apart from two items that

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TABLE 1. FACTOR ANALYSIS OF AUTONOMOUS CAR ITEMS

Items	Factors	
	1	2
Information sharing		
1. I wish to share information gathered while driving with the car manufacturer to aid them in making improvements	0.76	
2. I wish to share information gathered while driving with the local authorities regarding road hazards.	0.75	
3. I wish to share information gathered while driving with other drivers	0.69	
4. I do not wish to share information gathered while driving. (R)	-0.67	
5. I would like my car to share information on traffic issues gathered while driving, with the police and other drivers	0.65	
6. I wish to share information gathered while driving with the police regarding violation of traffic laws and violation by others on the road	0.6	
Need for control		
1. I would like to receive information from my car regarding traffic jams and road works		0.73
2. I would like my car to keep the safest distance from the car ahead		0.73
3. I would like to receive information from my car regarding a sudden speed deceleration		0.68
4. I would like to receive the same amount of information during both the day and the night		0.64
5. I would like to receive information about the state of the road before driving		0.64

double loaded on more than one factor, all other items loaded highest on one factor and had loadings that exceeded six. The reanalysis, based on Varimax rotation for orthogonal factors, without these two items, had two clear factors and another two theoretically undeterminable factors that were removed from the analysis. The two clear factors reflected (1) information sharing, namely the willingness to share information with others and (2) need for control, the strive for comfort and safety (Table 1). These factors accounted for 37.16 percent of the common variance. Correlations among the factors were modest: information sharing is positively correlated with need for control ( $r=0.35$ ,  $p=0.001$ ). Alpha coefficients for the six items information sharing scale was 0.79, whereas the alpha coefficients for the five items need for control scale was 0.74.

The sampling methodology comprised two rounds of sampling. In the initial round, 32 females (66.7 percent) and 16 males (33.3 percent) were recruited from the faculty of social science in exchange for credits. In the second round, an additional group, comprising 68 females (63.6 percent) and 39 (36.4 percent) males, studying in the same faculty, was recruited through a polling company. These participants received monetary compensation. To account for possible differences between the two samples in gender, a chi-square test was conducted; results were insignificant  $\chi^2(1)=0.12$ ,  $p=0.73$ , indicating no statistical difference in gender composition between the two groups. Similarly, to account for possible differences between the two samples in age, an independent samples  $t$ -test was conducted. The test yielded insignificant results  $t(148)=1.72$ ,  $p=0.09$ , indicating the age of first sample (mean=26.2,  $SD=6.11$ ,  $n=50$ ) was not significantly different than that of the second sample (mean=24.93,  $SD=2.97$ ,  $n=105$ ). Subsequently, to rule out the introduction of a confounding variable to the data due to the effects of type of sampling, independent samples  $t$ -tests were conducted on each of the main variables in the study as dependent variables and the sampling procedure (the two samples of participants) as the independent variable.

Results indicated no significant effect on any of the variables. Specifically, no difference was found for extraversion  $t(153)=0.79$ ,  $p=0.43$ , no difference was found for agreeableness  $t(153)=-0.98$ ,  $p=0.33$ , no difference was found for conscientiousness  $t(153)=-0.23$ ,  $p=0.82$ , no difference was found for neuroticism  $t(153)=0.51$ ,  $p=0.61$ , no difference was found for openness  $t(76.13)=1.59$ ,  $p=0.12$ , no difference was found for information sharing  $t(153)=0.43$ ,  $p=0.67$ , and, lastly, no difference was found for need for control  $t(153)=-0.83$ ,  $p=0.41$ .

The final sample of the study ( $N=155$ ) comprised 100 females and 55 males between the ages of 18 and 50 years.

## Results

A post hoc G power analysis<sup>10</sup> on 155 participants was conducted using an ordinary least squares (OLS) design estimating a fixed model's deviation from zero with a priori alpha levels of 0.05, seven predictors, and a medium effect size. This power analysis demonstrated relatively large effects (effects of power=0.95), which exceeded required estimations (0.80) in the literature.<sup>11</sup>

To arrive at the best possible model explaining the variance in information sharing, in this exploratory research, a

TABLE 2. REGRESSION COEFFICIENTS AND THEIR SIGNIFICANCE FOR EXPLAINING INFORMATION SHARING

DV: Information sharing $R^2=0.036$ , $F(1, 146)=5.46$ , $p=0.021$				
Variable	b (SE)	$\beta$	p	95% CI
Openness to experience	0.31 (0.13)	0.19	0.02	[0.05, 0.57]
Constant	3.13 (0.67)		0.000	[1.82, 4.44]

DV, dependent variable.

TABLE 3. REGRESSION COEFFICIENTS AND THEIR SIGNIFICANCE FOR NEED FOR CONTROL

DV: Need for control				
$R^2 = 0.18$ , $F(3, 146) = 10.63$ , $p = 0.021$				
Step 2: $\Delta R^2 = 0.07$ , $F(1, 147) = 11.55$ , $p = 0.001$				
Step 3: $\Delta R^2 = 0.02$ , $F(1, 146) = 4.19$ , $p = 0.04$				
Variable	b (SE)	$\beta$	p	95% CI
Openness to experience	0.30 (0.09)	0.24	0.002	[0.11, 0.49]
Conscientiousness	0.20 (0.10)	0.16	0.04	[0.01, 0.40]
Age	-0.06 (0.02)	-0.25	0.001	[-0.09, -0.02]
Constant	4.73 (0.86)		0.000	[3.03, 6.44]

stepwise regression analysis was performed based on OLS regression methodology. The model was calculated with information sharing as the dependent variable and with personality traits, age, and gender as the independent variables. The model was significant and consisted of one step in total and explained 3.6 percent of the variance in information sharing [ $R^2 = 0.036$ ,  $F(1, 146) = 5.46$ ,  $p = 0.021$ ]. From an examination of the effects found in the model, openness to experiences was found to be the only significant variable predicting information sharing. Specifically, as openness to experience increases, so does information sharing increase ( $b = 0.31$ ,  $SE = 0.13$ ,  $\beta = 0.19$ ,  $p = 0.02$ , 95% CI [0.05 – 0.57]). Table 2 presents the regression coefficients and their significance.

To arrive at the best possible model of explaining the variance in need for control, in this exploratory research, a stepwise regression analysis was performed based on OLS linear regression methodology. The model was calculated with need for control as the dependent variable and with personality traits, age, and gender as the independent variables. The model was significant and consisted of three steps in total and explained 18 percent of the variance in need for control [ $R^2 = 0.18$ ,  $F(3, 146) = 10.63$ ,  $p = 0.021$ ]. Furthermore, in both steps, the addition of the subsequent independent model was significant [step 2:  $\Delta R^2 = 0.07$ ,  $F(1, 147) = 11.55$ ,  $p = 0.001$ ] [step 3:  $\Delta R^2 = 0.02$ ,  $F(1, 146) = 4.19$ ,  $p = 0.04$ ]. From an examination of the effects found in the model, openness to experience was found to predict need for control. Specifically, as openness to experience increases, so does need for control increase ( $b = 0.30$ ,  $SE = 0.09$ ,  $\beta = 0.24$ ,  $p = 0.002$ , 95% CI [0.11 – 0.49]). Similarly, conscientiousness was found to be a significant predictor of need for control. As conscientiousness increases, so does need for control ( $b = 0.20$ ,  $SE = 0.10$ ,  $\beta = 0.16$ ,  $p = 0.04$ , 95% CI [0.01 – 0.40]). Lastly, age was found to significantly predict need for control. Specifically, as age increases, need for control decreases ( $b = -0.06$ ,  $SE = 0.02$ ,  $\beta = -0.25$ ,  $p = 0.001$ , 95% CI [-0.09 to 0.02]). Table 3 presents the regression coefficients and their significance.

## Discussion

Results demonstrate that openness to experience relates to both factors of the AC information exchange system, information sharing, and need for control. People who are open to experience are willing to share information with others. People who are open to experience are more likely to pursue greater control by requesting additional safety information.

In addition, people who score highly on conscientiousness, also score highly on the second factor, they have a higher need for control and want more information from the car. Conscientiousness refers to carrying out tasks diligently.<sup>12</sup> Such people will feel comfortable when they receive information on, for example, road conditions. As age increases, need for control decreases, such that younger people ask for more control on the information exchange system so as to feel comfortable in their user experience.<sup>13</sup>

One possible limitation of this study is that of the sampling strategy that yielded a larger number of women in the sample. Research has found significant differences between the genders on several of the personality traits<sup>14</sup> and in attitudes toward cars, driving, and transportation in general.<sup>15</sup> It is, however, important to note that in our analysis, gender was calculated as an independent variable in the model and no significant effects were found for it. In addition, to the best of our knowledge, no research has found a significant difference in openness to experience between men and women. That said, we recommend that future studies ensure gender parity among participants.

Results suggest that personality is an important factor in building trust in the AC, so realizing its potential is essential. This sends a message to designers and others that the success of this car will depend on users' feeling that it is responsive to their individual personality needs. This is in keeping with previous studies demonstrating the relationship between personality and technology. It is vital that design methods for technology based around the user's personality<sup>3–5</sup> and the knowledge accumulated from it be utilized with the positive aim of enhancing users' well-being and not be exploited by manipulating the individual into purchasing services or products.

## Author Disclosure Statement

No competing financial interests exist.

## Funding Information

No funding was received for this article.

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