Master thesis – Economics & Business

IMPLICATIONS OF COMPLEMENTARY COMPONENTS ON BRAND IMAGE: LESSONS FROM A CAR'S INTERIOR

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Executive summary

Many firms form several industries choose to share components among their several brands to keep production costs relatively low while still offering a high variety of products. The effect of this, so called, platform-based strategy has been widely examined. Earlier research has shown that sharing of components between brands reduces the extent of differentiation. Which, in its turn, could harm the attractiveness of a product and therefore its turnover.

Little research is done on the effects of shared components between different manufactures. In particular, components that consumers can choose to use as a complement to the actual product, a complementary component. This study aims to explore the effects of a complementary component on brand image. This would help managers by understanding the possible implications of making their product(s) compatible for complementary components which they could use in their decisions among marketing practices and within the development of new products.

The effect of complementary components is examined by using a 2x2 mixed design experiment, in which the product design (mass market vs. premium brand) and the use of a high-equity complementary component (no vs. yes) is manipulated.

The study revealed that the use of a high-equity complementary component does not have a direct effect on brand image directly. However, the use of complementary components can have a moderating effect on the effect of brand design on brand image. This can also result in a reduction in differentiation between two brands across certain dimensions of brand image.

In general, premium brands are viewed as more lively, more safe and more usable relative to mass market brands. However, when a mass market brand is being compared to a premium brand, a common complementary component can moderate the effect of both designs on brand image. In one analysis, the mass market brand was viewed as more elegant, nimble and sophisticated relative to the premium brand, when both brands had the same complementary component in their interior. The complementary component also enhanced the brand image of the mass market brand in terms of *Livelihood* when it was being compared to a premium brand. However, these effects were not found in a comparison between two other brands.

The differentiation between mass market and premium brands can be reduced as well as increased due to the use of a common complementary component. This effect varies across certain dimensions of brand image. In one comparison, it reduced the differentiation between brands in terms of *Livelihood* and *Usability* but it increased the differentiation in terms of how ‘safe’ both brands were viewed. In addition, there was no significant difference found in the level of differentiation in the other comparison. So, again, the occurrence of the effect also varies across certain comparisons. Which indicates that, for some brands, previous brand associations withstand the influence of a common complementary component.

Marketing managers in competitive industries should be very cautious in their decisions when it comes to making their products compatible for complementary components. They should evaluate the benefits and drawbacks of such a decision on their brand image and how it would fit in their differentiation strategy, this requires a clear understanding of the brand equity of the complementary component. Accordingly, they should also decide to what extent they would emphasize complementary components in their marketing practices.

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1. Introduction

Many firms from several industries have adopted a platform-based strategy in which they use the same components among their several brands in the vertical product line. This strategy should allow firms to use a product design that offers a high variety in the market with relatively low component variety and production complexity (Fisher, Ramdas, and Ulrich 1999; Verhoef, Pauwels, and Tuk 2012). For example, Volkswagen AG, a car manufacture, designed a modular platform that enables their brands to use the same design elements for their models such as: engines, mechanical parts, interior components and body panels, mostly for cost saving measures (Karssen and Autoblog 2018). Hewlett Packard (HP), a technology company, offered a digital camera called the HP PhotoSmart C618 which shared the same platform with the Pentax EI-200, a digital camera of Pentax, a camera and lens maker (Olson 2008). These cameras looked almost identical as they shared the same mechanical parts among other things. Another example would be the printers of Dell, a computer technology company. Their printers are manufactured by Lexmark, a manufacturer of laser printers and imaging products. This results in printers of both brands sharing the same components (Atlantic Inkjet's Blog 2012).

Another form of component sharing would be via a complementary component. The difference is that this form of component sharing is unintentionally. An example would be complementary software such as Apple CarPlay that connects one's phone to a car's infotainment system, the phone then basically takes over the infotainment screen and you would see a similar interface design like the one on your phone. As more infotainment systems become compatible for complementary software, models from different manufacturers are logically appearing to share similar (design) features due to the actual use of this complementary component. For example, when a consumer in a Mercedes car uses Apple CarPlay as well as a consumer in a Volvo car, both cars would appear to share a similar infotainment system. According to Verhoef, Pauwels and Tuk (2012), sharing an interior with another car in the vertical product line – products from the same manufacturer of different quality levels – has a significant negative effect on a car's attractiveness. However, little is known about the effect of component commonality outside the vertical product line.

Earlier research has shown that sharing of components between brands reduces the extent of differentiation (Sullivan 1998; Kim and Chhajed 2000; Heese and Swaminathan 2006; Štrach and Everett 2006; Olson 2008). The effect of component sharing (in the vertical product line) has been widely examined so far (Robertson and Ulrich 1998; Sullivan 1998; Fisher, Ramdas, and Ulrich 1999; Kim and Chhajed 2000; Desai, Kekre, Radhakrishnan, and Srinivasan 2001; Ramdas, Fisher, and Ulrich 2003; Heese and Swaminathan 2006; Štrach and Everett 2006; Olson 2008; Ramdas and Randall 2008; Verhoef et al. 2012). In contrast to recent studies on the effect of component sharing among different brands, little research has been done on the effects of components that consumers can choose to use as a complement to the actual product as well as the effect of commonality of these 'complementary components' between different manufacturers, on brand image. The aim of this research is to understand the implications of complementary components on the brand image of brands from different manufacturers, using empirical evidence from a car's interior. Thus, the central question for this study is as follows:

'What is the effect of complementary components on brand image?'

This thesis is relevant for managers because it would help them understand the possible implications of using complementary components in their product. Therefore, it will help them decide if the use of complementary components is the best decision in the realm of marketing practices.

2. Literature review

In this chapter, the possible effect of complementary components on brand image will be explored using literature related to product design, brand image, co-branding, ingredient branding and commonality. Accordingly, lessons from the literature will be used as a basis for the hypothesis that will be tested.

2.1 Product design

As described earlier, technology has become more and more important with regards to product differentiation, however product design is a critical element of a product's competitive advantage (Talke et al. 2009). Product design has been found to be a driver of differentiation between brands, consumer preferences, and product sales (Kotler and Rath 1984; Cooper and Kleinschmidt 1987; Veryzer and Hutchinson 1998; Creusen and Schoormans 2005; Kim and Ko 2010), Kim and Ko (2010) find that innovative design characteristics have a significant influence on brand attitude and purchase intention with regards to luxury fashion brands. They found a difference in purchase attention with regards to bags, shoes and accessories that where associated with innovative design characteristics rather than traditional design characteristics.

With regards to automotive brands, Ranscombe et al. (2012) found that the front fascia – the front side of a vehicle – has the greatest influence on brand recognition. Unfortunately, the interior (or infotainment system) of the car was not taken into consideration. However, previous research on the implications of a car's infotainment system and a car's interior in general have shown that this area is also of significant importance (Zheng, Lin, Zapf, and Knapheide 2007; Chang and Hsiao 2011; Eklund 2019) when it comes to brand image.

Zheng et al. (2007) find confirmation for the paradigm that the appearance of a product affects its perceived usability. According to their study, a professional and organized human machine interface (HMI) – an interface that allows humans to interact with a machine – increases the perceived usability of a car's infotainment system. Accordingly, Chang and Hsiao (2011) find that the perceived usability of a car's infotainment system along with the perceived ability to enhance driving safety will increase the consumers value perception which, in its turn, will influence their purchase decision. Furthermore, Eklund (2019) demonstrates that an automotive brand's brand image can be impacted by a car's interior through sensory cues that provide a harmonious experience in the car. However, there are many more factors that play a role in how a person perceives a brand. For example, Birdwell (1968) showed that one's perception of a brand is linked to his or her ownership of a product in a certain price-class. He asked his subjects to review eight cars of different brands with the help of 22 descriptive polar terms along a seven-point scale and found significant differences between the scale means among different ownership groups (based on price-class).

Depending on the type of complementary components used, one might argue that it could increase the perceived usability of a product relative to products in the same product category that do not include the same specific complementary component. According to the findings of Chang and Hsiao (2011), one might argue that a smartphone's interface would moderate a consumer's value perception of a car's interior, for example. One might also expect complementary components to disrupt the consistency within a product's design, according to the findings of Eklund (2019) and therefore impact the brand image based on product design.

2.2 Brand image

2.2.1 Definition of brand Image

Numerous definitions of brand image have been formed in the past, see table 1 (Ditcher 1985; Aaker 1992; Park, Jaworksi, and Maclnnis 1986; Reynolds 1965; Kotler 2001; Kapferer 2008). According to Dobni and Zinkhan (1990), the definition of brand image has not remained stable. In an attempt to identify the essential elements of brand image, they concluded that brand image is largely a subjective and perceptual phenomenon that is formed through consumer interpretation, whether reasoned or emotional. They also state that the perception of reality is more important than the reality itself with concerns to brand image.

Author	**Definition**
P. Kotler (2001) p. 273	The set of beliefs, ideas, and impression that a person holds regarding an object
E. Ditcher (1985) p. 75	It describes not individual traits or qualities, but the total impression an entity makes on the minds of others
D.A. Aaker (1992) p. 101	Brand image is a set of associations, usually organised in some meaningful way
W. Park, B.J. Jaworski, and D.J. Maclnnis (1986) p. 135	It is the understanding consumers derive from the total set of brand related activities engaged by the firm
W.H. Reynolds (1965) p. 69	It is the mental construct developed by the consumer on the basis of a few selected impressions among the flood of total impressions
JN. Kapferer (2008) p. 21	The collective representation shaped over time by the accumulated experiences of oneself, of close relations, by word of mouth and advertising

Table 1 Definitions of brand image by different authors

Keller (2003) adds more detail with regards to the associations that make up the brand image. He states that the brand associations that make up the brand image can be characterised and profiled according to the following three dimensions: strength, favourability and uniqueness. The first dimension covers how strongly the brand is identified with a brand association, the second dimension covers how important or valuable a brand association is to customers and the third dimension covers how distinctively the brand is identified with a brand association (Keller, 2003).

2.2.2 Relation between brand image and brand identity

According to Kapferer (2008), brand image is the result and interpretation of brand identity. It is on the receiver's – the consumers – side while brand identity is on the senders' – the brand – side. He further states that an image results from decoding a message, which, in this case, relates to brand messages such as: brand name, visual, symbols, products, advertisements, sponsoring. Janonis et al. (2007) seem to agree, following their theoretical model of brand identity in which they consider brand image as a result of brand positioning which, in its turn, is a result of the brand identity.

2.2.3 Implications of brand image

Previous research has shown that brand image can effect consumers' behaviour (Batra and Homer 2004; Shukla 2011; Wang and Yang 2010; Malik et al. 2013; Ataman and Ülengin 2003; Wu 2011), perceived risk (Rao and Monroe 1988) and perceived value (Fredericks and Slater 1998; Aghekyan-Simonian, Forsythe, Kwon, and Chattaraman 2012). Shukla (2011) found that brand image can act as

a moderator between normative interpersonal influences and luxury purchase intentions. Wang and Yang (2010) found that brand image can act as a moderator between brand credibility and consumers' brand purchase intention. Wu (2011) also discovered a direct and indirect relationship between hospitals' brand image and patient loyalty. According to Rao and Monroe (1988), a brand with a positive image can lower a consumer's perceived risk about a product. Fredericks and Slater (1998) and Aghekyan-Simonian et al. (2012) found that a brand with a positive image can increase a consumer's perceived value of a product. This goes to show that a company's brand image can affect the company in different ways and it is therefore very important for a company to know how their brand(s) is/are being perceived and what affects their brand image.

2.3 Co-branding & Ingredient branding

2.3.1 Definition of Co-branding

Grossman and Till (1998) regard a joint appearance of two brands on the logo and/or package of a new product as a co-branding strategy. According to Blackett and Russel (1999) co-branding is a type of co-operation between two or more brands with significant customer recognition, in which all the participants' brand names are retained.

One might argue that the use of complementary components can be seen as a type of co-branding, following Grossman and Till's (1998) definition, especially when the design of the complementary component can easily be linked to the co-brand.

2.3.2 Implications of co-branding

Co-branding usually functions as a differentiation tool that transfers positive associations, such as brand awareness, image and brand quality from one brand to another (McCarthy and Norris 1999). Some of these effects have been examined in greater detail. For example, both Geylani et al. (2008) and Besharat (2010) find the level of brand equity of the participants within a co-branding strategy to be a significant predictor of a new product's perception. Having two 'high-equity brands' participating within a co-branding strategy can significantly enhance the strength of quality signals compared to having two 'low-equity brands' participating within a co-branding strategy (Besharat 2010). One might expect that the use of complementary components from a high-equity brands would lead to a higher perceived quality of the final product relative to the use of complementary components of lower-equity brands.

Consistent with the results of Besharat (2010) and Geylani et al. (2008). Simonin and Ruth (1998) find that the effect of a co-branding strategy is dependent on the degree to which the brand alliance itself is evaluated favourably. A participating brand that is more familiar to a consumer will have a bigger effect on the alliance evaluation (Simonin and Ruth 1998). Therefore, one might expect that complementary components of high-equity brands would have a more positive impact on a brand's brand image than a standard component or a complementary component of a less salient firm.

However, an earlier study of Washburn et al. (2000) showed that the level of brand equity does not affect the benefits of co-branding. They find that co-branding is a win/win strategy (in terms of product evaluations) for both co-branding participants.

2.3.3 Definition of Ingredient branding

Ingredient branding is a specific category of co-branding where an existing brand of a consumer product is used as an 'ingredient' of the end product from a manufacturer (the 'host' brand) rather than the partner brand being used in a single offer to the consumer (Smit 1999; Norris 1992). Ingredient branding is often used to enhance the differentiation of the host brand from its competitors (Norris 1992).

2.3.4 Implications of ingredient branding

According to the current literature, ingredient branding can affect consumers' purchase intentions (Moon and Sprott 2016) and their perception of quality (McCarthy and Norris 1999) (Abbo 2005). Consistent with the findings of Simonin and Ruth (1998), Moon and Sprott (2016) find that a positive perception of 'fit' between the two brand partners influences the purchase intentions of consumer's with regards to premium brands. However, this effect is moderated by the consumer's perception of a brand's premium nature. With regards to quality, both McCarthy and Norris (1999) and Abbo (2005) find that only brands with lower perceived rating of quality, in comparison with other brands in the same product category, can positively increase their perceived quality by using a high-quality branded ingredient. Using a 'high-quality' branded ingredient for an end product of a host brand that is already perceived as a high quality brand will provide little or no effect with regards to the perception of quality (Abbo 2005). Interestingly, this seems to be in contradiction with the earlier stated findings of Besharat (2010). This might be explained by the fact that the partnership between the two brands is being more explicitly addressed to the consumer in a co-branding strategy.

2.4 Implications of commonality

Consistent with the findings of Meixner et al. (2017), Talke et al. (2009) found that the launch of automotive vehicles that are more technologically advanced compared to vehicles of a competitor will lead to higher sales relative to the sales of the competitor. These findings underline the importance of technology. The question then remains how much of an influence a 'common' complementary component such as complementary software would be to the performance of a brand.

2.4.1 Commonality and brand choice

In a research on the effect of common attributes on brand choice, Chernev (1997) examined the moderating role of attribute weight. The findings suggest that the effect of commonality on a brand's choice depends on the importance weight assigned to the attribute. A common attribute that is weighted with more importance (relative to the other attributes) would reduce the dispersion in choice between brands, while a unique attribute that is weighted with relatively more importance would increase the dispersion.

2.4.2 Commonality in the video game industry

Research on the effect of commonality on a firm's performance has shown several implications consistent with the findings of Chernev (1997). In an analysis of the video game industry Mantena, Sankaranarayanan and Viswanathan (2007) find that exclusive licensing deals – meaning that a video game is only compatible for that specific video game console (platform) – are necessary for platforms to attract new customers. Consistent with this finding Landsman and Stremersch (2011) find that platform sales are negatively affected when the applications on this platform are also available on competing platforms. These findings support the idea that the loss of product differentiation can lead to less attractive products and reductions in revenue.

2.4.3 Commonality in the automotive industry

In contrast to earlier research in the video game industry, research on component commonality[1] in the automotive industry has shown that a strategy of sharing components in the vertical product line can sometimes be more beneficial for a manufacturer than designing unique components. Heese and Swaminathan (2006) find that commonality can lead to higher revenues when customers evaluate the common component to be of high quality, especially in relatively lower class market segments. Higher (perceived) quality would actually overcompensate the loss in product differentiation. Component commonality would then lead to lower unit production costs and therefore increase revenue (Heese

[1] Products sharing the same components

and Swaminathan 2006). These results are somewhat contrary to those of Cherney (1997) and Desai et al. (2001), the latter argue that only less important weighted components can be made common because the reduction in product differentiation would then be less severe, according to their findings.

Further research on commonality in the vertical product line also showed that it reduces the difference in perceived quality and it will negatively affect the performance of a brand when this difference is expected to be higher (Kim and Chhajed 2000). For example, when an expensive sportscar would share a lot of components with a normal car and the consumer would be aware of this commonality, the perceived quality of the sportscar would be reduced. In line with this result, Verhoef et al. (2012) find that the evaluation of automotive premium brands is more negatively affected by component sharing (in the vertical product line) with a mass market brand than a mass market brand's evaluation would be affected by component sharing with an economy brand. The level of impact is determined by several factors such as the type of component and whether or not consumers are aware of the commonality. Following an econometric analysis, they also find that component commonality may affect market shares. A premium brand would lose market share when sharing components with volume or economy brands, which, in return, would gain market share.

3. Theoretical framework

As product design has been found to be a driver of differentiation between brands and value perception (see paragraph 2.1), this thesis proposes that the use of complementary components plays a significant role when consumers form a brand image based on product design, see figure 1 for the conceptual framework.

As discussed in paragraph 2.3.2, the level of brand equity of the participants within a co-branding strategy can be a significant predictor of a new product's perception (Geylani et al. 2008; Besharat 2010). As proposed in this paragraph, a complementary component of a high-equity brand could have a positive impact on a brand's brand image relative to a standard component. Therefore, the following hypothesis will be tested:

H1*: High-equity complementary components have a direct positive effect on brand image*

As proposed in paragraph 2.1, several aspects of a brands brand image could be influenced by a complementary component as they would disrupt the perceived consistency within a product's design and therefore moderate the effect of product design on brand image. Therefore, the following hypothesis will be tested:

H2: *Common complementary components moderate the effect of product design on brand image*

Following the literature on commonality and brand choice (see paragraph 2.4.1) one might expect complementary components to reduce the differences in brand image if consumers would weigh the component with relatively more importance (Chernev 1997). Research in the automotive industry also concluded that commonality of components can reduce the difference in perceived quality (Kim and Chhajed 2000). It is worth exploring how brand image relates to commonality with regards to complementary components. Therefore, the following hypothesis will be tested:

H3*: Common complementary components reduce the perceived differentiation between mass market and premium brands*

So far, the research on the effects of common components has been limited to the vertical product line rather than commonality between different manufacturers. This thesis aims to explore the effects of complementary components among brands of several manufacturers.

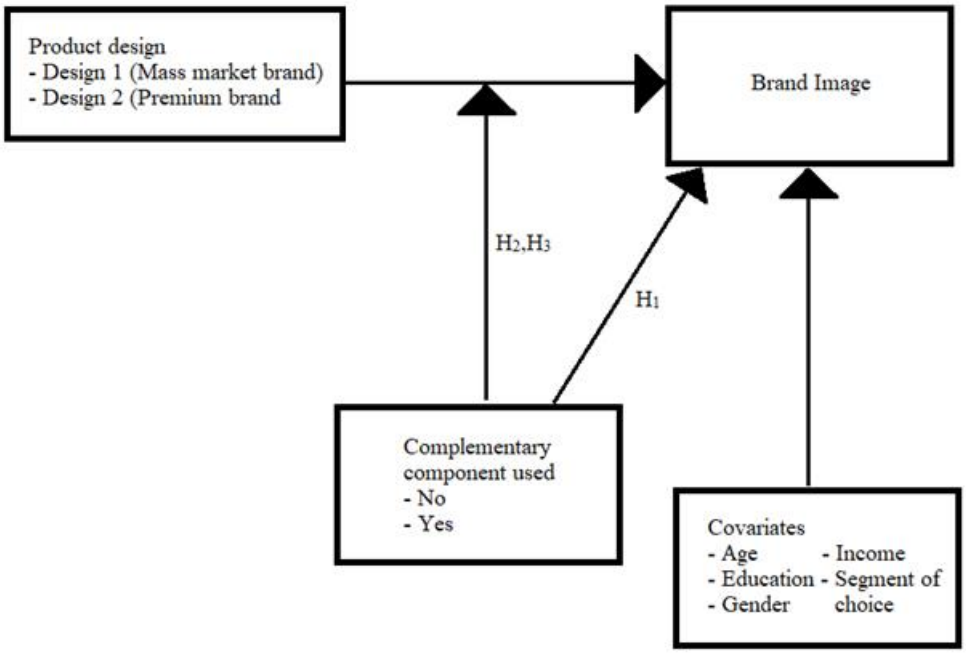


Figure 1 Conceptual framework

4. Methodology

This chapter presents the scientific methods that have been used to collect the data and answer the research questions.

4.1 Research design

This study intends to explore the relationship between complementary component and brand image of. An experimental design was set up to measure a possible effect and possible differences in effect when the proposed moderator, a complementary component, was used or not used as a manipulator. In order to test the hypotheses, a factorial 2 (design one vs. design two) by 2 (no complementary component vs. complementary component) between-subjects design was used, see table 2 for an overview of the four conditions.

		Complementary component	
		No	Yes
Product design	Design 1 (mass market brand)	Condition 1	Condition 3
	Design 2 (Premium brand)	Condition 2	Condition 4

Table 2 Experimental conditions

The experiment is held among at least 160 participants who are distributed among two sets of product designs. So participants are either asked to judge the interior of a Ford and a BMW or the interior of a Honda and a Mercedes-Benz. So essentially the analysis is performed twice. This will allow to see whether possible effects still hold for different comparisons. The participants are also balanced into the groups to make sure the sampling sizes are reliable.

Accordingly, participants could either be exposed to the first and second condition or to the third and fourth condition (see table 2) within their set of brand comparisons. This between subject design is used to minimize learning and transfer effects between the two groups.

However, contrary to a between subject design, having participants to judge the interior of two brands should instigate a learning and comparison effect. The goal is to see to what extent this learning and comparison effect changes due to a complementary component. Hence, if the effect of product design is moderated by a complementary component, this research design will also allow to test whether differences in brand image will be mitigated by a complementary component.

4.2 Measures

4.2.1 Independent variables

Product design

As discussed in paragraph 2.1, product design has been found to have a significance influence on the image of a brand (Zheng, Lin, Zapf, and Knapheide 2007; Kim and Ko 2010; Chang and Hsiao 2011; Ranscombe et al. 2012; Eklund 2019). Accordingly, different car interior designs from different manufacturers have been selected based on Eklund's (2019) study in which he showed that a car's interior can have a significance influence on brand image. The interiors used in this experiment are all from cars that fall under the 'hatchback' category (Riswick 2019). This way, the participant can at least make a fair comparison between the different product designs, as one design wouldn't be influenced by the type of category it belongs to.

Out of the four brands used, two mass market brands (Ford and Honda) have been selected as well as two premium brands (BMW and Mercedes-Benz). These brands are considered to be 'mass market' or 'premium' based on their positioning strategy and how (automotive) news websites refer to these

brands (BMW Group 2021; Perkins 2021; Keaton 2020; TopGear 2021; Mercedes-Benz AG 2021; Vincent M. 2020; Groves 2015; Raevskaya 2020; CarLogos 2021). The distinction between mass market and premium allows to test the second and third hypothesis.

Complementary component

The benefit of using car interiors is that the complementary component can be added into the infotainment screen of the interior and thus it's visible for the participant in the experiment. Apple CarPlay, a software program that allows your car to connect with an iPhone (mobile phone) has been selected as the complementary component. According to Statista (2021), Apple is the most valuable brand worldwide. Based on this fact, Apple CarPlay was considered to be a high-equity complementary component and therefore suitable for this experiment.

Covariates

To check whether the effect is different among certain social-demographics, the following covariates are included in the analysis: age, income, gender, education and the type of segment to which the participant owned car belongs to. The last one is included to check if Birdwell's (1968) finding that one's perception is linked to the ownership of a certain product still holds for a car's interior (see paragraph 2.1).

4.2.2. Dependent variables

Brand image

In order to measure brand image, a previous study of Birdwell (1968) is used to develop a multi-item scale questionnaire. Birdwell (1968) did a study on the influence of image congruence on consumer choice; in his study he asks his subjects, among other things, to evaluate eight automotive brands based on this same scale. To construct this scale, he used a master list of bipolar terms that are commonly used to describe automobiles. Because he used this list to evaluate car brands, and this study uses a car's interior to test the previous mentioned hypotheses, this list is considered to be suitable for this study. However, in order to minimize possible response biases due to a survey that is considered "too long", the amount of scale variables used in this survey has been brought down to 12, instead of the 22 variables used in the original questionnaire. The participants are asked to fill in to which degree they find the term on either side of the 5-point semantic scale suitable for the specific interior that is shown to them.

4.3 Procedure

An online survey is used to gather the quantitative data that is needed to test the hypotheses. The software program "Qualtrics" is used, this program enables to distribute the participants randomly among the two conditions. Accordingly, several social media channels were used to distribute the online survey. To motivate people to fill in the survey, a 50 euro bol.com gift card is raffled among the participants. At the start of the survey, a short explanation is given on what is expected of the participant. Accordingly, the participant will see pictures of two car interiors alternately to create a comparison effect, and is asked to fill in to which degree he or she finds one term suitable for that specific interior. After that, the participant is asked about his or her social-demographics. The full survey can be found in appendix A.

After the survey was completed by enough respondents, dummies were used that captured which product design was shown (1 = Ford, 2 = BMW, 3 = Honda, 4 = Mercedes-Benz), as well as the use of a complementary component (0 = No, 1 = Yes). Accordingly, an exploratory factor analysis was conducted among the first 12 questions in order to identify any clusters of variable and to reduce the data set to a more manageable size. Accordingly, outliers where removed to increase the reliability of the data.

To test the first and second hypothesis, a multivariate analysis of covariance (MANCOVA) was conducted. MANCOVA was chosen because it allows to include several dependent variables in the same analysis, and therefore takes account of the relationship between these variables. Therefore, it can detect if groups differ along a combination of dimensions which, in this case, make up the brand image (Field 2016). In addition, this analysis allows to look at interactions between independent variables, which is required for the second hypothesis and it allows to look at the effects of covariates. The analysis was conducted for each set of predictor variables (Ford/BMW and Honda/Mercedes-Benz).

To test the third hypothesis, the differences between the scores of each dependent variable were computed between the two brands for both conditions (no complementary component vs. the use of a complementary component). Accordingly, a multivariate analysis of variance (MANOVA) was carried out between the two conditions to test whether the difference between brands is significantly reduced due to the use of a complementary component.

5. Results

This chapter provides a detailed analysis of the quantitative results of the experiment. In the first paragraph, the descriptive statistics will be presented. In the second paragraph, the results of the factor analysis will be presented and in the third paragraph, the formulated hypotheses are tested.

5.1. Descriptive statistics

The survey for this experiment has been fully completed by 172 respondents. The majority of the respondents happen to be male in both groups. The age of the respondents varied between 20 and 62 years old. The majority of the respondents have a Higher Vocational-or higher degree in both groups. The majority of the respondents have an average income. The majority of the respondents also owns a car that belongs to the mass market segment. Table 3 shows the demographic frequencies for each group.

	Group 1 – No complementary component	**Group 2 – complementary component**	**Total**
Group Size (N)	87	85	172
Gender			
Male	62	58	120
Female	25	27	52
Age (mean)	26.72	26.45	26.59
Education			
Secondary education	8	7	15
Post-secondary vocational education	15	13	28
Higher Vocational education	44	42	86
Bachelor's degree	7	9	16
Master's degree	13	14	27
Income			
Below average	17	17	34
Average	46	47	93
Above average	24	21	45
Own car segment			
Mass market	56	57	113
Premium	18	21	39
No segment (no car owned)	13	7	20

Table 3 Descriptive Statistics of the experiment

5.2. Factor analysis

Before the factor analysis results can be interpreted as reliable, a test for multicollinearity and an adequate sample size is needed (Field 2016). As shown in table 4, none of the correlation coefficients in the top half of the correlation matrix are greater than 0.9. This shows that there is no multicollinearity in the data (Field 2016).

Correlation matrix												
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Correlation	Q1	1.000	-.090	.060	-.255	.030	.108	-.419	-.197	-.335	-.526	-.364	-.440
	Q2	-.090	1.000	.458	.455	.277	.195	.356	.265	.372	.313	.468	.317
	Q3	.060	.458	1.000	.329	.268	.233	.239	.182	.168	.071	.204	.163
	Q4	-.255	.455	.329	1.000	.207	.153	.400	.282	.319	.387	.371	.406
	Q5	.030	.277	.268	.207	1.000	.530	.340	.405	.080	.107	.160	.095
	Q6	.108	.195	.233	.153	.530	1.000	.149	.262	-.053	-.020	.078	-.022
	Q7	-.419	.356	.239	.400	.340	.149	1.000	.564	.460	.630	.544	.584
	Q8	-.197	.265	.182	.282	.405	.262	.564	1.000	.174	.315	.342	.324
	Q9	-.335	.372	.168	.319	.080	-.053	.460	.174	1.000	.656	.601	.481
	Q10	-.526	.313	.071	.387	.107	-.020	.630	.315	.656	1.000	.620	.699
	Q11	-.364	.468	.204	.371	.160	.078	.544	.342	.601	.620	1.000	.601
	Q12	-.440	.317	.163	.406	.095	-.022	.584	.324	.481	.699	.601	1.000
Sig. (1-tailed)	Q1		.048	.134	.000	.287	.022	.000	.000	.000	.000	.000	.000
	Q2	.048		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Q3	.134	.000		.000	.000	.000	.000	.000	.001	.093	.000	.001
	Q4	.000	.000	.000		.000	.002	.000	.000	.000	.000	.000	.000
	Q5	.287	.000	.000	.000		.000	.000	.000	.068	.024	.002	.039
	Q6	.022	.000	.000	.002	.000		.003	.000	.162	.356	.076	.345
	Q7	.000	.000	.000	.000	.000	.003		.000	.000	.000	.000	.000
	Q8	.000	.000	.000	.000	.000	.000	.000		.001	.000	.000	.000
	Q9	.000	.000	.001	.000	.068	.162	.000	.001		.000	.000	.000
	Q10	.000	.000	.093	.000	.024	.356	.000	.000	.000		.000	.000
	Q11	.000	.000	.000	.000	.002	.076	.000	.000	.000	.000		.000
	Q12	.000	.000	.001	.000	.039	.345	.000	.000	.000	.000	.000	

Table 4 Correlation matrix of the conducted factor analysis

Question	To what extent do you find each concept suitable for this interior?
1	Simple – Complex
2	Elegant – Plain
3	Nimble – Clumsy
4	Sophisticated – Unsophisticated
5	Reliable – Unreliable
6	Safe – Dangerous
7	Husky – Weak
8	Robust – Fragile
9	Young – Old
10	Lively – Calm
11	Fresh – Stale
12	Eccentric – Conventional

Table 5 Description of the questions

In order to test for an adequate sample size, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy has been used. The minimum value of the test needs to be above 0.5. As shown in table 6, the value of this test is 0.854, which is well above the minimum criterion of 0.5. Thus, the sampling size is adequate for factor analysis.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequancy		.854
Bartlett's Test of Sphericity	Approx. Chi-Square	1688.970
	df	66
	Sig.	.000

Table 6 Result of the KMO and Barttlett's Test of the conducted factor analysis

In addition to the KMO measure of sampling adequacy, the highlighted diagonal elements of the anti-image correlation matrix in table 7 all show a value above 0.5, this indicates that none of the variables should be excluded from the analysis.

Anti-image Matrices

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Anti-image Correlation	Q1	.894a	-.087	-.111	.106	-.078	-.068	.149	.006	-.020	.221	.054	.065
	Q2	-.087	.843a	-.306	-.245	-.084	-.024	.003	-.020	-.103	-.003	-.245	.020
	Q3	-.111	-.306	.773a	-.154	-.062	-.081	-.109	.023	-.073	.156	.020	-.076
	Q4	.106	-.245	-.154	.910a	-.008	-.065	-.037	-.043	-.012	-.064	.024	-.123
	Q5	-.078	-.084	-.062	-.008	.741a	-.436	-.176	-.194	-.018	.014	.042	.050
	Q6	-.068	-.024	-.081	-.065	-.436	.683a	.013	-.073	.111	-.010	-.071	.078
	Q7	.149	.003	-.109	-.037	-.176	.013	.883a	-.375	-.055	-.234	-.073	-.155
	Q8	.006	-.020	.023	-.043	-.194	-.073	-.375	.843a	.122	.011	-.090	-.021
	Q9	-.020	-.103	-.073	-.012	-.018	.11	-.055	.122	.850a	-.393	-.290	.079
	Q10	.221	-.003	.156	-.064	.014	-.010	-.234	.011	-.393	.844a	-.099	-.368
	Q11	.054	-.245	.020	.024	.042	-.071	-.073	-.090	-.290	-.099	.899a	-.239
	Q12	.065	.020	-.076	-.123	.050	.078	-.155	-.021	.079	-.368	-.239	.887a

Table 7 Anti-image matrices of the factor analysis

In order to improve the interpretability of the extracted factors, a factor rotation has been used (Field, 2016) The rotated factor matrix (table 8) shows the factor loadings for each variable after rotation. The matrix shows three factors; factor one consists of question one, question seven and nine to twelve, factor two consists of question two to four and question eight and factor three consists of question five and six.

Rotated Factor Matrix

	Factor		
	1	2	3
Q1 **(Simple:Complex)**	**-.612**	.031	.080
Q2 **(Elegant:Plain)**	.250	.170	**.739**
Q3 **(Nimble:Clumsy)**	.019	.237	**.568**
Q4 **(Sophisticated:Unsophisticated)**	.377	.183	**.422**
Q5 **(Reliable:Unreliable)**	.033	**.740**	.196
Q6 **(Safe: Dangerous)**	-.115	**.601**	.185
Q7 **(Husky:Weak)**	**.704**	.415	.150
Q8 **(Robust:Fragile)**	.368	**.538**	.086
Q9 **(Young:Old)**	**.636**	-.066	.314
Q10 **(Lively: Calm)**	**.878**	.035	.126
Q11 **(Fresh:Stale)**	**.674**	.092	.358
Q12 **(Eccentric:Conventional)**	**.750**	.061	.191

Table 8 Rotated factor matrix of the conducted factor analysis

To test whether each factor score is reliable, the Cronbach's Alpha is used. The Cronbach's Alpha indicates the reliability of the scale for each factor (Field 2016) As shown in table 9, the first factor, Livelihood, has a reasonable reliability with a Cronbach's alpha of 0.684 since this number needs to be around 0.7 to 0.8 (Field 2016) to be good. The second and third factor, Safety and Usability both also have a reasonable reliability with Cronbach's alpha's of 0.662 and 0.679, respectively. However, table 10 shows that if question one (Simple:Complex) would be deleted, the overall Alpha of the first factor ,and thus the reliability, would improve to 0.877. Therefore, this variable should be excluded from the calculation and accordingly the factor analysis should be rerun to make sure the factor structure won't be affected (Field 2016).

Reliability Statistics

Factor	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of items
Livelihood	.684	.670	6
Safety	.662	.666	3
Usability	.679	.679	3

Table 9 Reliability check for all three factors using Cronbach's Alpha

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Simple:Complex	13.34	23.718	-.510	.295	.877
Husky:Weak	13.61	13.230	.607	.464	.579
Young:Old	13.35	12.292	.631	.494	.561
Lively:Calm	13.22	11.516	.723	.683	.521
Fresh:Stale	13.55	12.767	.689	.516	.552
Eccentric:Conventional	13.17	12.432	.657	.558	.555

Table 10 Item-Total Statistics for the factor Livelihood

Rerun of the factor analysis

As shown in table 11, none of the correlation coefficients in the top half of the correlation matrix are greater than 0.9. This shows that there is, again, no multicollinearity in the data (Field 2016).

Correlation matrix												
		Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Correlation	Q2	1.000	.458	.455	.277	.195	.356	.265	.372	.313	.468	.317
	Q3	.458	1.000	.329	.268	.233	.239	.182	.168	.071	.204	.163
	Q4	.455	.329	1.000	.207	.153	.400	.282	.319	.387	.371	.406
	Q5	.277	.268	.207	1.000	.530	.340	.405	.080	.107	.160	.095
	Q6	.195	.233	.153	.530	1.000	.149	.262	-.053	-.020	.078	-.022
	Q7	.356	.239	.400	.340	.149	1.000	.564	.460	.630	.544	.584
	Q8	.265	.182	.282	.405	.262	.564	1.000	.174	.315	.342	.324
	Q9	.372	.168	.319	.080	-.053	.460	.174	1.000	.656	.601	.481
	Q10	.313	.071	.387	.107	-.020	.630	.315	.656	1.000	.620	.699
	Q11	.468	.204	.371	.160	.078	.544	.342	.601	.620	1.000	.601
	Q12	.317	.163	.406	.095	-.022	.584	.324	.481	.699	.601	1.000
Sig. (1-tailed)	Q2		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Q3	.000		.000	.000	.000	.000	.000	.001	.093	.000	.001
	Q4	.000	.000		.000	.002	.000	.000	.000	.000	.000	.000
	Q5	.000	.000	.000		.000	.000	.000	.068	.024	.002	.039
	Q6	.000	.000	.002	.000		.003	.000	.162	.356	.076	.345
	Q7	.000	.000	.000	.000	.003		.000	.000	.000	.000	.000
	Q8	.000	.000	.000	.000	.000	.000		.001	.000	.000	.000
	Q9	.000	.001	.000	.068	.162	.000	.001		.000	.000	.000
	Q10	.000	.093	.000	.024	.356	.000	.000	.000		.000	.000
	Q11	.000	.000	.000	.002	.076	.000	.000	.000	.000		.000
	Q12	.000	.001	.000	.039	.345	.000	.000	.000	.000	.000	

Table 11 Correlation matrix of the repeated factor analysis

As shown in the KMO test in table 12, the value of 0.840 is well above the minimum criterion of 0.5. Thus, the sampling size is adequate for factor analysis. In addition to the KMO measure of sampling adequacy, the highlighted diagonal elements of the anti-image correlation matrix in table 13 all show a value above 0.5, this again indicates that none of the variables should be excluded from the analysis.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequancy		.840
Bartlett's Test of Sphericity	Approx. Chi-Square	1550.718
	df	55
	Sig.	.000

Table 12 Result of the KMO and Barttlett's Test of the repeated factor analysis

Anti-image Matrices												
		Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Anti-image Correlation	Q2	.844a	-.318	-.238	-.092	-.030	.016	-.019	-.105	.017	-.241	.025
	Q3	-.318	.769a	-.144	-.071	-.090	-.094	.024	-.076	.186	.027	-.070
	Q4	-.238	-.144	.913a	.001	-.058	-.054	-.043	-.010	-.090	.018	-.131
	Q5	-.092	-.071	.001	.740a	-.444	-.167	-.194	-.019	.032	.046	.055
	Q6	-.030	-.090	-.058	-.444	.675a	.023	-.073	.110	.005	-.068	.082
	Q7	.016	-.094	-.054	-.167	.023	.872a	-.381	-.052	-.277	-.082	-.167
	Q8	-.019	.024	-.043	-.194	-.073	-.381	.835a	.122	.010	-.090	-.021
	Q9	-.105	-.076	-.010	-.019	.110	-.052	.122	.839a	-.398	-.289	.080
	Q10	.017	.186	-.090	.032	.005	-.277	.010	-.398	.822a	-.113	-.393
	Q11	-.241	.027	.018	.046	-.068	-.082	-.090	-.289	-.113	.892a	-.244
	Q12	.025	-.070	-.131	.055	.082	-.167	-.021	.080	-.393	-.244	.867a

Table 13 Anti-image matrices of the factor analysis of the repeated factor analysis

The rotated factor matrix in table 14 shows three factors; factor one consists of question seven and question nine to twelve, factor two consists of question five, six and eight and factor three consists of question two to four.

Rotated Factor Matrix			
	Factor		
	1	2	3
Q2 **(Elegant:Plain)**	.301	.157	**.728**
Q3 **(Nimble:Clumsy)**	.067	.229	**.558**
Q4 **(Sophisticated:Unsophisticated)**	.388	.174	**.421**
Q5 **(Reliable:Unreliable)**	.059	**.737**	.196
Q6 **(Safe: Dangerous)**	-.092	**.600**	.197
Q7 **(Husky:Weak)**	**.711**	.404	.114
Q8 **(Robust:Fragile)**	.379	**.532**	.069
Q9 **(Young:Old)**	**.667**	-.078	.256
Q10 **(Lively: Calm)**	**.885**	.025	.064
Q11 **(Fresh:Stale)**	**.705**	.081	.304
Q12 **(Eccentric:Conventional)**	**.762**	.051	.141

a. Rotation converged in 5 iterations.

Table 14 Rotated factor matrix of the repeated factor analysis

Table 15 shows the mean factor scores for each brand. In order identify these factors a label is assigned to each factor based on the underlying variables common theme.

In factor 1, The variables that make up this factor, question seven and nine to twelve, all have an element of livelihood to them. Therefore, factor one will be labelled as *Livelihood*. The lower the score, the higher this person rated this interior on livelihood. According to the mean factor scores, both mass market brands, Ford and Honda, are viewed as less lively in general, relative to the two premium brands, BMW and Mercedes-Benz.

In factor 2, the three variables that make up the factor, question five, six and eight, all have an element of safety to them. Therefore, factor three will be labelled as *Safety*. The score on this factor would indicate how 'safe' a respondent considers the car to be, based on the interior that was shown to him or her. The lower the score, the higher this person rated this interior on safety. According to the mean factor scores, both mass market brands are viewed as less safe in general, relative to the two premium brands.

In factor 3, the three variables that make up the factor, question two to four, all have an element of usability to them. Therefore, factor two will be labelled as *Usability*. The lower the score, the higher this person rated this interior on usability. According to the mean factor scores, both mass market brands are viewed as less usable in general, relative to the two premium brands

	Livelihood score	Safety score	Usability score
Ford	.752	.029	.042
BMW	-.841	-.105	-.041
Honda	.759	.103	.130
Mercedes-Benz	-.669	-.023	-.131

Table 12 Mean factor scores for each brand

According to the Cronbach Alpha's in table 16, Livelihood has a high reliability ($\alpha = .877$), Safety has a reasonable reliability ($\alpha = .662$) and the third factor also has a reasonable reliability ($\alpha = .679$).

Reliability Statistics			
Factor	**Cronbach's Alpha**	**Cronbach's Alpha Based on Standardized Items**	**N of items**
Livelihood	.877	.877	6
Safety	.662	.666	3
Usability	.679	.679	3

Table 13 Reliability check for all three factors of the repeated factor analysis using Cronbach's Alpha

5.3. Testing the hypotheses using MAN(C)OVA

5.3.1. First and second hypothesis

This analysis examines whether a high-equity complementary component has a direct effect on brand image and if a common complementary component moderates the effect of product design on brand image.

Assumptions

According to the Durbin-Watson test results, the first assumption of independent errors has been met for each set of predictor variables with all values being close to two (see table 17).

Durbin-Watson test	
Livelihood	
Ford – BMW	2.016
Honda – Mercedes-Benz	2.002
Safety	
Ford – BMW	2.292
Honda – Mercedes-Benz	1.965
Usability	
Ford – BMW	1.834
Honda – Mercedes-Benz	2.447

Table 17 Durbin-Watson test for both set of predictor variables

The normality Q-Q plots in appendix B1 to B24 all show that the majority of the residuals lie along the diagonal lines, except for the Q-Q plot in appendix B13; the s-shaped distribution of the residuals indicate that the assumption of multivariate normality has been violated for this factor. However, the residuals still seem to be distributed symmetrical which indicates little reason for concern. Thus, this assumption has been met.

According to the Box's test results, the third assumption of homogeneity of covariance matrices has been met for both sets of predictor variables as both p-values are insignificant (see table 18).

Box's Test of Equality of Covariance Matrices					
	Box's M	F	df1	df2	Sig.
Ford - BMW	28.698	1.539	18	88106.375	.067
Honda – Mercedes-Benz	17.794	.954	18	88106.375	.511

Table 18 Box's test of equality of covariance matrices for each set of conditions

Results

For each multivariate test, Pillai's Trace was used as the test statistic to determine the nature of the effects since the assumption of homogeneity of covariance matrices as well as the assumption of multivariate normality has been met this test is considered as most robust (Field 2016). The results are discussed below.

Ford – BMW

Table 19 shows the multivariate statistics of the first set of predictor variables. According to these statistics, the effect of product design on brand image is significant, V = .730, F = 136.390, p = .00(<.05). The direct effect of a high-equity complementary component on brand image is insignificant, V = .027, F = 1.385, p = .250(>.05).

The interaction between product design and a complementary component is significant, V = .084, F = 4.596, p = .004(<.05). The covariates (gender, age, education, income, own choice of segment) seem to have no effect on brand image as all the p-values are insignificant. The p-values in table 20 indicate that these results are robust except for the usability factor (p = .032<.05).

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	.013	.685b	3.000	151.000	.563
Gender	.018	.923b	3.000	151.000	.431
Age	.015	.749b	3.000	151.000	.525
Education	.019	.969b	3.000	151.000	.409
Income	.004	.194b	3.000	151.000	.901
Own choice of segment	.016	.829b	3.000	151.000	.480
Product design	.730	136.390b	3.000	151.000	.000
Complementary component	.027	1.385b	3.000	151.000	.250
Product design * Complementary component	.084	4.596b	3.000	151.000	.004

Table 19 Multivariate test statistics using Pillai's Trace (Ford – BMW)

Levene's test of equality of error Variances

	F	df1	df2	Sig.
Livelihood score	.817	3	158	.486
Safety score	.459	3	158	.711
Usability score	3.014	3	158	.032

Table 20 Levene's test of equality of error variances (Ford - BMW)

Thus, the first hypothesis that high-equity complementary components have a direct positive effect on brand image is not supported within this comparison. The second hypothesis that common complementary components moderate the effect of product design on brand image is supported within this comparison.

According to the estimated marginal means in table 21, BMW is viewed as more lively (*M* = -.818), more safe (*M* = -.151) and more usable (-.157) based on interior design alone. However, when a common complementary component is added to the mix, BMW is still viewed as more lively (*M* = -.822) and more safe (*M* = -.236) but Ford is now viewed as more usable (*M* = -.143) (see table 22).

Estimates					
				95% Confidence interval	
Dependent variable	Product design	Mean	Std. Error	Lower bound	Upper bound
Livelihood score	Ford	.762a	.056	.652	.872
	BMW	-.818a	.055	-.926	-.709
Safety score	Ford	-.013a	.083	-.177	.152
	BMW	-.151a	.082	-.314	.012
Usability score	Ford	-.019a	.078	-.174	.135
	BMW	-.157a	.077	-.309	-.004

Table 21 Estimated marginal means of the factor scores with brand as predictor variable (Ford - BMW)

Estimates						
					95% Confidence Interval	
Dependent Variable	Product design	Complementary component	Mean	Std. Error	Lower Bound	Upper Bound
Livelihood score	Ford	No	.878a	.079	.721	1.034
		Yes	.647a	.079	.490	.804
	BMW	No	-.814a	.079	-.970	-.658
		Yes	-.822a	.079	-.977	-.667
Safety score	Ford	No	-.023a	.119	-.257	.211
		Yes	-.002a	.119	-.237	.233
	BMW	No	-.066a	.118	-.299	.167
		Yes	-.236a	.118	-.468	-.003
Usability score	Ford	No	.104a	.111	-.116	.323
		Yes	-.143a	.112	-.363	.078
	BMW	No	-.385a	.111	-.604	-.166
		Yes	.071a	.110	-.147	.289

Table 22 Estimated marginal means of the factor scores with product design*complementary component interaction as predictor variable (Ford - BMW)

The graphs in figure two to four show how the views change when a common complementary component is used in the interior design. Ford benefits more in terms of livelihood rating when a complementary component is used as their score improves more compared to BMW (figure 2). BMW benefits more in terms of safety rating when a complementary component is used as their score improves while the score of Ford deteriorates (figure 3). Finally, Ford benefits more as well in terms of Usability rating when a complementary component is used as their score improves while the score of BMW deteriorates (figure 4). These changes support the hypothesis that common complementary components moderate the effect of product design on brand image.

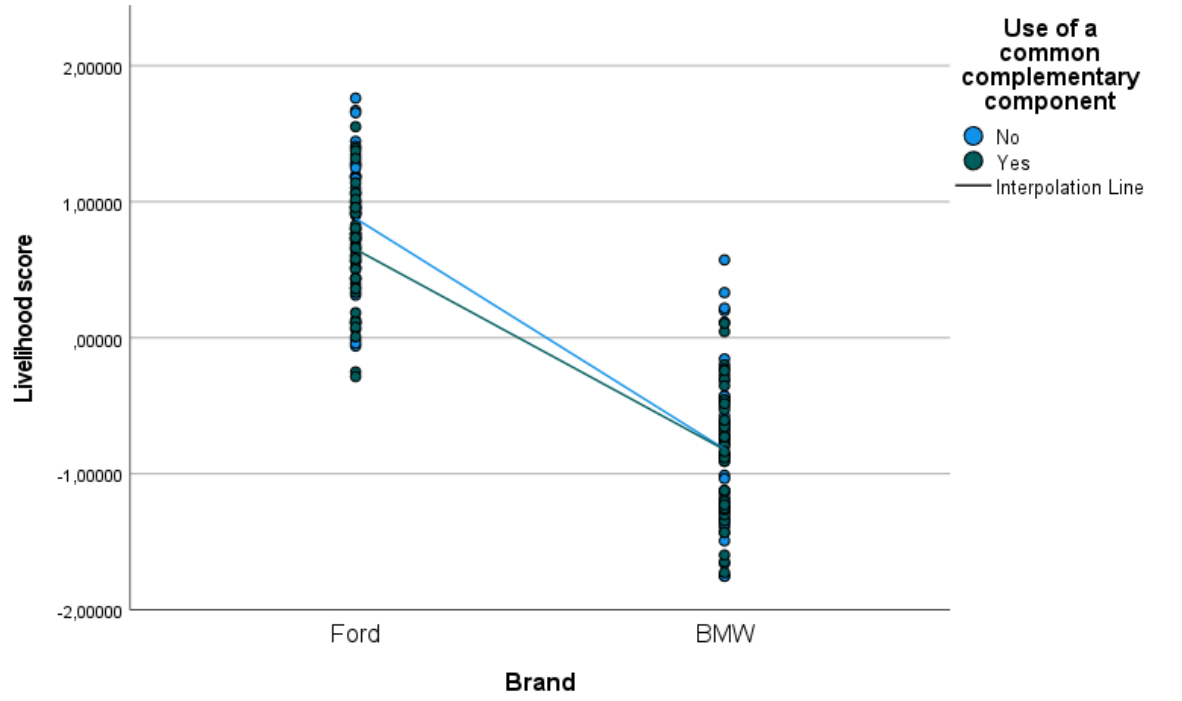


Figure 2 Scatter Plot of Livelihood score (Ford - BMW)

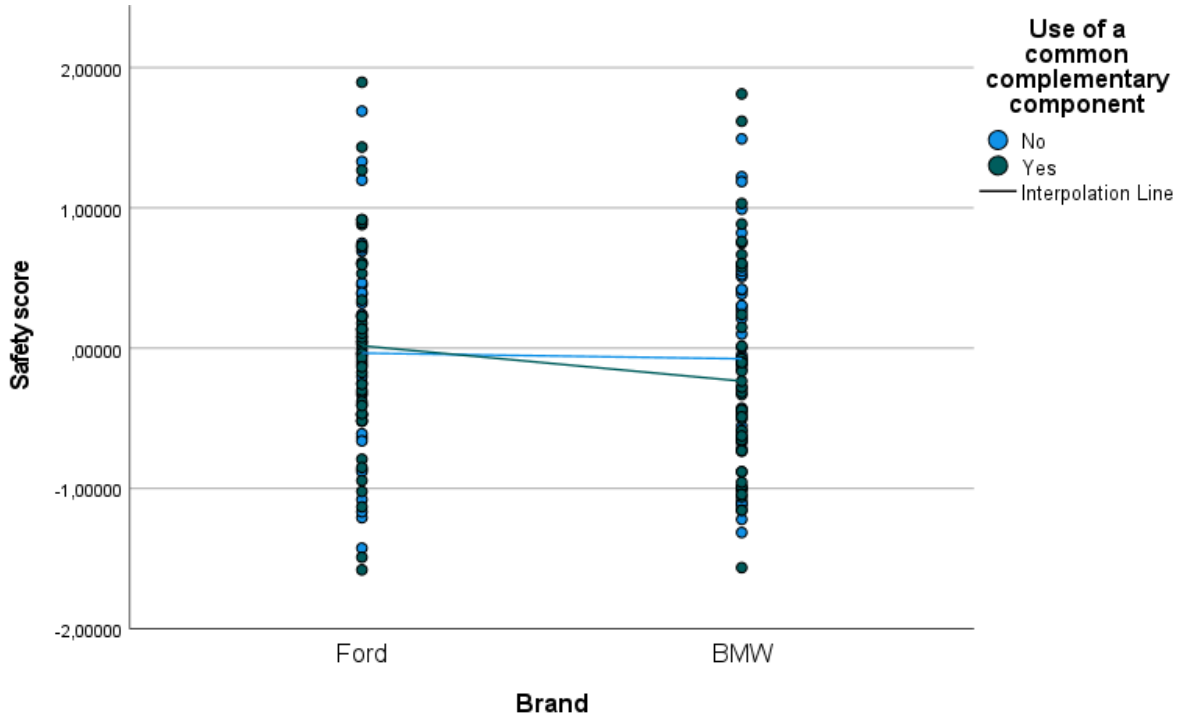


Figure 3 Scatterplot of Safety score (Ford - BMW)

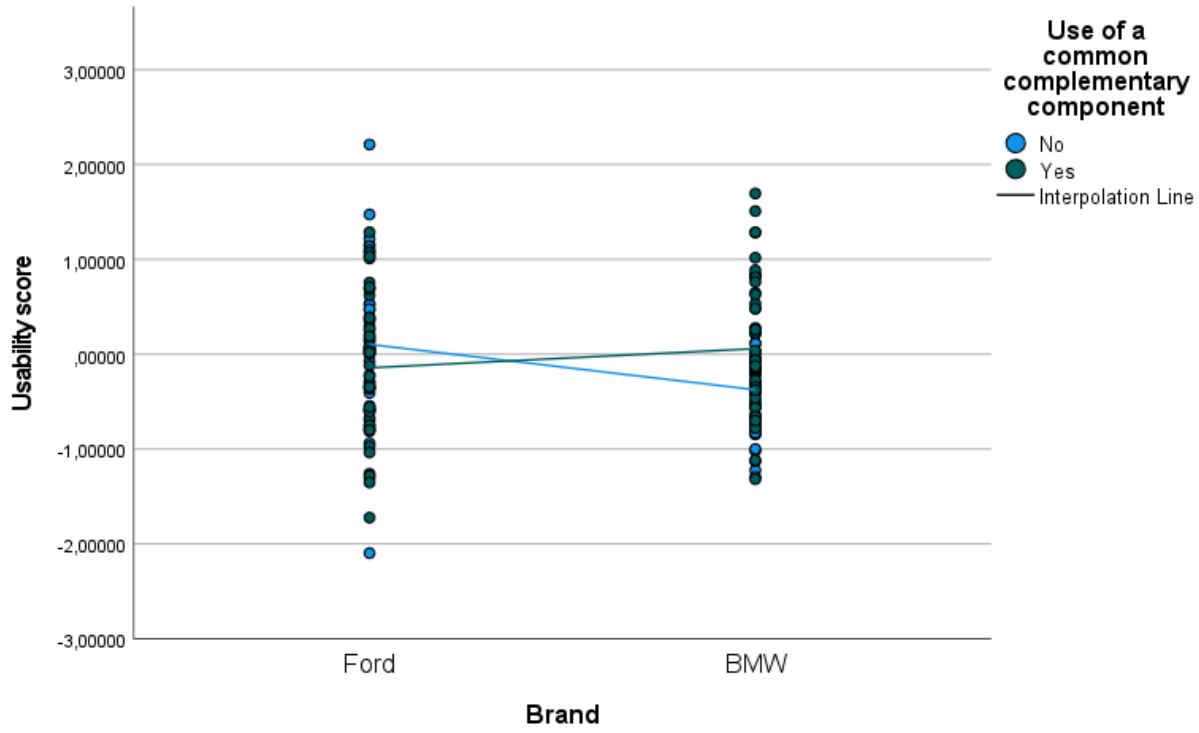


Figure 4 Scatterplot of Usability score (Ford - BMW)

Honda – Mercedes-Benz

Table 23 shows the multivariate statistics of the second set of predictor variables. According to these statistics, the effect of product design on brand image is significant as well, V = .669, F = 101.506, p = .00(<.05). The direct effect of a high-equity complementary component on brand image is insignificant, V = .010, F = .519, p = .670(>.05).

Contrary to the first set of predictors, the interaction between product design and a complementary component is insignificant, V = .039, F = 2.062, p = .108. The covariates seem to have no effect on brand image as all the p-values are insignificant again. The insignificant p-values in table 24 indicate that these results are robust.

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	.017	.895b	3.000	151.000	.446
Gender	.022	1.158b	3.000	151.000	.328
Age	.016	.806b	3.000	151.000	.492
Education	.005	.246b	3.000	151.000	.864
Income	.003	.158b	3.000	151.000	.924
Own choice of segment	.009	.473b	3.000	151.000	.702
Product design	.669	101.506b	3.000	151.000	.000
Complementary component	.010	.519b	3.000	151.000	.670
Product design * Complementary component	.039	2.062b	3.000	151.000	.108

Table 23 Multivariate test statistics using Pillai's Trace (Honda - Mercedes-Benz)

Levene's test of equality of error Variances

	F	df1	df2	Sig.
Livelihood score	.958	3	158	.414
Safety score	.961	3	158	.413
Usability score	2.525	3	158	.062

Table 24 Levene's test of equality of error variances (Honda – Mercedes-Benz)

Thus, the first hypothesis that high-equity complementary components have a direct positive effect on brand image is again, not supported within this comparison. Contrary to the first set of predictor variables, the second hypothesis that common complementary components moderate the effect of product design on brand image is not supported within this comparison.

According to the estimated marginal means in table 25, Mercedes-Benz is viewed as more lively (*M* = -.671), more safe (*M* = -.100) and more usable (-.140) based on interior design alone.

Estimates

Dependent variable	Product design	Mean	Std. Error	95% Confidence interval Lower bound	Upper bound
Livelihood score	Honda	.790a	.059	.674	.906
	Mercedes-Benz	-.671a	.060	-.788	-.553
Safety score	Honda	.145a	.092	-.037	.326
	Mercedes-Benz	-.100a	.093	-.284	.084
Usability score	Honda	.106a	.086	-.064	.277
	Mercedes-Benz	-.140a	.087	-.313	.032

Table 25 Estimated marginal means of the factor scores with brand as predictor variable (Honda - Mercedes-Benz)

5.3.2. H3. Common complementary components reduce the perceived differentiation between mass market and premium brands

This analysis examines whether the differences in *Livelihood*, *Safety* and *Usability* scores between brands are reduced when a common complementary component is used.

Assumptions

According to the Durbin-Watson test results, the first assumption of independent errors has been met for each set of predictor variables with all values being close to two (see table 26).

Durbin-Watson test	
Livelihood	
Ford – BMW	1.875
Honda – Mercedes-Benz	2.091
Safety	
Ford – BMW	2.522
Honda – Mercedes-Benz	2.376
Usability	
Ford – BMW	2.293
Honda – Mercedes-Benz	2.287

Table 26 Durbin-Watson test for both set of predictor variables

The normality Q-Q plots in appendix C1 to C12 all show that the majority of the residuals lie along the diagonal lines. Thus, this assumption has been met.

According to the Box's test results, the third assumption of homogeneity of covariance matrices has been met for both sets of predictor variables as both p-values are insignificant (see table 27).

Box's Test of Equality of Covariance Matrices

	Box's M	F	df1	df2	Sig.
Ford - BMW	9.710	1.551	6	44080.302	.157
Honda – Mercedes-Benz	2.477	.396	6	44080.302	.882

Table 27 Box's test of equality of covariance matrices for each set of conditions

Results

The results are displayed below, for each set of predictor variables separately. For each multivariate test, Pillai's Trace was used as the test statistic to determine the nature of the effects since the assumption of homogeneity of covariance matrices as well as the assumption of multivariate normality has been met this test is, again, considered as most robust (Field 2016). The results are discussed below.

Ford – BMW

Table 28 shows the multivariate statistics of the first set of predictor variables. According to these statistics, there is a significant difference between the mean difference in *Livelihood*, *Safety* and *Usability* scores, V = .129, F = 4.076, p = .010(<.05). The p-values in table 29 indicate that these results are robust except for the Livelihood factor where all p-values are below 0.05.

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	.838	131.076b	3.000	76.000	.000
Complementary component	.139	4.076b	3.000	76.000	.010

Table 28 Multivariate test statistics using Pillai's trace (Ford - BMW)

Levene's Test of Equality of Error Variances

		Levene Statistic	df1	df2	Sig.
Difference in Livelihood score	Based on Mean	5.373	1	78	.023
	Based on Median	4.115	1	78	.046
	Based on Median and with adjusted df	4.115	1	71.843	.046
	Based on trimmed mean	5.291	1	78	.024
Difference in Safety score	Based on Mean	.020	1	78	.887
	Based on Median	.006	1	78	.937
	Based on Median and with adjusted df	.006	1	77.594	.937
	Based on trimmed mean	.020	1	78	.889
Difference in Usability score	Based on Mean	1.041	1	78	.311
	Based on Median	1.019	1	78	.316
	Based on Median and with adjusted df	1.019	1	77.364	.316
	Based on trimmed mean	1.033	1	78	.313

Table 29 Levene's test of equality of error variances (Ford - BMW)

According to the estimated marginal means in table 30, the difference in *Livelihood* score decreases (M = 1.458 < 1.718), the difference in *Safety* score increases (M = .228>.053) and the difference in *Usability* score decreases (M = .207 < .483) when a common complementary component is used. The size of the bars in figure five to seven illustrate these changes.

Estimates

Dependent variable	Use of a common complementary component	Mean	Std. Error	95% Confidence interval Lower bound	Upper bound
Livelihood score	No	1.718	.114	1.492	1.944
	Yes	1.458	.114	1.231	1.684
Safety score	No	.053	.178	-.301	.407
	Yes	.228	.178	-.126	.583
Usability score	No	.483	.160	.164	.802
	Yes	-.207	.160	-.526	.112

Table 30 Estimated marginal means of the difference in factor scores with common complementary component as predictor variable (Ford - BMW)

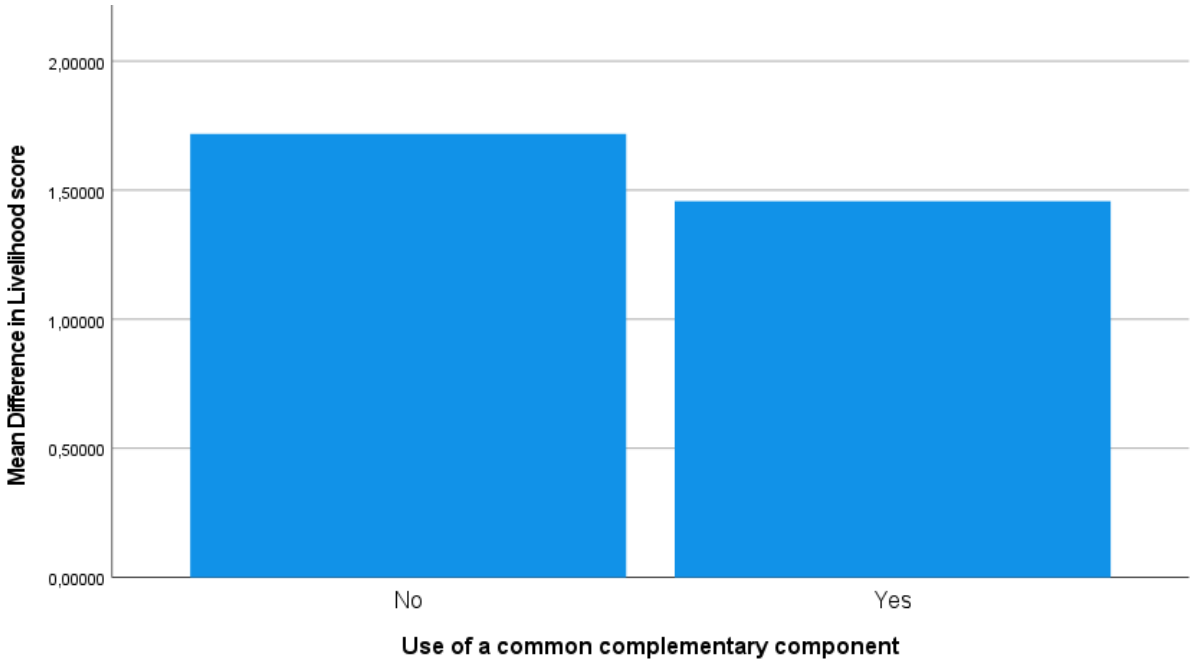


Figure 5 Change in Livelihood score mean difference when a common complementary component is used

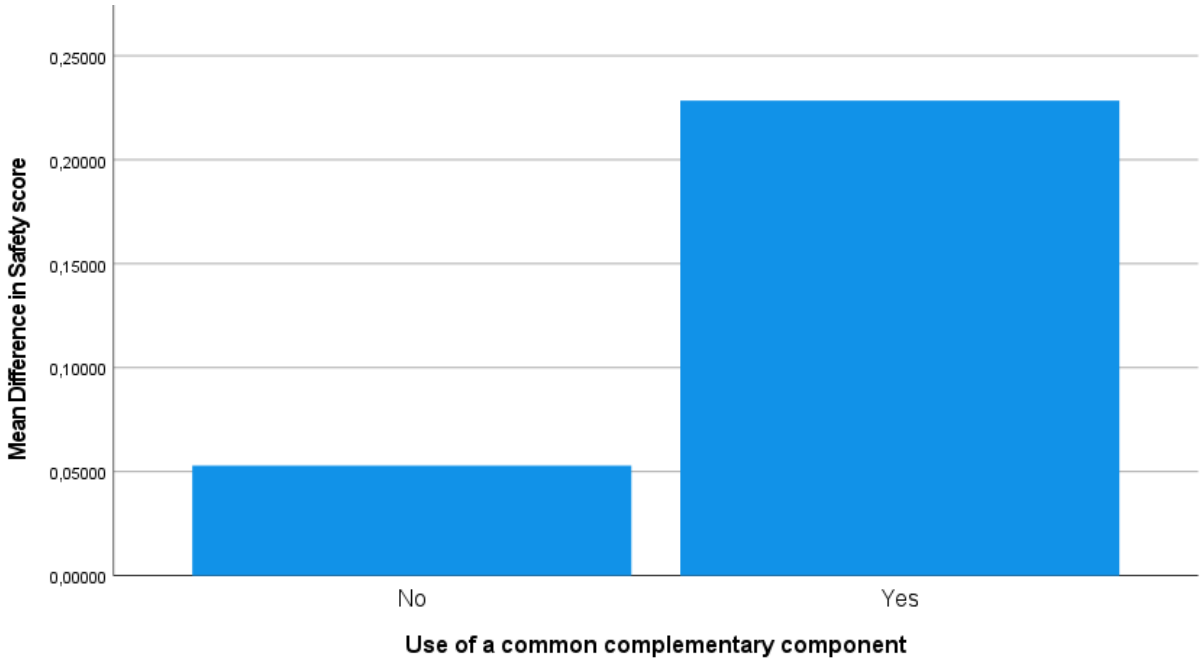


Figure 6 Change in Safety score mean difference when a common complementary component is used

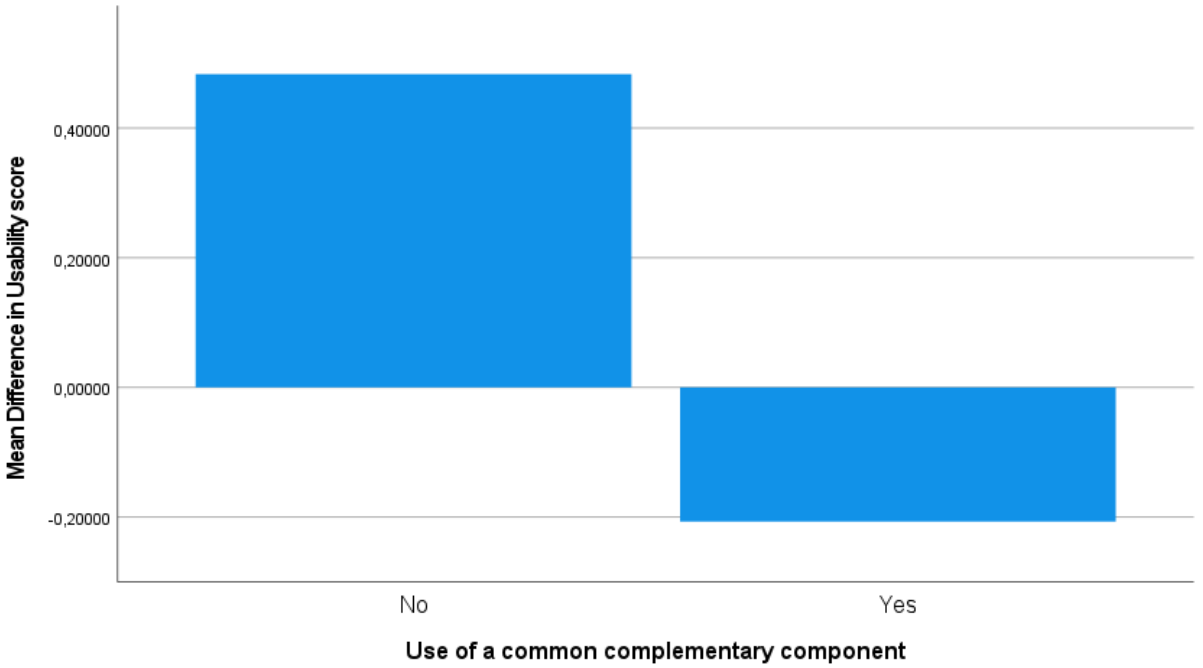


Figure 7 Change in Usability score mean difference when a common complementary component is used

The changes in differences in *Livelihood* and *Usability* score support the hypothesis that the use of a common complementary component reduces differentiation between brands. However, the increase of difference in *Safety* score does not support this hypothesis.

Honda – Mercedes-Benz

Table 31 shows the multivariate statistics of the first set of predictor variables. Contrary to the first set of predictors, there is no significant difference between the mean difference in *Livelihood*, *Safety* and *Usability* scores, V = .062, F = 1.668, p = .181>(.05). The p-values in table 32 indicate that these results are robust as al these values are insignificant.

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	.788	94.440b	3.000	76.000	.000
Complementary component	.062	1.668b	3.000	76.000	.181

Table 31 Multivariate test statistics using Pillai's trace (Ford - BMW)

Levene's Test of Equality of Error Variances

		Levene Statistic	df1	df2	Sig.
Difference in Livelihood score	Based on Mean	.452	1	78	.503
	Based on Median	.452	1	78	.503
	Based on Median and with adjusted df	.452	1	75.327	.503
	Based on trimmed mean	.466	1	78	.497
Difference in Safety score	Based on Mean	.070	1	78	.793
	Based on Median	.053	1	78	.818
	Based on Median and with adjusted df	.053	1	77.859	.818
	Based on trimmed mean	.066	1	78	.799
Difference in Usability score	Based on Mean	.344	1	78	.559
	Based on Median	.334	1	78	.565
	Based on Median and with adjusted df	.334	1	76.709	.565
	Based on trimmed mean	.330	1	78	.567

Table 32 Levene's test of equality of error variances (Honda – Mercedes-Benz)

According to the estimated marginal means in table 33, the difference in *Livelihood* score decreases (*M* = 1.283 < 1.638), the difference in *Safety* score increases (*M* = .339>.164) and the difference in *Usability* score increase (*M* = .295< .189). However, these changes are not significant. Thus there is no support for the hypothesis.

Estimates

Dependent variable	Use of a common complementary component	Mean	Std. Error	95% Confidence interval Lower bound	95% Confidence interval Upper bound
Livelihood score	No	1.638	.124	1.391	1.884
	Yes	1.283	.124	1.037	1.529
Safety score	No	.164	.172	-.178	.506
	Yes	.339	.172	-.002	.681
Usability score	No	.189	.169	-.148	.527
	Yes	.295	.169	-.043	.632

Table 33 Estimated marginal means of the difference in factor scores with common complementary component as predictor variable (Honda – Mercedes-Benz)

6. General discussion

This chapter provides the key findings of this study based on the analyses that were conducted. Furthermore, the implications, limitations and areas for future research will be discussed.

6.1 Key findings

The first finding is that brand image is made up of three dimensions, within this empirical context. The first one, *Livelihood*, entails to what degree a brand is viewed as husky, young, lively, fresh and eccentric. The second one, *Safety*, entails to what degree a brand is viewed as reliable, safe and robust. The third one, *Usability*, entails to what degree a brand is viewed as elegant, nimble and sophisticated.

The second finding is that premium brands, used in this thesis (BMW and Mercedes-Benz), are viewed as more lively, more safe and more usable relative to the two mass market brands (Ford and Honda).

The third finding is that the use of a high-equity complementary component does not have an effect on brand image directly, however the use of these components can moderate the effect of product design on brand image in various ways. Based on interior design, premium brands are viewed as more lively, more safe and more usable compared to mass market brands. However, in one analysis the use of a common complementary component caused the mass market brand to be viewed as more usable. The perceived *Livelihood* of the mass market brand had also improved relative to when a common complementary component was not used. This indicates that a high-equity complementary component can have a positive effect on the brand image of a mass market brand when it is being compared with a premium brand. The increase in *Livelihood* rating was also larger for the mass market brand compared to the premium brand, this finding is consistent with the finding of Washburn et al. (2000) who noted that a low-equity brand may benefit more from co-branding. But when it comes to safety ratings, the premium brand benefits more from the use of a high-equity complementary component as it improved while the score of the mass market brand deteriorated. In the other analysis, where two other brands were used as input variables, the moderating effect was not significant. So the nature of the moderating effect changes across the certain dimensions of brand image and the occurrence of the moderating effect varies across brand comparisons.

The third finding is that common complementary components can reduce, as well as increase the differentiation between brands. However, these effect are not, again, guaranteed. In one analysis the differentiation between the two brands is reduced for two dimensions of brand image (*Livelihood* and *Usability*) and increased for the other dimension (*Safety*). However, in the other analysis there was no significant difference found between the differences in brand image. So there is some consistency with the findings of Sullivan (1998), Kim and Chhajed (2000), Heese and Swaminathan (2006), Štrach and Everett (2006) and Olson (2008), who found that component sharing between brands reduces the extent of differentiation. But, there is also some inconsistency with these findings as the occurrence of reduced differentiation varies across dimensions of brand image and certain selection of brand comparisons.

6.2 Implications

The aim of this study was to explore the effects of using complementary components on a brand's brand image. The study revealed that the use of complementary components does not have a direct effect on brand image but it can have a moderating effect when the brand is being compared to another brand. However, the occurrence and nature of the effect varies across brands, segments and dimensions of brand image itself.

Marketing managers in competitive industries should therefore be very cautious in their decisions to use a complementary component in their products. A clear knowledge of their own brand image as

well as their competitor's brand image would be the first determining factor in such a decision. Accordingly, they should evaluate if this complementary component would fit their differentiation strategy as the effect of a complementary component can vary between dimensions of their brand image. Therefore, they should evaluate the benefits as well as the drawbacks that the usage of a particular complementary component brings in terms of brand image. To understand the benefits and drawbacks, a clear understanding of the brand equity of a complementary component is needed.

If they do decide to use a complementary component, they should also decide to what extent this use is emphasized in marketing practices if a competitor is using the same complementary component, such as the launch of a new product. For example, if their brand is considered 'premium' they might not emphasize it too much in their campaigns as it could affect their brand image. But if their brand is considered as 'mass market' they might emphasize it a bit more, to improve their image in certain dimensions.

6.3 Limitations and areas for future research

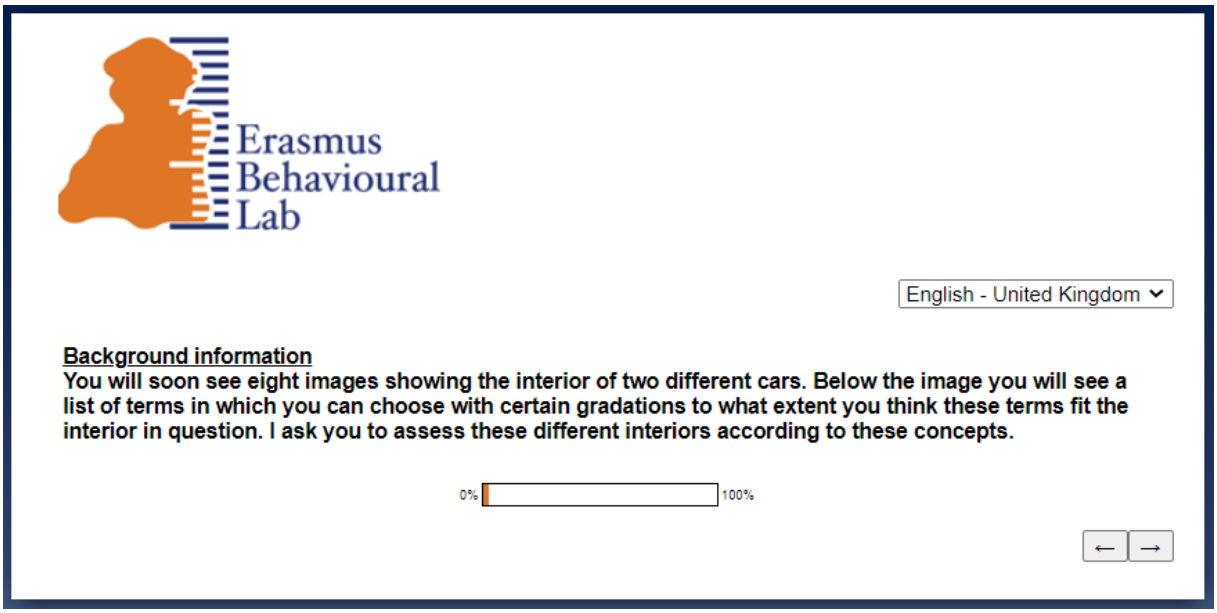
This study does have its limitations that offers room for improvement in further areas of future research. First of all, this empirical study only focuses on one industry, the automotive industry. Further research could explore the effect of complementary components on brand image in other industries.

Secondly, this study only captured brand image based on appeal, interior design in particular, while brand image is influenced by many more factors. For example, further research could explore the effect of complementary components through experience instead of appeal.

The third limitation of this study is that a comparison effect was created between brands of different segments while consumers may not compare a mass market brand to a premium brand in real life, simply because they are planning to buy a car in specifically in the mass market segment or premium segment. Therefore, the results presented in this study may not represent the entire population. Future research could explore the effect of complementary components between brands in the same segment.

The fourth limitation of this study is that there was only one complementary component used (Apple Carplay) while the response might be different for other complementary component such as Android Auto due to previous established brand associations. Further research could explore the effects and the differences in effects of multiple complementary components on brand image.

Appendix A. Full survey



Erasmus Behavioural Lab

English - United Kingdom

Indicate for each interior to what extent you find each concept suitable for this interior. You can do this by selecting one of the five boxes.

0% 100%

← →

Brand: Honda

Simple	○ ○ ○ ○ ○	Complex
Elegant	○ ○ ○ ○ ○	Plain
Nimble	○ ○ ○ ○ ○	Clumsy
Sophisticated	○ ○ ○ ○ ○	Unsophisticated

0% 100%

→

Brand: Mercedes

Simple	○	○	○	○	○	Complex
Elegant	○	○	○	○	○	Plain
Nimble	○	○	○	○	○	Clumsy
Sophisticated	○	○	○	○	○	Unsophisticated

0% 100%

← →

Brand: Honda

Reliable	○ ○ ○ ○ ○	Unreliable
Safe	○ ○ ○ ○ ○	Dangerous
Husky	○ ○ ○ ○ ○	Weak
Robust	○ ○ ○ ○ ○	Fragile

0% 100%

← →

Brand: Mercedes

Reliable	○ ○ ○ ○ ○	Unreliable
Safe	○ ○ ○ ○ ○	Dangerous
Husky	○ ○ ○ ○ ○	Weak
Robust	○ ○ ○ ○ ○	Fragile

0% 100%

← →

Brand: Honda

Young	○ ○ ○ ○ ○	Old
Lively	○ ○ ○ ○ ○	Calm
Fresh	○ ○ ○ ○ ○	Stale
Eccentric	○ ○ ○ ○ ○	Conventional

0% 100%

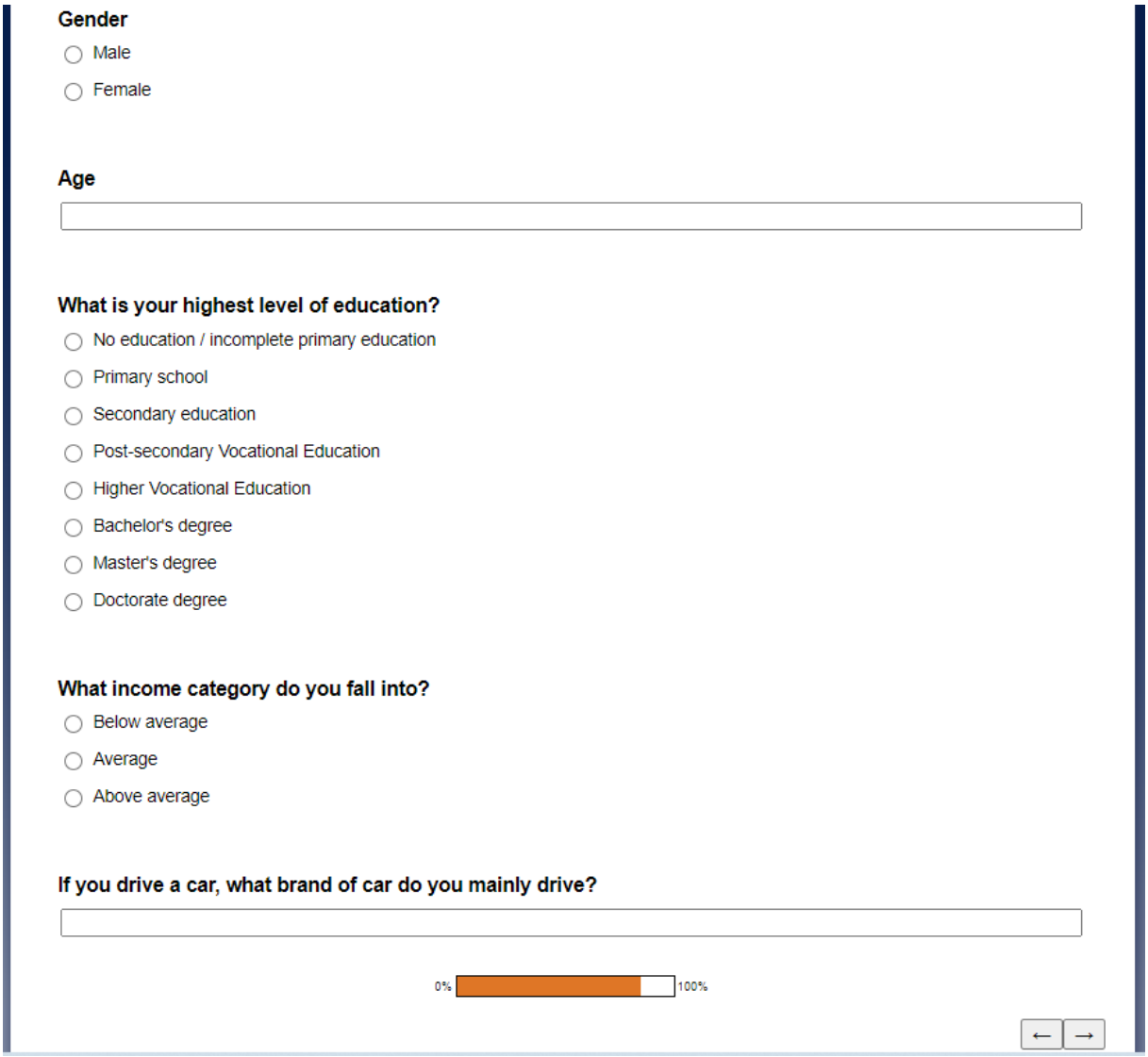
← →

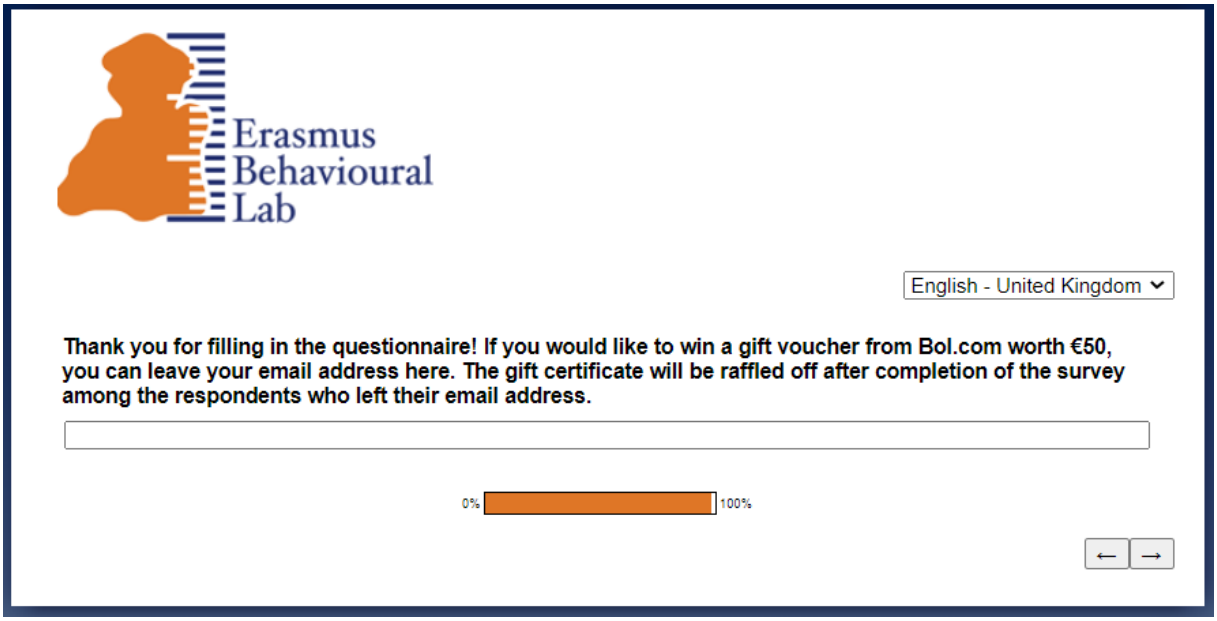
Brand: Mercedes

Young	○ ○ ○ ○ ○	Old
Lively	○ ○ ○ ○ ○	Calm
Fresh	○ ○ ○ ○ ○	Stale
Eccentric	○ ○ ○ ○ ○	Conventional

0% 100%

← →





The following combinations of interiors can also be shown to the participant instead of the above.

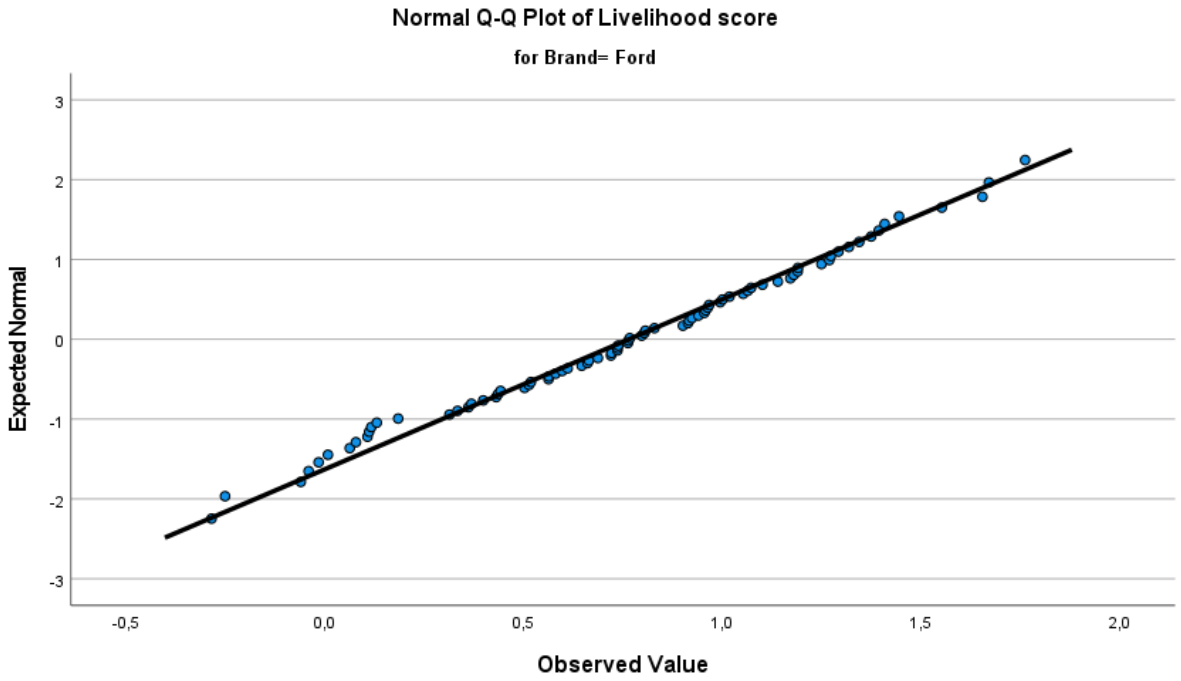
Combination 2

Combination 3

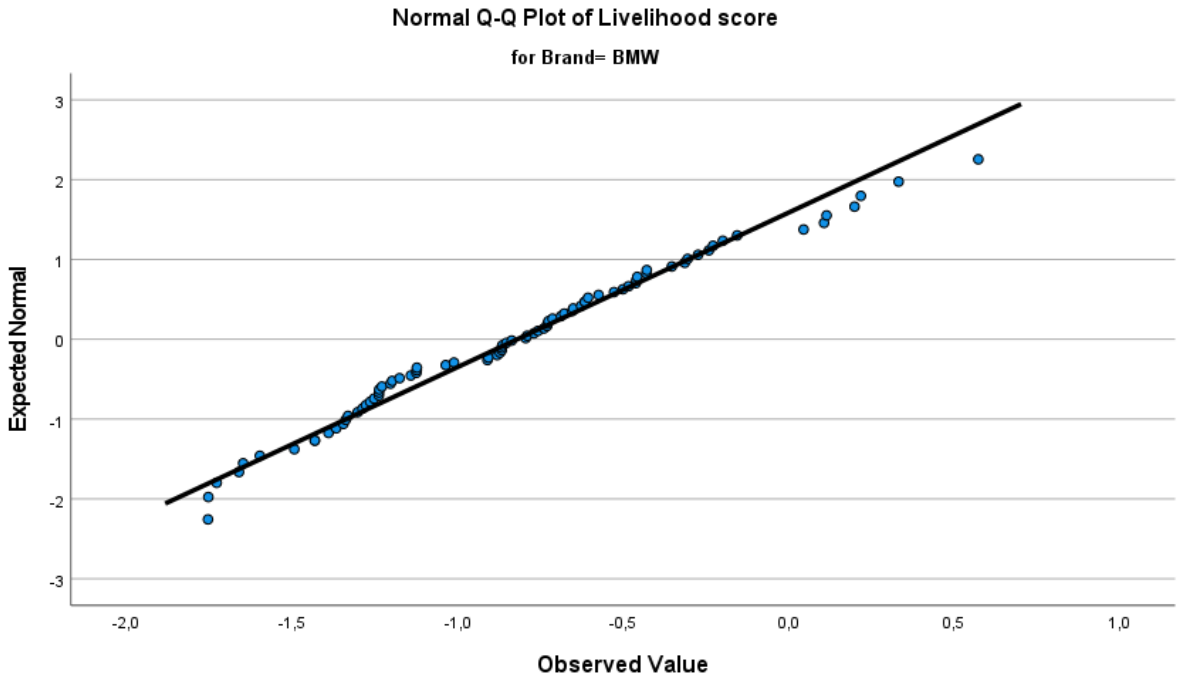
Combination 4

Appendix B. Hypothesis 1 and 2 testing statistics

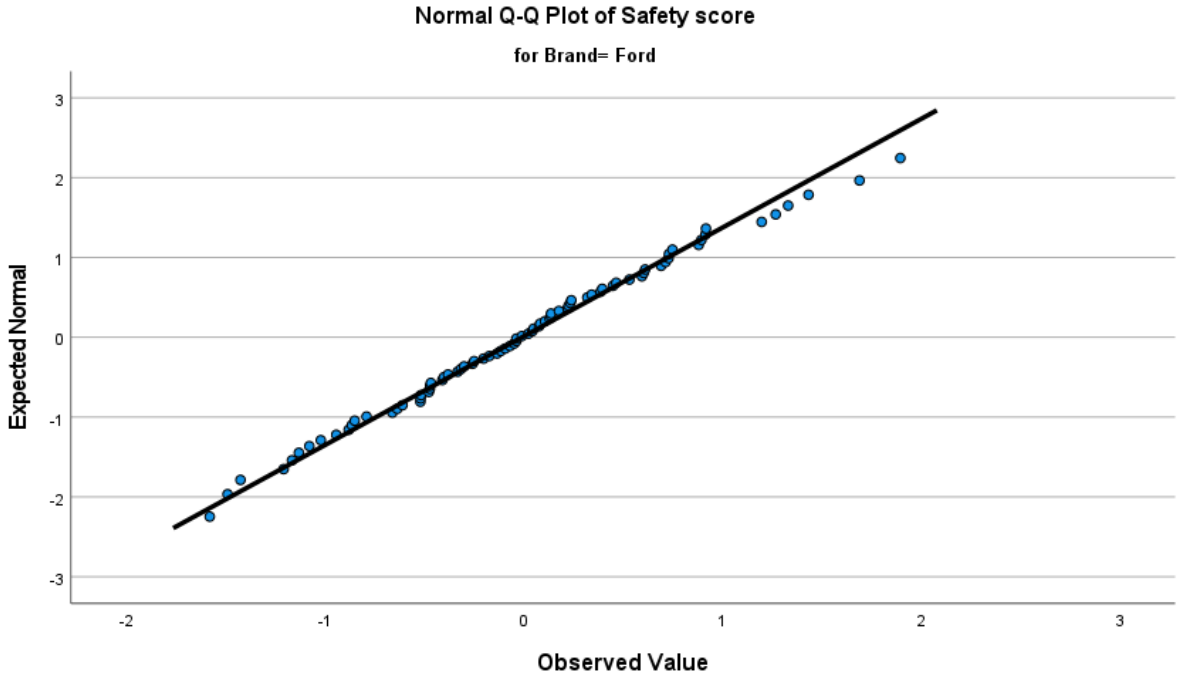
B1. Normality Q-Q plot of Livelihood score (Ford)



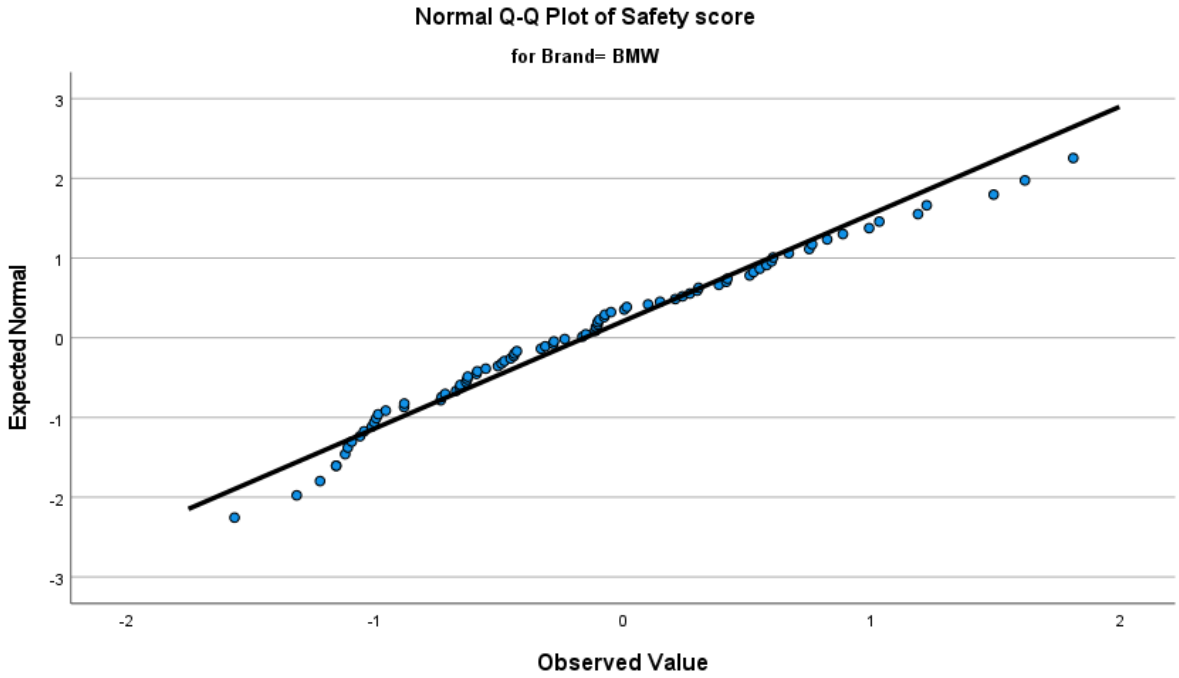
B2. Normality Q-Q plot of Livelihood score (BMW)



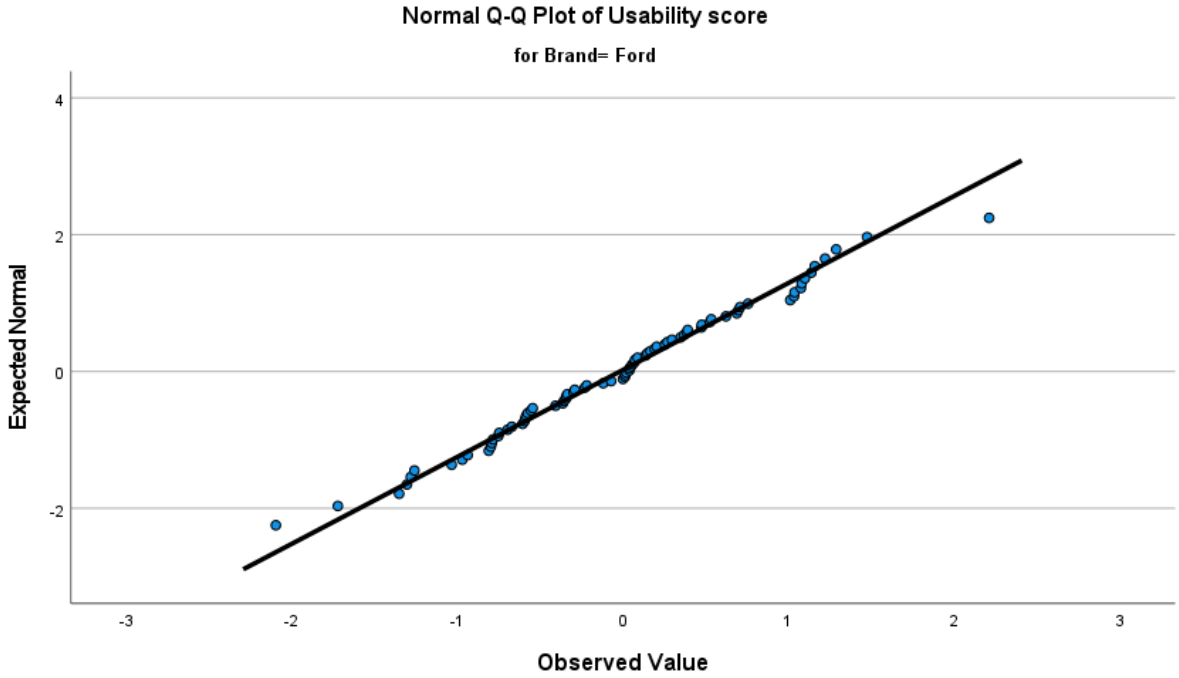
B3. Normality Q-Q plot of Safety score (Ford)



B4. Normality Q-Q plot of Safety score (BMW)

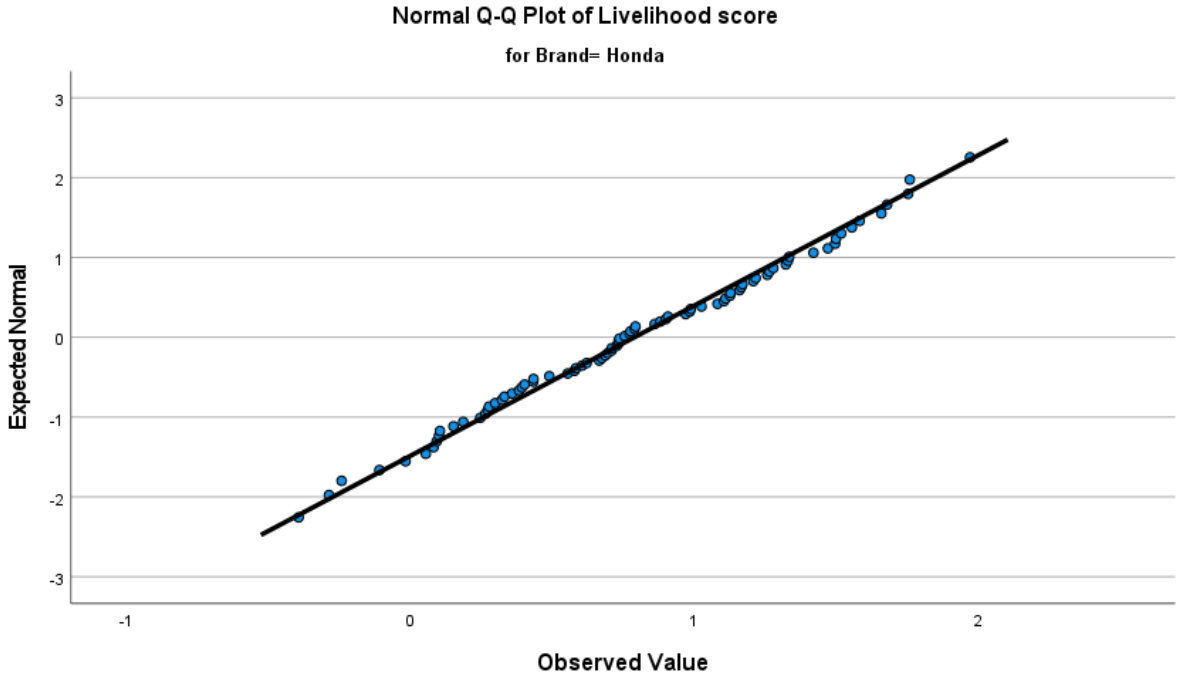


B5. Normality Q-Q plot of Usability score (Ford)

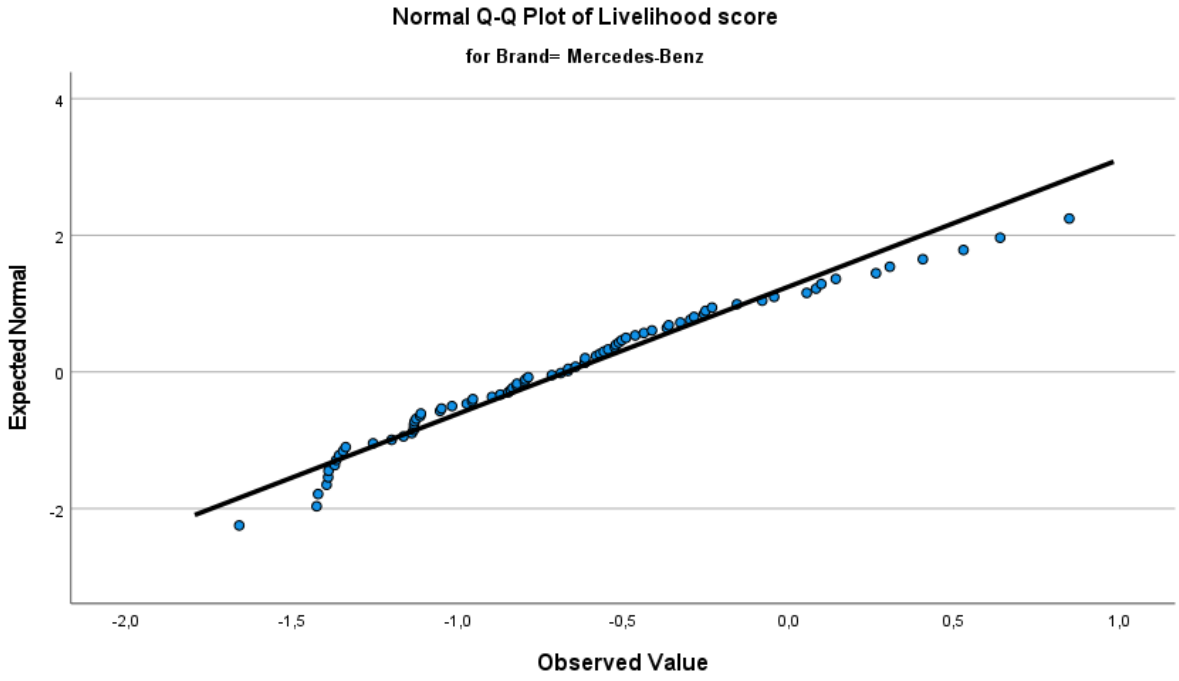


B6. Normality Q-Q plot of Usability score (BMW)

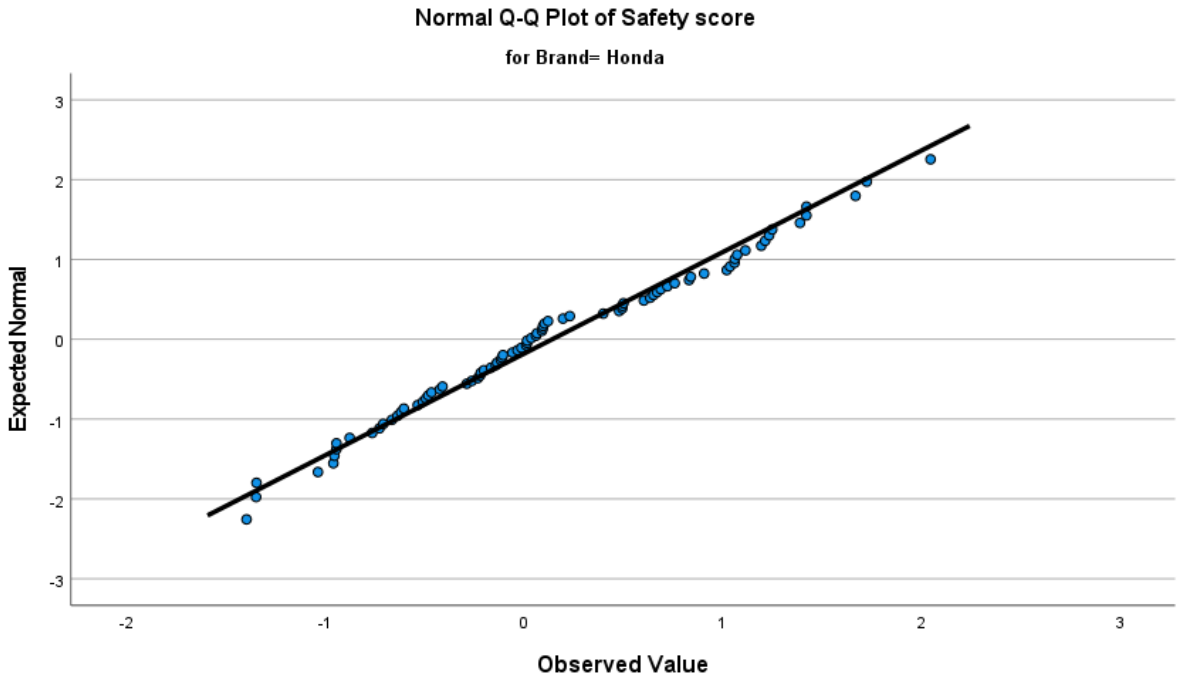
B7. Normality Q-Q plot of Livelihood score (Honda)



B8. Normality Q-Q plot of Livelihood score (Mercedes-Benz)

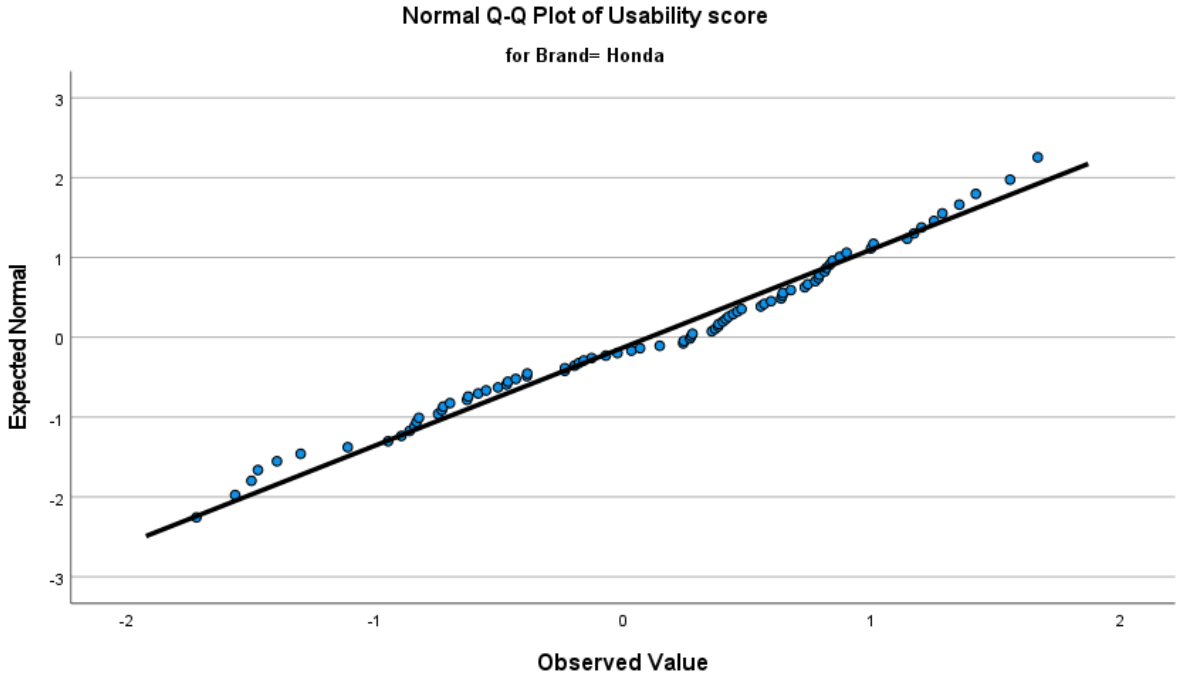


B9. Normality Q-Q plot of Safety score (Honda)

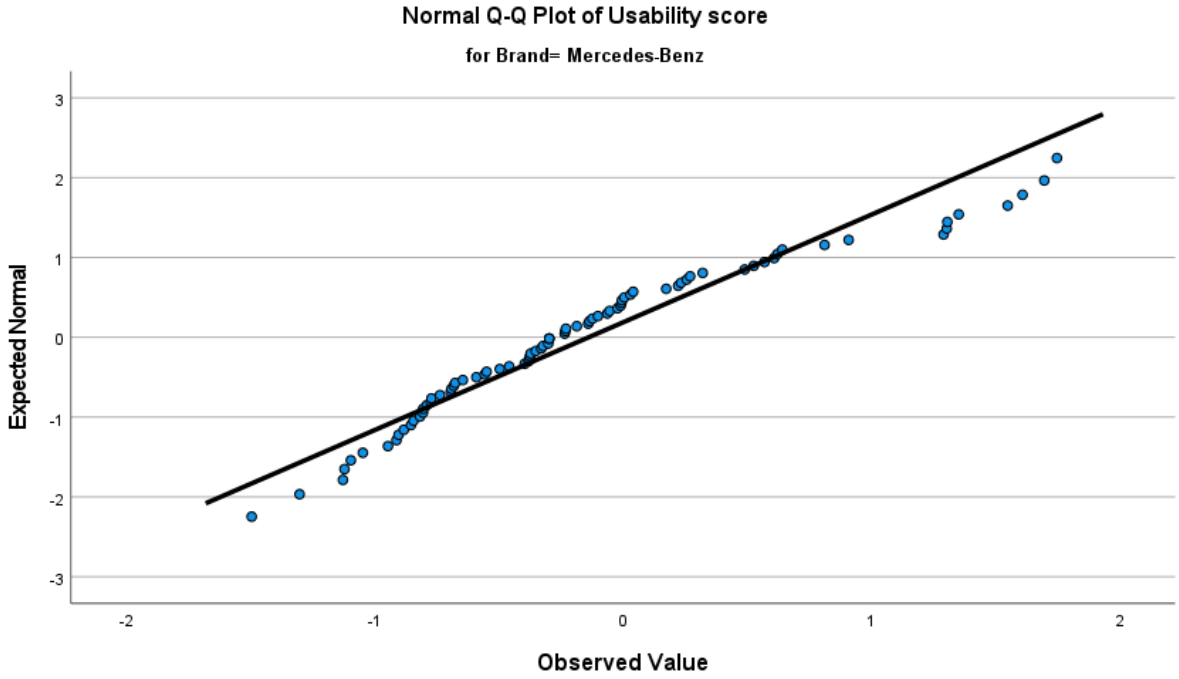


B10. Normality Q-Q plot of Safety score (Mercedes-Benz)

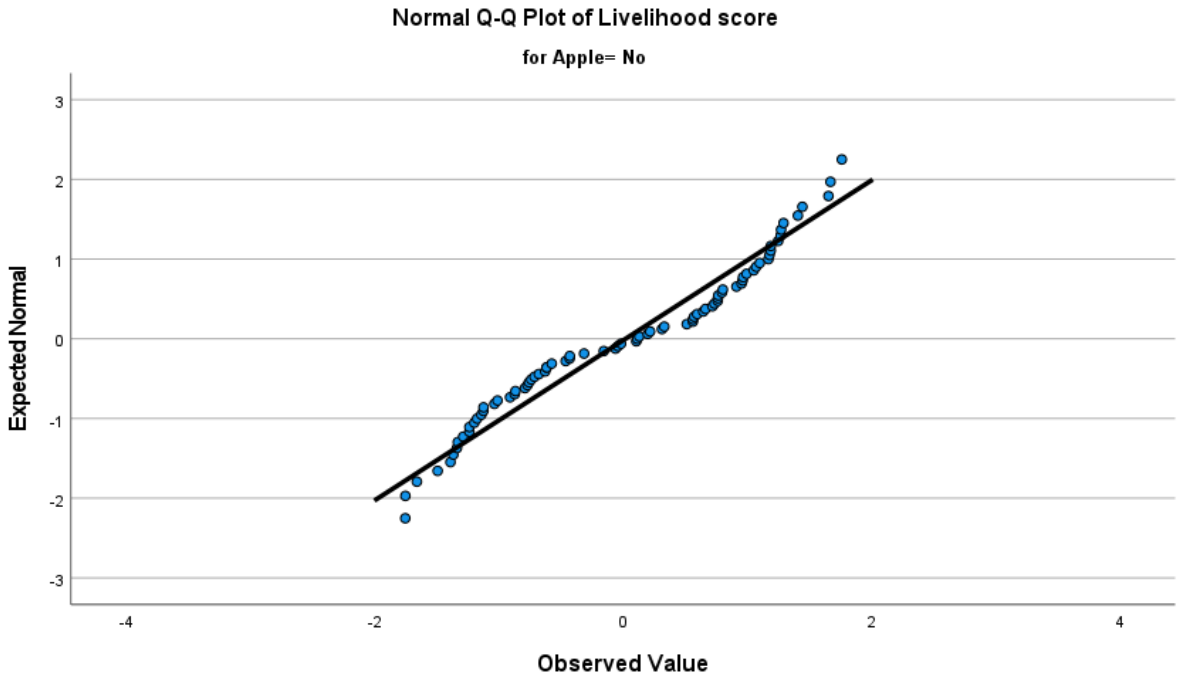
B11. Normality Q-Q plot of Usability score (Honda)



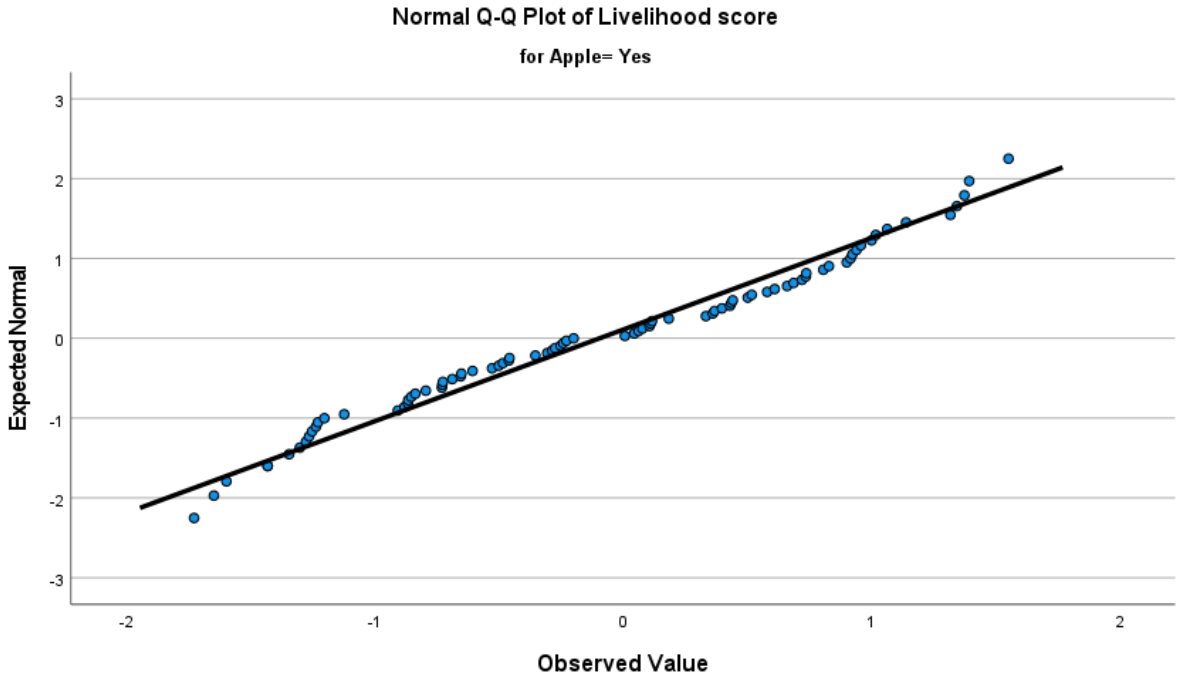
B12. Normality Q-Q plot of Usability score (Mercedes-Benz)



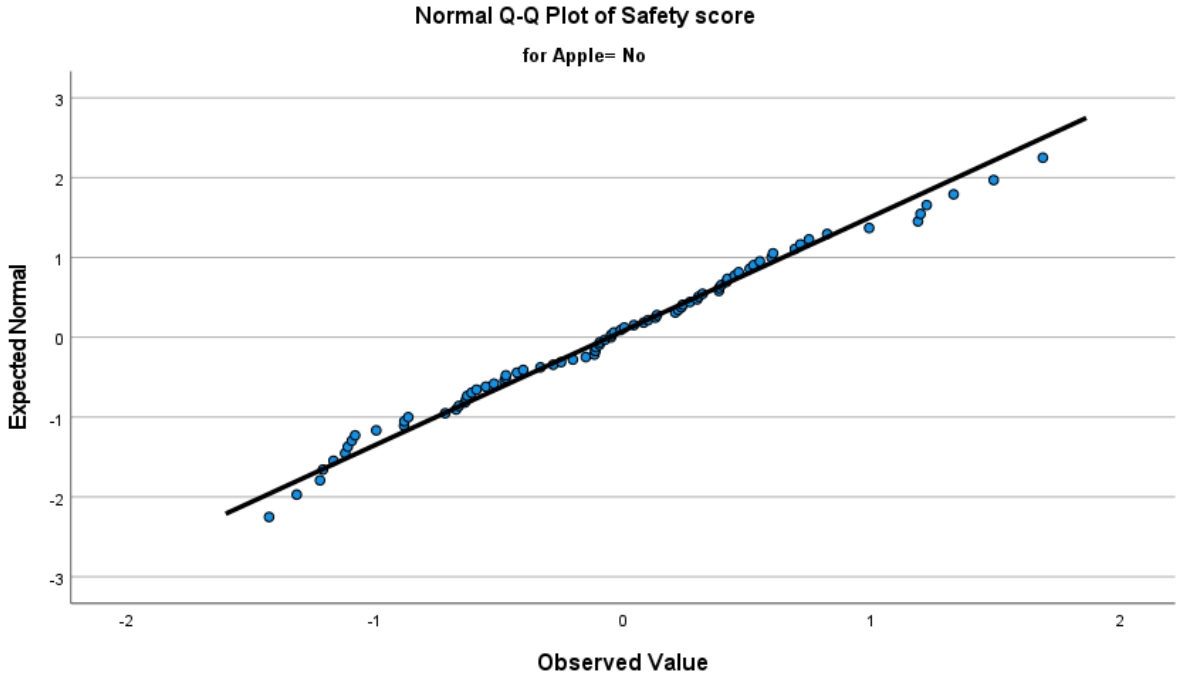
B13. Normality Q-Q plot of Livelihood score (with no complementary component)(Ford – BMW)



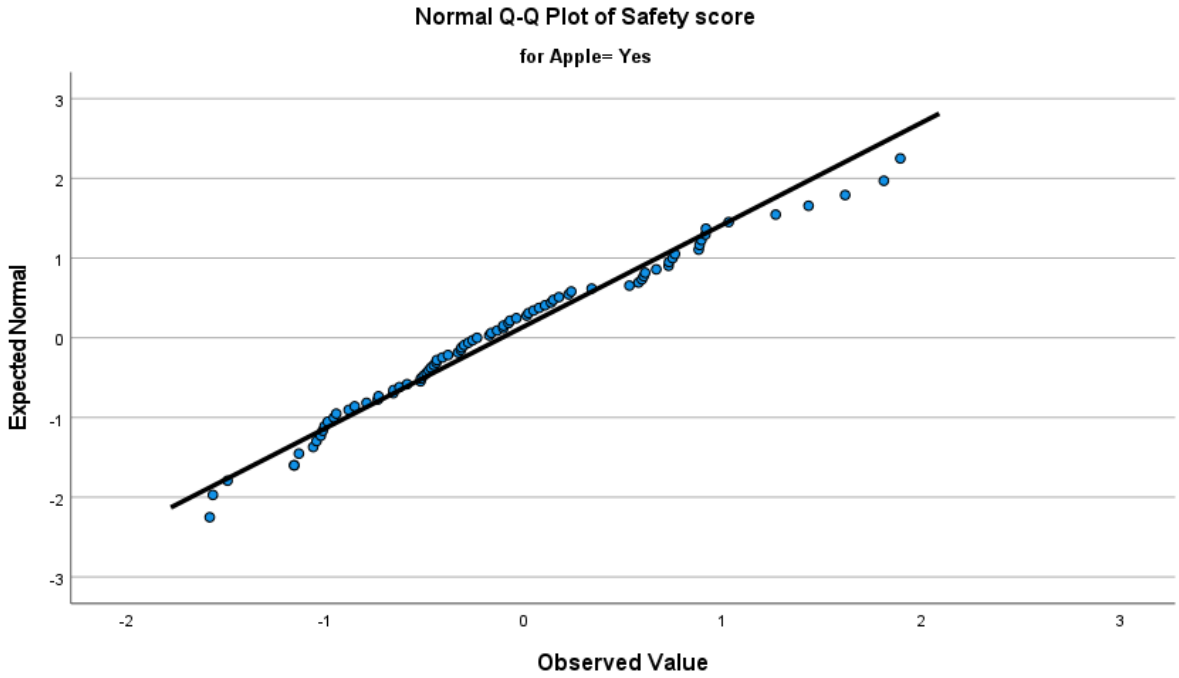
B14. Normality Q-Q plot of Livelihood score (with complementary component)(Ford – BMW)



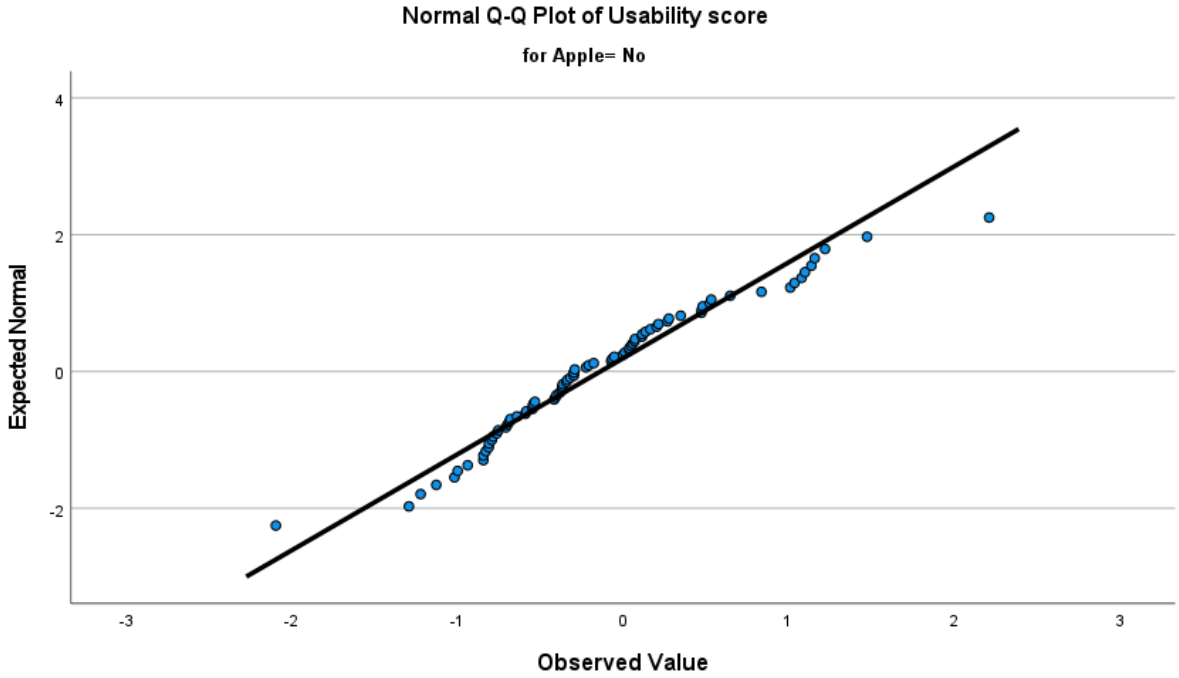
B15. Normality Q-Q plot of Safety score (with no complementary component)(Ford – BMW)



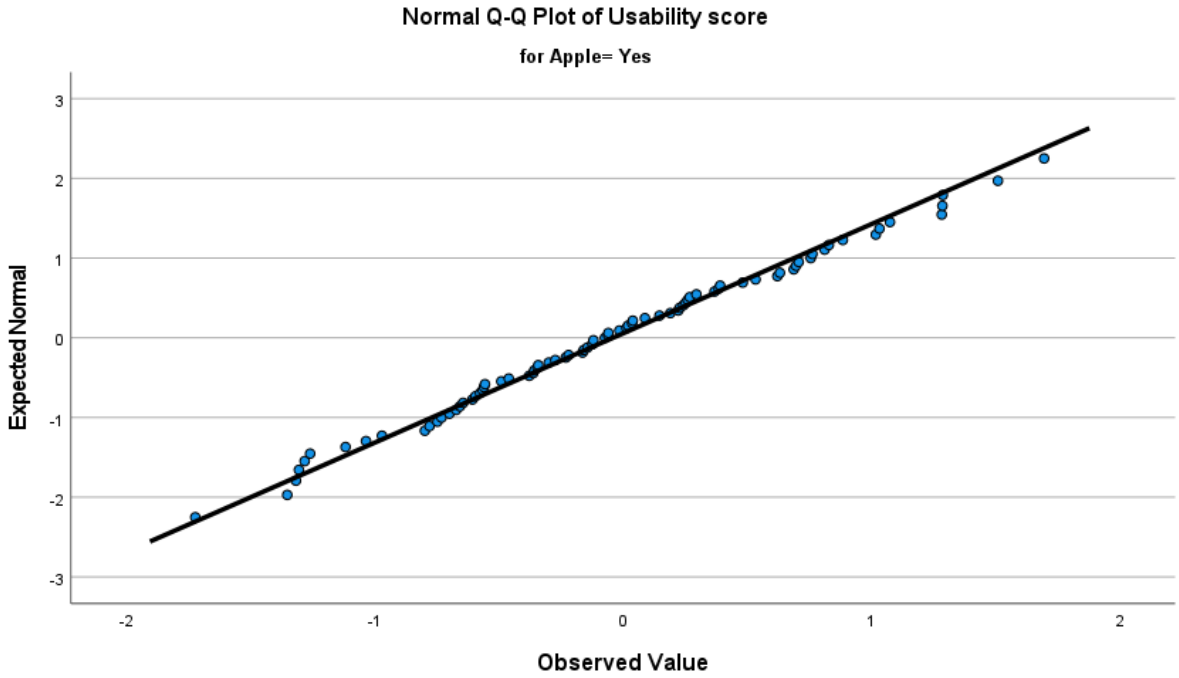
B16. Normality Q-Q plot of Safety score (with complementary component)(Ford – BMW)



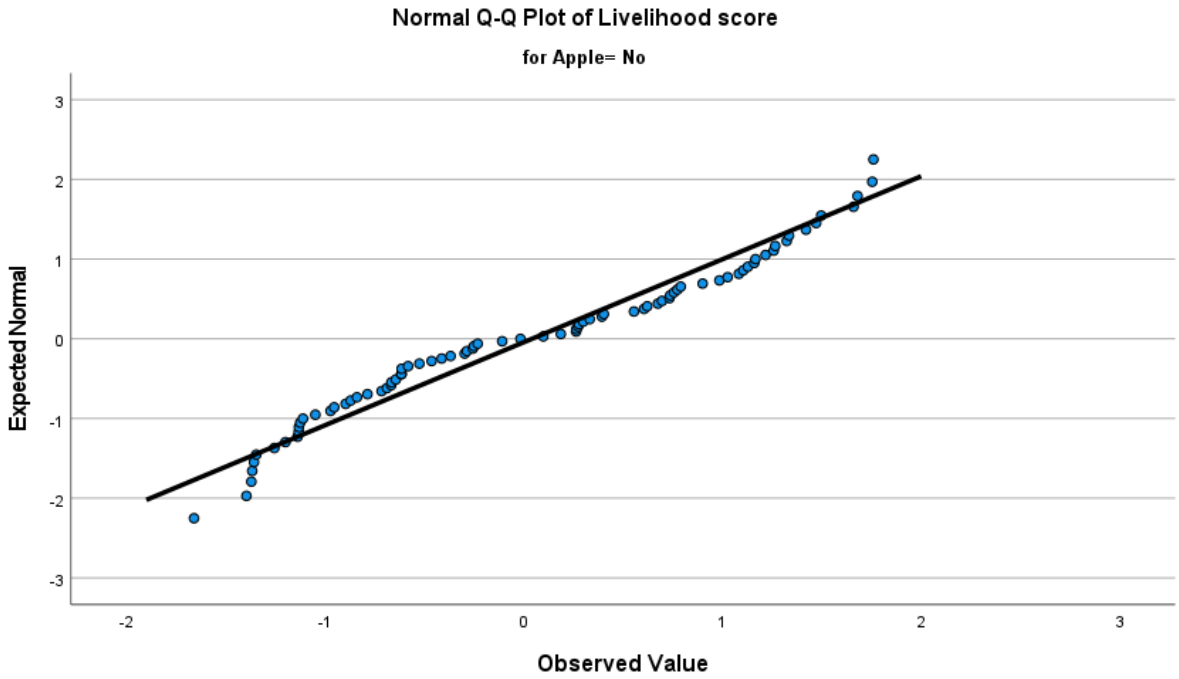
B17. Normality Q-Q plot of Usability score (with no complementary component)(Ford – BMW)



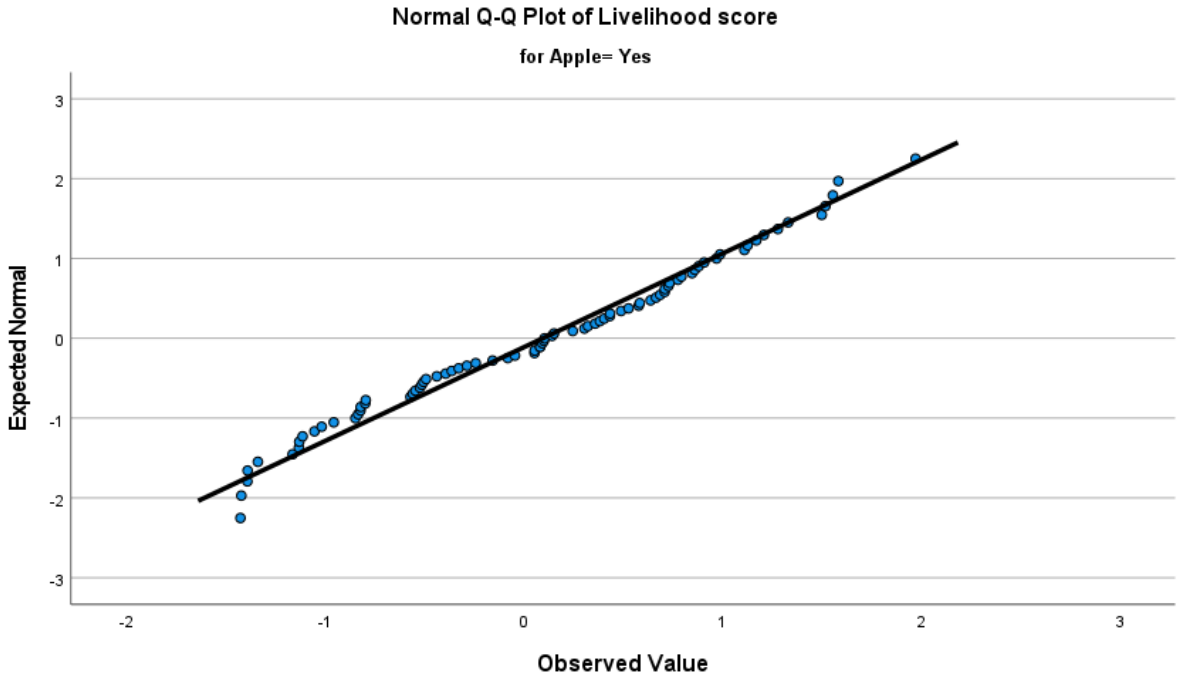
B18. Normality Q-Q plot of Usability score (with complementary component)(Ford – BMW)



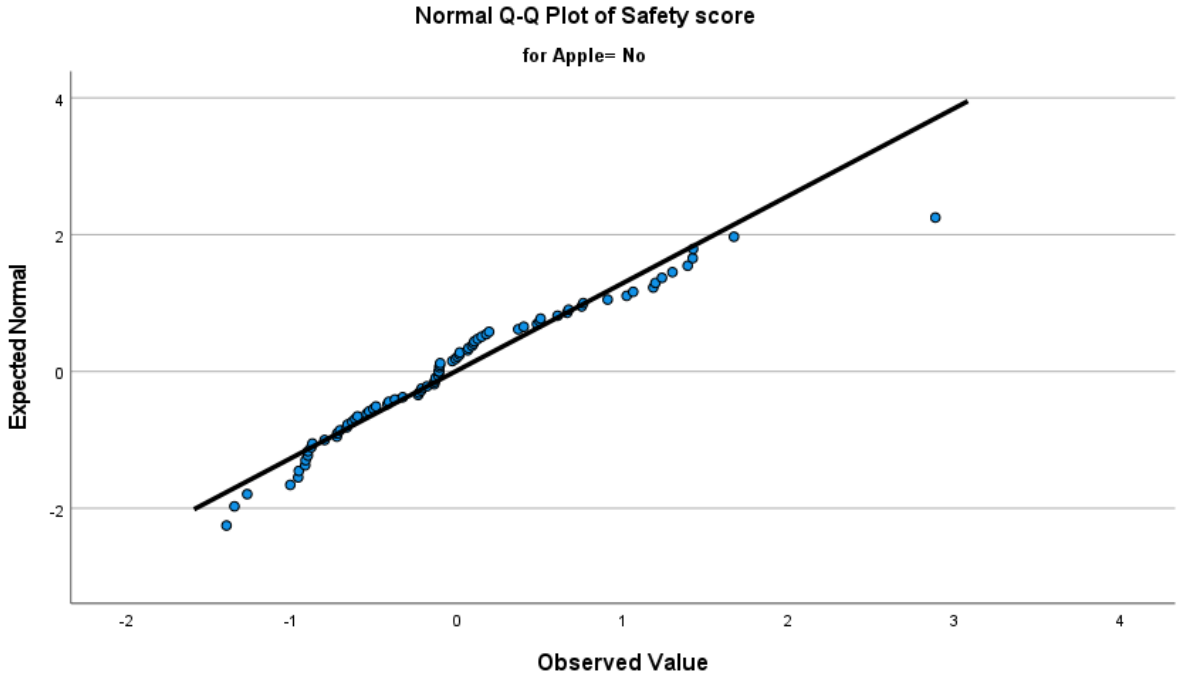
B19. Normality Q-Q plot of Livelihood score (with no complementary component)(Honda – Mercedes-Benz)



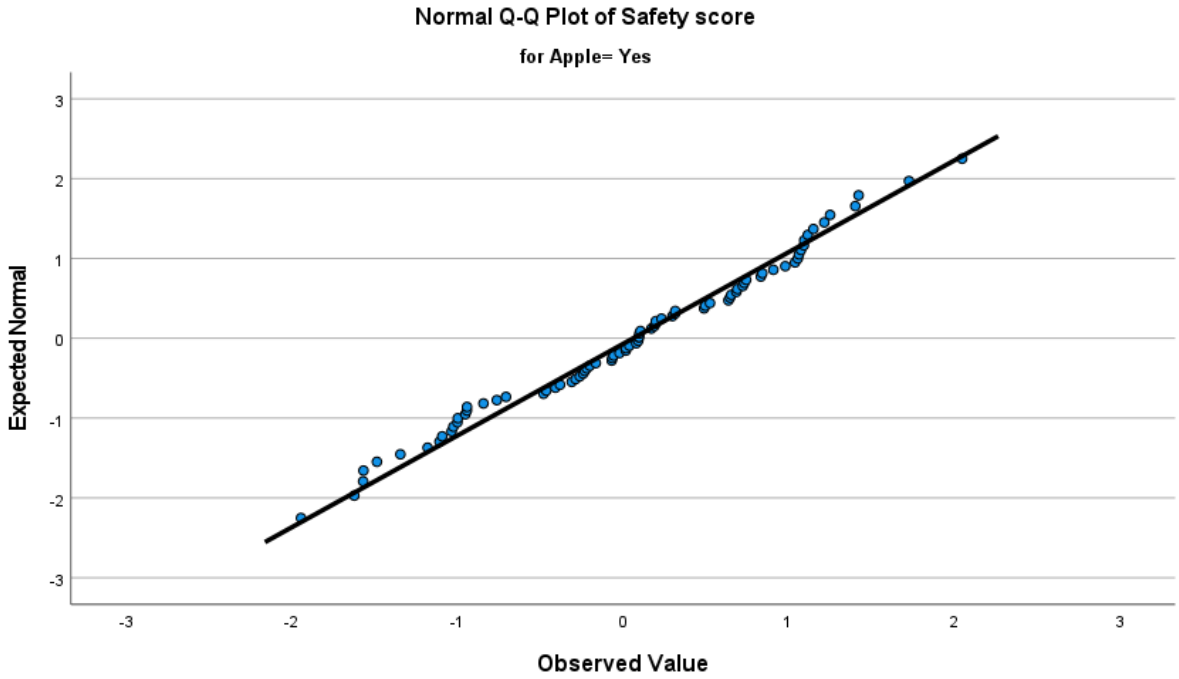
B20. Normality Q-Q plot of Livelihood score (with complementary component) (Honda – Mercedes-Benz)



B21. Normality Q-Q plot of Safety score (with no complementary component) (Honda – Mercedes-Benz)

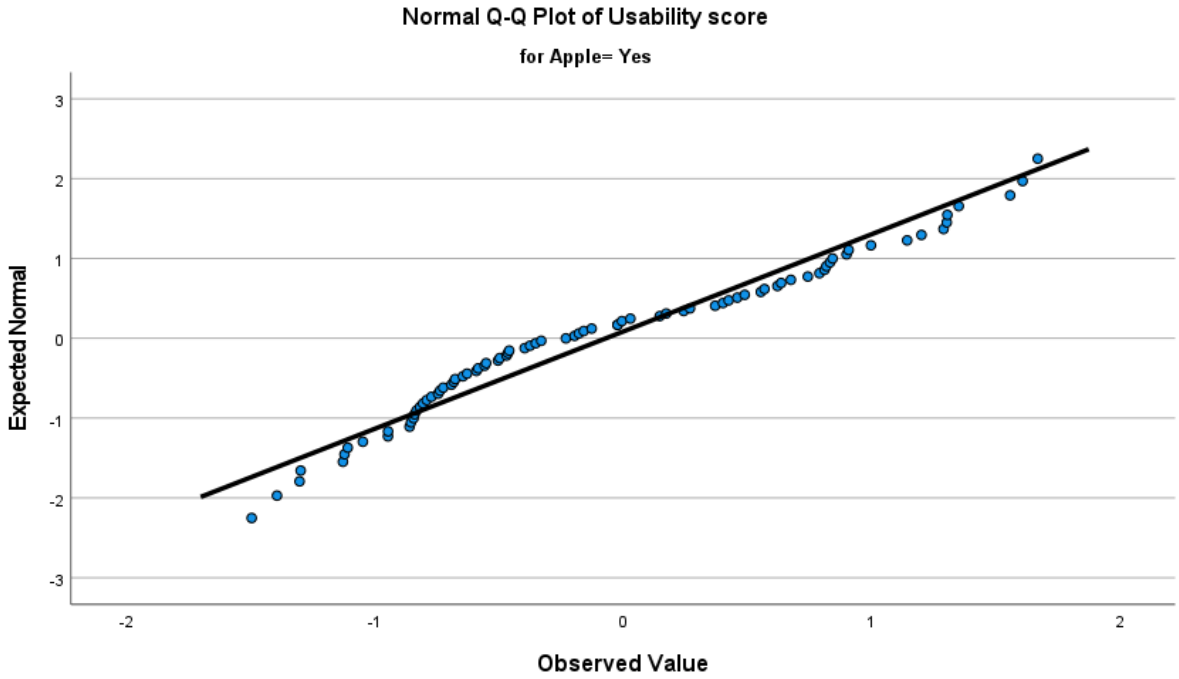


B22. Normality Q-Q plot of Safety score (with complementary component) (Honda – Mercedes-Benz)



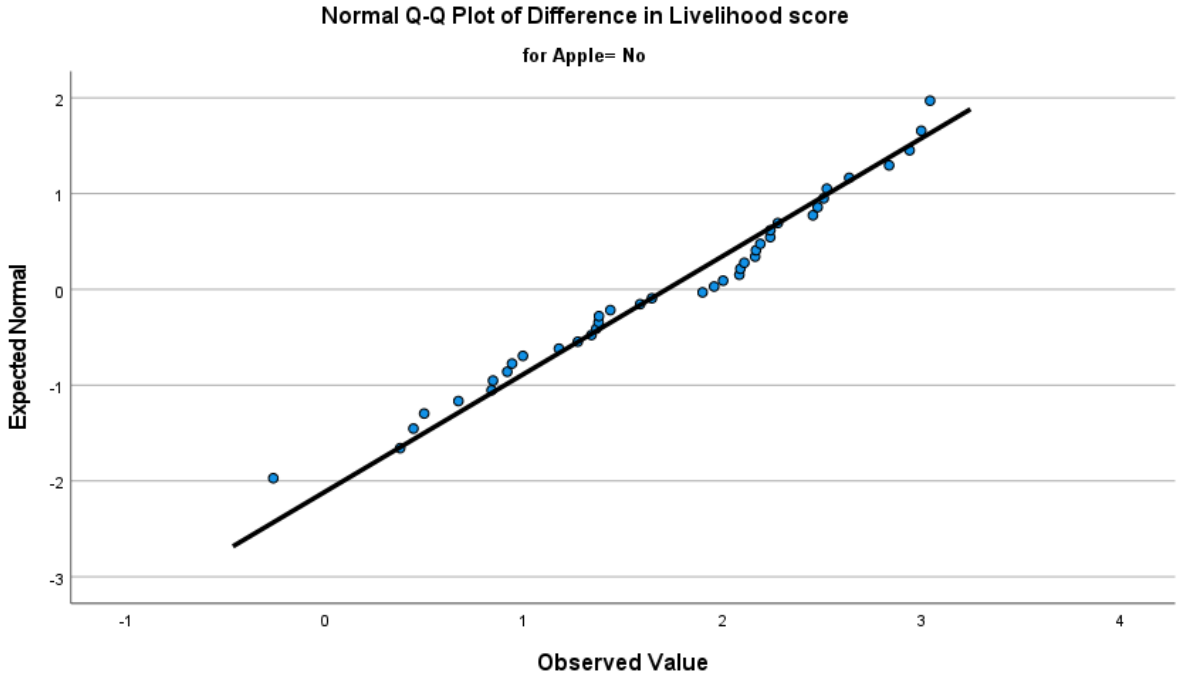
B23. Normality Q-Q plot of Usability score (with no complementary component) (Honda – Mercedes-Benz)

B24. Normality Q-Q plot of Usability score (with complementary component) (Honda – Mercedes-Benz)

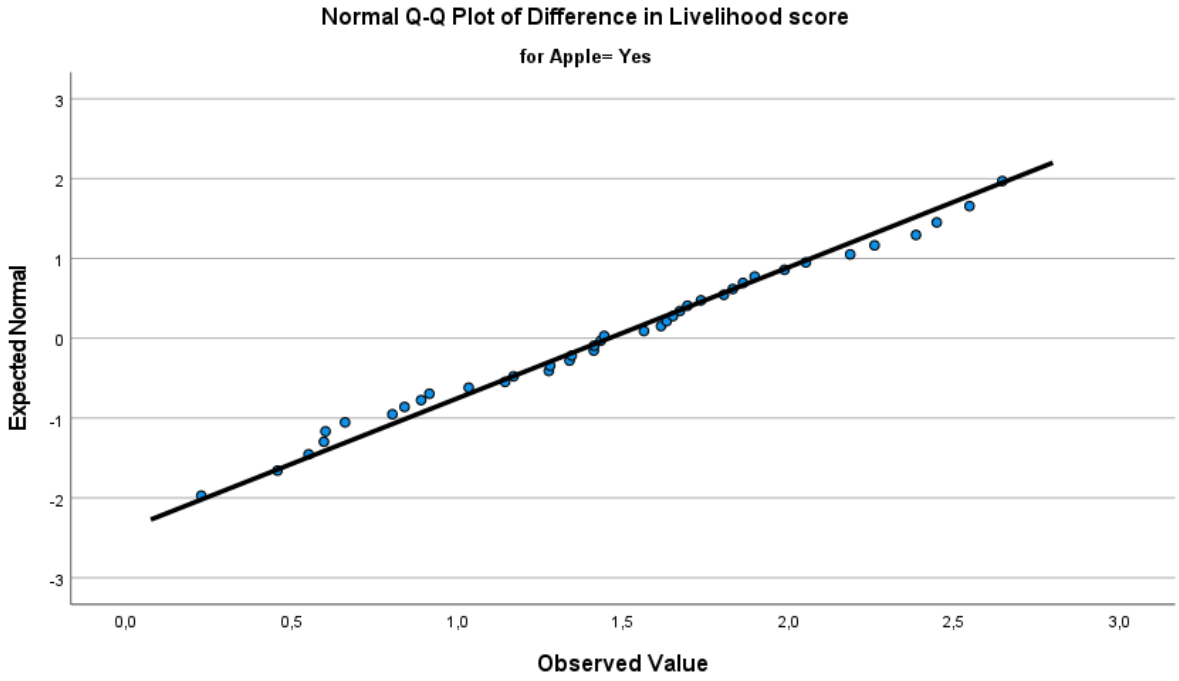


Appendix C. Hypothesis 3 testing statistics

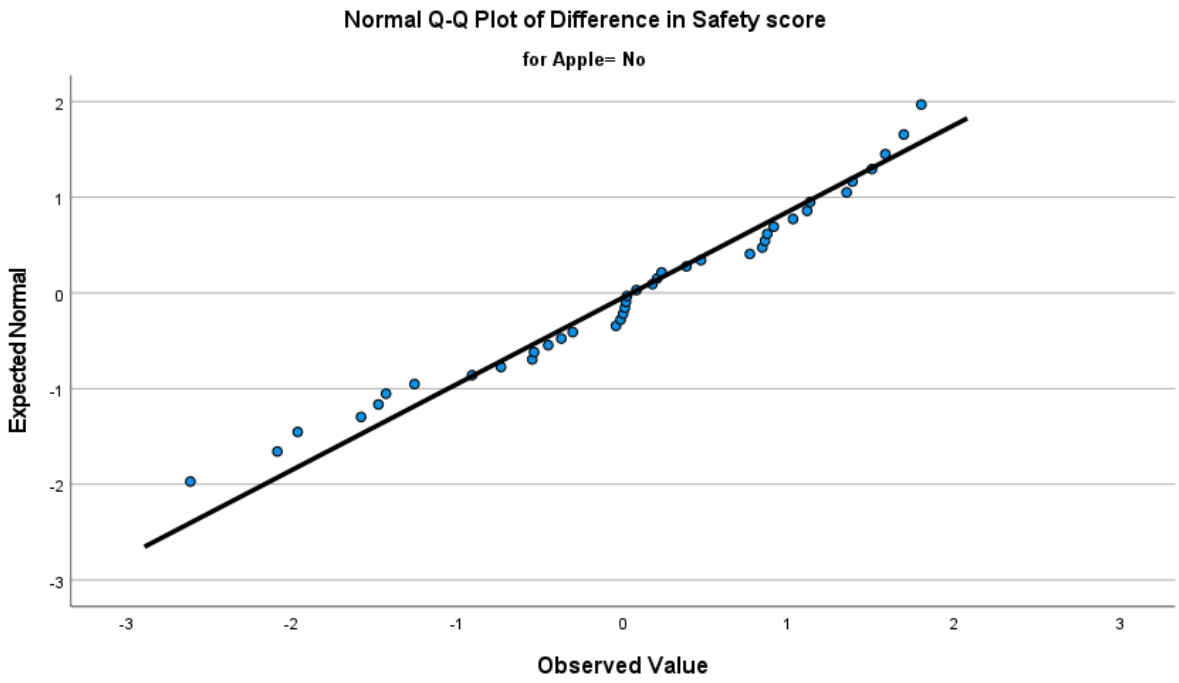
C1. Normality Q-Q plot of difference in Livelihood score (with no complementary component) (Ford – BMW)



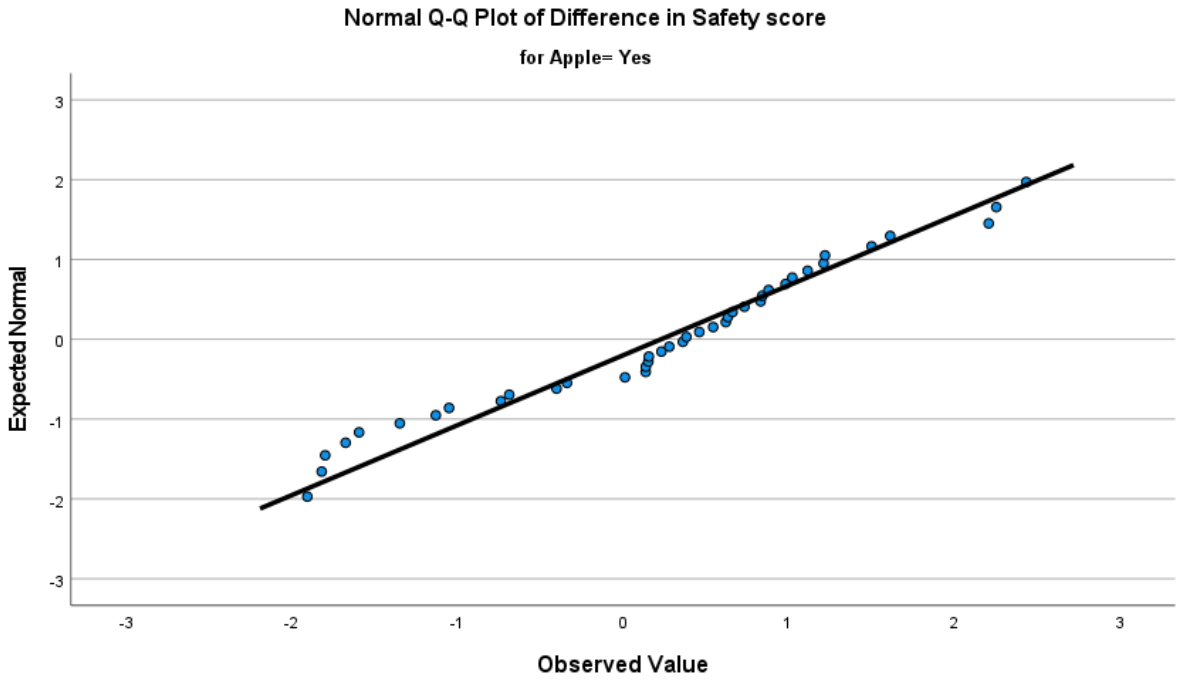
C2. Normality Q-Q plot of difference in Livelihood score (with complementary component) (Ford – BMW)



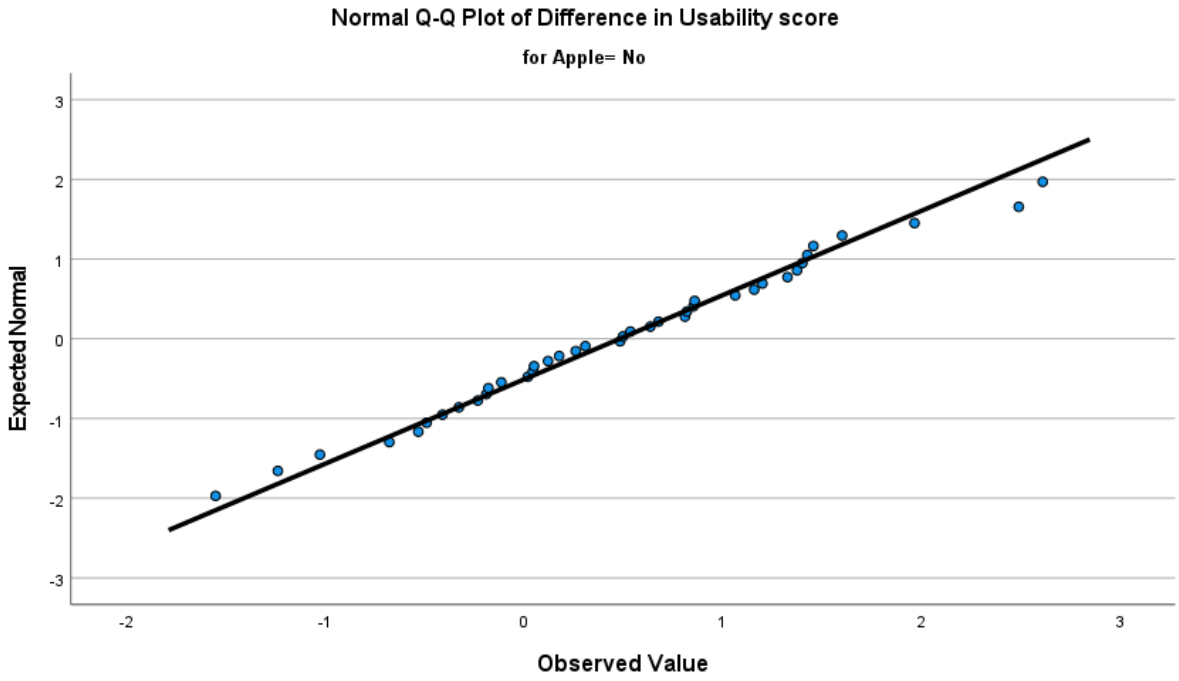
C3. Normality Q-Q plot of difference in Safety score (with no complementary component) (Ford – BMW)



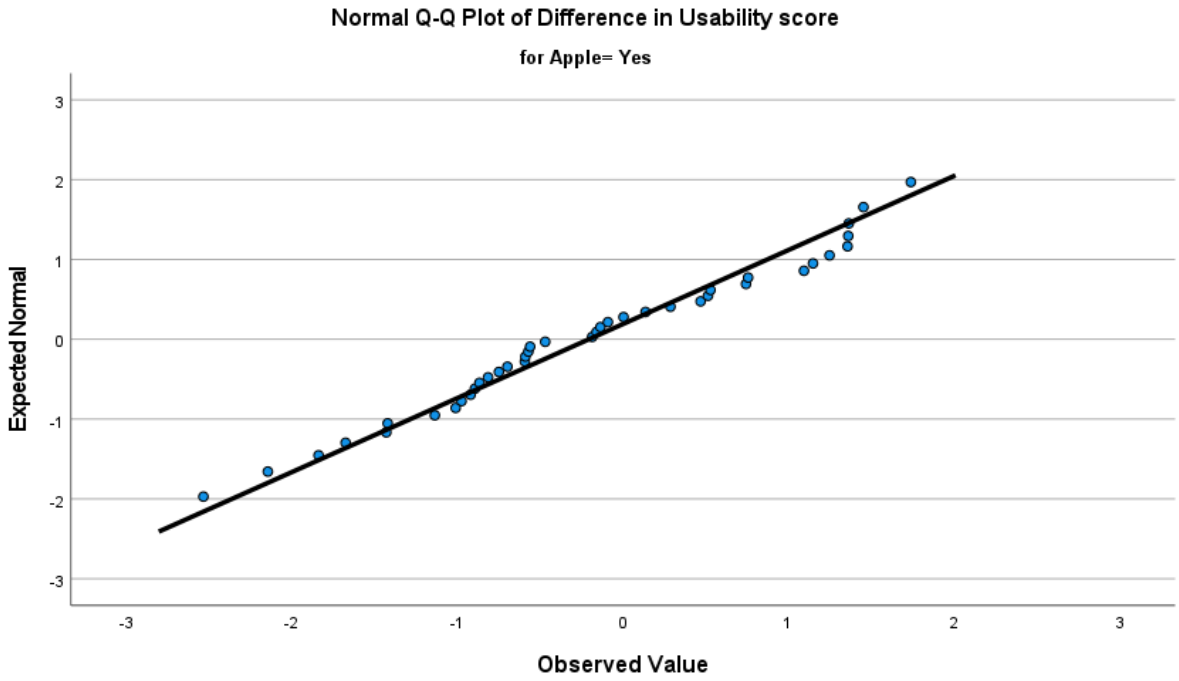
C4. Normality Q-Q plot of difference in Safety score (with complementary component) (Ford – BMW)



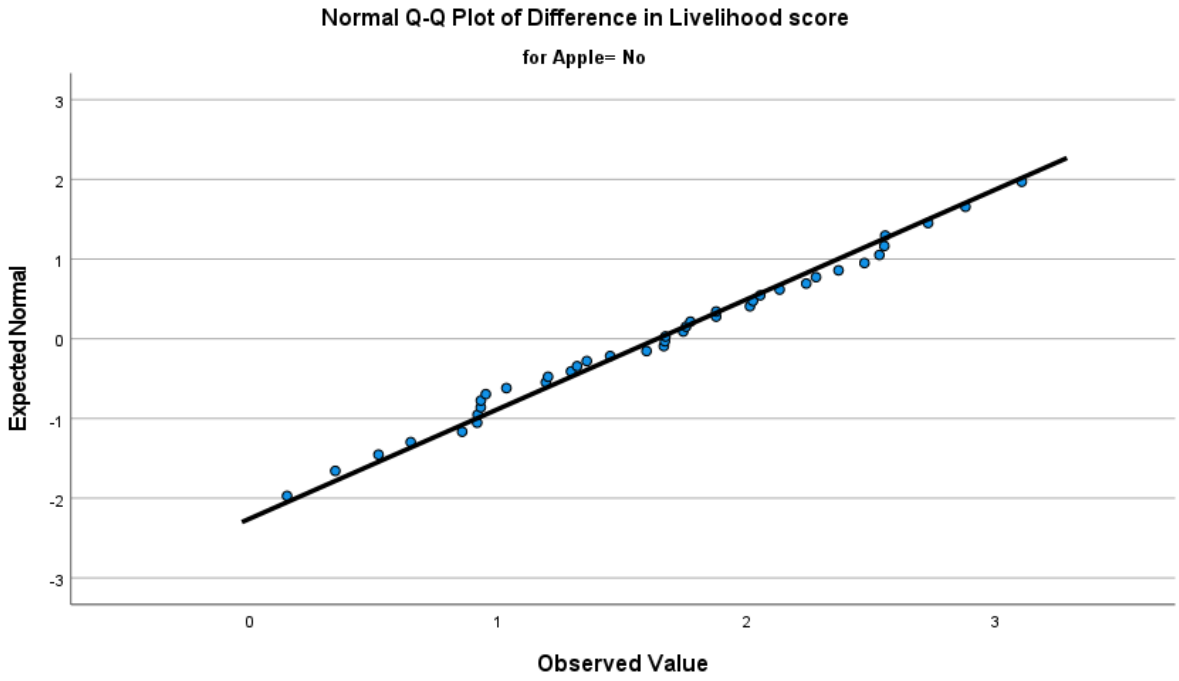
C5. Normality Q-Q plot of difference in Usability score (with no complementary component) (Ford – BMW)



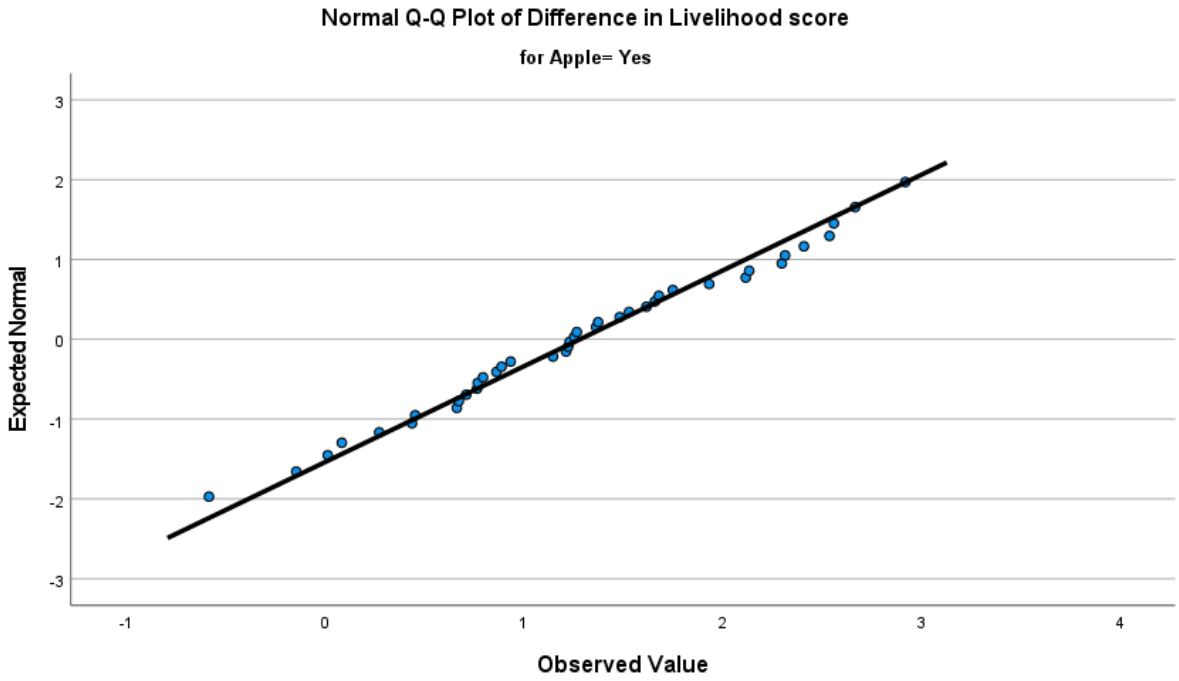
C6. Normality Q-Q plot of difference in Usability score (with complementary component) (Ford – BMW)



C7. Normality Q-Q plot of difference in Livelihood score (with no complementary component) (Honda – Mercedes-Benz)

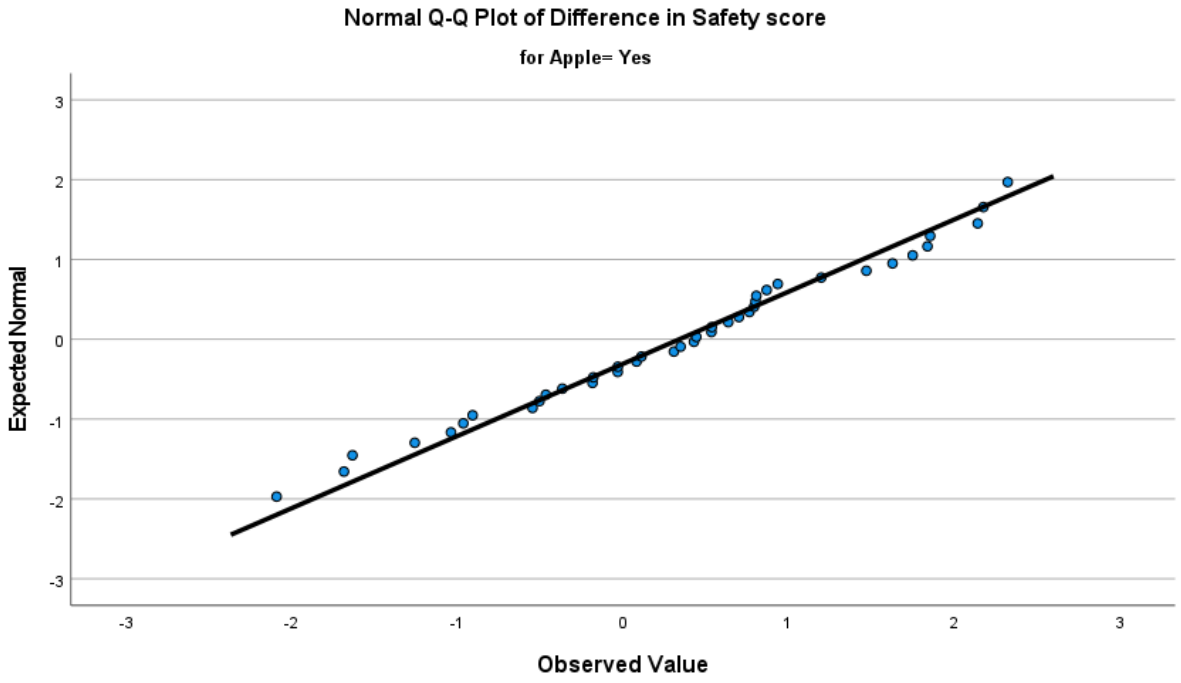


C8. Normality Q-Q plot of difference in Livelihood score (with complementary component) (Honda – Mercedes-Benz)

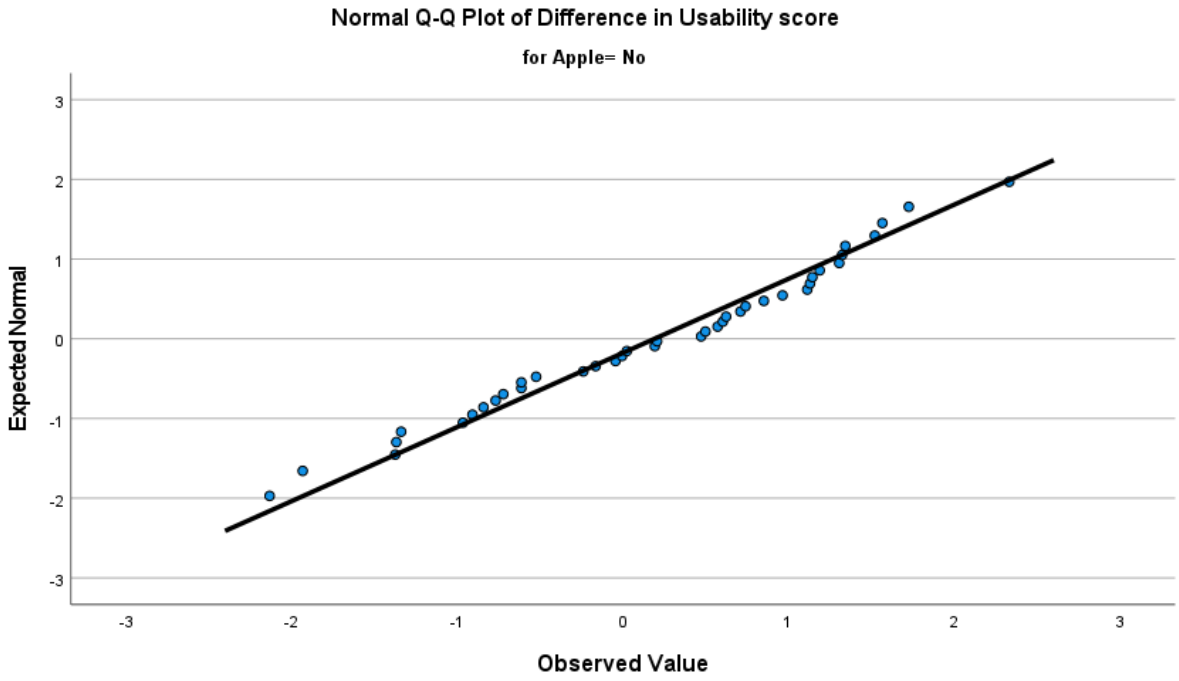


C9. Normality Q-Q plot of difference in Safety score (with no complementary component) (Honda – Mercedes-Benz)

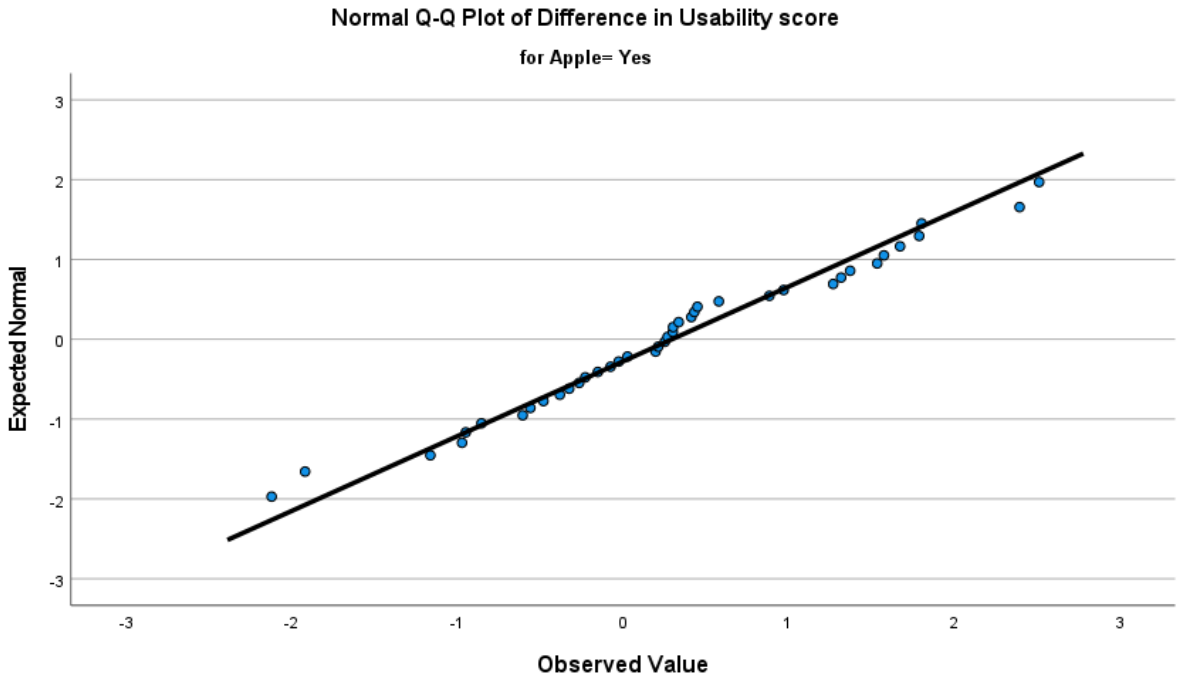
C10. Normality Q-Q plot of difference in Safety score (with complementary component) (Honda – Mercedes-Benz)



C11. Normality Q-Q plot of difference in Usability score (with no complementary component) (Honda – Mercedes-Benz)



C12. Normality Q-Q plot of difference in Usability score (with complementary component) (Honda – Mercedes-Benz)



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