



**UHASSELT**

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## **Faculteit Geneeskunde en Levenswetenschappen**

master in de revalidatiewetenschappen en de  
kinesitherapie

### ***Masterthesis***

***Explorative research for gender related differences on risk behaviour, impulsivity and cognitive flexibility in young adults***

**Lise Caenen  
Stefanie Ver Eecken**

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij inwendige aandoeningen

### **PROMOTOR :**

Prof. dr. Raf MEESEN



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[www.uhasselt.be](http://www.uhasselt.be)  
Universiteit Hasselt  
Campus Hasselt:  
Martelarenlaan 42 | 3500 Hasselt  
Campus Diepenbeek:  
Agoralaan Gebouw D | 3590 Diepenbeek

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Arnold Sauwenlaan 32, 3650 Dilsen-Stokkem, 31/05/2018

L.C.

Broosveldstraat 21, 3570 Alken, 31/05/2018

S.V.



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## **1. Research context**

Risk behaviour is a common understanding in our society. There are several concepts which may include risk behaviour: gambling, traffic situations, sports, sensation seeking, social behaviour and substance abuse. In this research we are interested in whether or not we can distinguish gender related differences in risk behaviour. In our society men are expected to be more risky than women, but up to now there is a lack of evidence in this context. This study focusses on observing risk behaviour of school going men and women within the age of 18-25 years, because this has not yet been researched. When it turns out that there is a difference between men and women in this age category, this can lead to further research.

Our research protocol was designed in consultation with our promotor, Prof. dr. Raf Meesen. Despite a number of adjustments we managed to formulate a clear protocol. We have applied for the ethical committee with the following self-written documents: informed consent, general data of subjects questionnaires, protocol, methodology, assurance, recruitment,... Ethical committee gave its approval under the Belgian number: B9115201836555. See appendix 1.

Recruitment of the subjects was done by 3 different groups: two groups of students in their second bachelor and us. The two groups of students recruited subjects for their mini research and we were given permission to use their obtained data. Our own subjects were recruited by announcements on social media (Facebook) and posters hanged on the campus of the University of Hasselt.

Data from our subjects was obtained by two different researchers, Lise Caenen and Stefanie Ver Eecken. We tested the subjects in a random and independently manner. Afterwards the data was processed independently with the use of JMP pro 13.





# Explorative research for gender related differences on risk behaviour, impulsivity and cognitive flexibility in young adults.

## 2. Abstract

**BACKGROUND** Risk behaviour and impulsivity are well-known subjects in our society. Effects can be: gambling, drug abuse, alcohol abuse, sensation seeking, smoking, fighting, ... Men are more likely to cause car accidents according to Vias, Belgian Institute for Road Safety.

**OBJECTIVES** To find gender related differences and the correlation between impulsivity, risk taking and cognitive flexibility by using the Barratt Impulsiveness Scale (BIS-11), Balloon Analogue Risk Task (BART) and Wisconsin Card Sorting Test (WCST).

**PARTICIPANTS** Group 1: sixty-six healthy adults (thirty three men and thirty three women). Group 2: 106 participants (fifty-nine men and forty-seven women). Group 3: 141 participants (sixty-seven men and seventy-four women). All participants meet following inclusion criteria: age between 18 and 25 years, normal or corrected to normal vision. Four exclusion criteria were used: (1) psychological or cognitive impairment, (2) use of medication that influence the brain function, (3) previous experiences with the BART or the WCST, (4) depending on drug and/or alcohol.

**MEASUREMENTS** All participants filled in the BIS-11 and completed the Balloon Analogue Risk Task and/or the Wisconsin Card Sorting Test.

**RESULTS** A significant difference between men and women was found with the BART, only for the outcome measure: average pumps for balloons that did not explode (Group 1 and 3). The BIS-11 and the WCST showed no significant difference between the two genders (Group 1, 2 and 3). Group 1 found a significant correlation between the BIS-11 and the BART and a significant correlation between the BART and the WCST. No significant difference between the BIS-11 and the WCST was found (Group 1 and 2).

**CONCLUSION** A significant difference between men and women based on risk taking (BART) was found. A significant correlation between the BIS-11 and the BART was demonstrated with our data, as well as between the BART and the WCST. Different strategies were used between participants with a higher and lower risk behaviour.

### 3. Introduction

Traffic accidents occur regularly in daily life. According to the Vias Institute, Belgian Institute for Road Safety, it turns out that more accidents in Belgium are caused by male road users in comparison with female road users. They also found that young versus elderly persons and men versus women behave different in traffic. Another difference can be found in the amount of time spent on the road and some people generate more dangerous behaviour than others. Exposure and risk of road crash are the two factors who declare the inequality we see in different age groups and genders in traffic accident statistics. Figure 1 and 3 show that men are the most common casualties. Young persons (15-30 years) have more risk to get injured or killed by a traffic accident than older age groups (Figure 2 and 3), this declares the high amount of victims in this age group. But data suggests that the difference in risk taking among young persons and other age groups had dropped the last ten years.

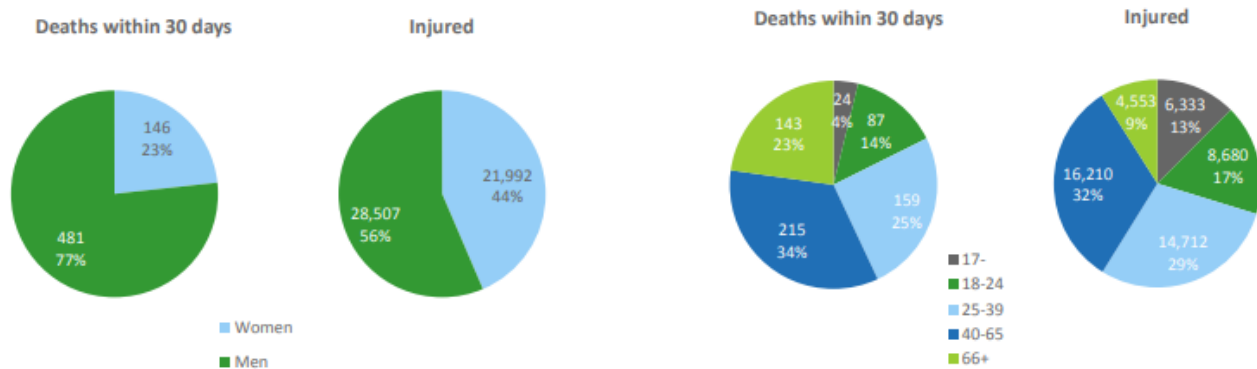


Figure 1: Distribution of deaths and injured road users by gender

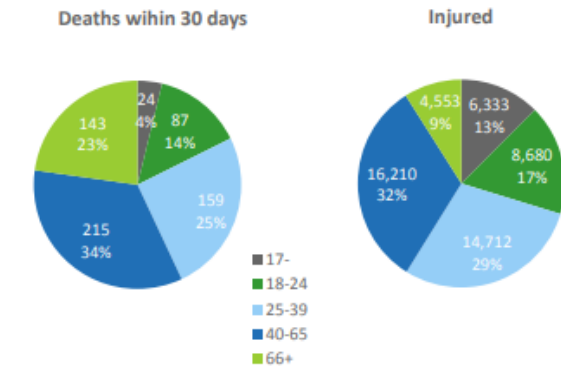


Figure 2: Distribution of deaths and injured road users by age

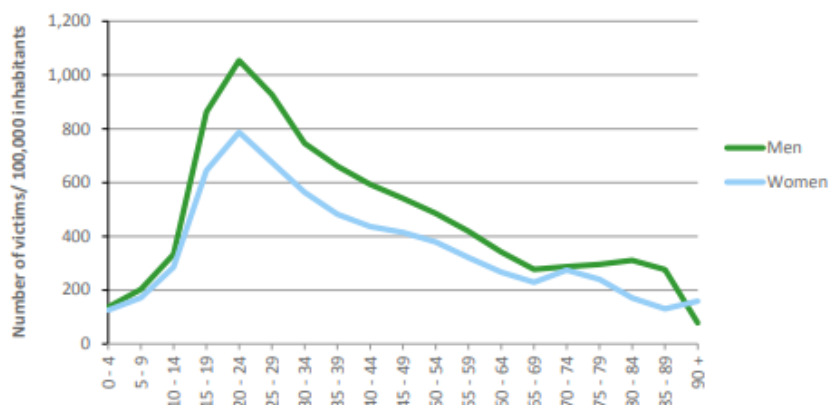


Figure 3: Number of casualties per 100,000 inhabitants by age and gender

Jones (2017) found that young adult drivers (17-19 years) are over-represented in accidents compared with older drivers (30-59 years). Furthermore Zhang and Chan (2016) found that there was a stronger relationship between driving anger and risky driving by young drivers compared with elderly drivers. Other studies also show that there is no gender related difference in driving skills, but that female drivers are less self-confident than male drivers (Wayne & Miller, 2018). A study of Ul Baset et al. (2017) shows that there were significant more deaths in traffic accidents in male than in female drivers. They found mortality rates of 9.2 deaths per 100,000 males in comparison with 4.7 deaths per 100,000 females, this data suggests that there may be gender related differences in driving behaviour. Risk behaviour, impulsivity and cognitive flexibility may be possible causes of differences in driving behaviour.

The Encyclopaedia of Behavioural Medicine defines risky behaviour as “any consciously, or non-consciously controlled behaviour with a perceived uncertainty about its outcome, and/or about its possible benefits, or costs for the physical, economic or psycho-social well-being of oneself or others” (Killianova, 2013). Impulsivity can be defined as “a dysfunctional tendency to act in response to immediate stimuli without consideration for future consequences”(Kopetz, Woerner, & Briskin, 2018). Cognitive flexibility is “the ability to adjust behaviour according to a changing environment. It enables a person to work efficiently to disengage from a previous task, reconfigure a new response set and implement this new response set to the task at hand”(Dajani & Uddin, 2015). Effects of risk behaviour and impulsivity can be: gambling, drug abuse, alcohol abuse, sensation seeking, smoking, fighting (Kann et al., 2018; Romer et al., 2009)

In addition Romer et al. (2009) found a correlation between impulsivity, risk behaviour, externalizing and internalizing problems. This can be important for understanding risk taking. Both impulsivity and risk behaviour are under control of the prefrontal cortex and the subcortical motivational systems of the brain.

As described above young drivers are likely to cause more traffic accidents. Based on these results we have investigated risk behaviour, impulsivity and cognitive flexibility in young adults with an age between 18 and 25 years. Impulsiveness and risk behaviour are more associated with young males than with young females by public opinion. To our knowledge, there is no scientific evidence up to now that examines this three factors. For this reason we want to investigate gender related differences in risk behaviour, impulsivity and cognitive flexibility.

Following research questions are addressed in this study:

1. Is there a gender related difference in impulsivity, risk taking or cognitive flexibility?
2. Is there a correlation between impulsivity, risk behaviour and/or cognitive flexibility?
3. Is there a gender related difference in strategy in addressing risk behaviour?

This study assumes the following null hypothesis:

1. There are no gender related differences in impulsivity, risk taking or cognitive flexibility?
2. There is no correlation between impulsivity, risk behaviour and/or cognitive flexibility?
3. There is no gender related difference in strategy in addressing risk behaviour?

## 4. Method

### 4.1. Participants

Participants of group 1 were sixty-six healthy adults (thirty three men and thirty three women, mean age 21.24 ) between the age of 18 and 25 who were recruited through advertisements in the University of Hasselt and social media. Two inclusion criteria were used: (1) age between 18 and 25 years old, (2) normal or corrected to normal vision. Four exclusion criteria were used: (1) psychological or cognitive impairment, (2) use of medication that influence the brain function, (3) previous experiences with the BART or the WCST, (4) dependence of drugs and/or alcohol. We consider someone dependent when they consume more than one time a day. Participants were pseudorandomised in two groups. One group did first the BART and afterwards the WCST. The second group did first the WCST and afterwards the BART.

Two classes participated in a mini-research. Class one (group 2) had 106 participants (fifty-nine men and forty-seven women) who performed the BIS-11 and the WCST. Class two (group 3) had 141 participants (sixty-seven men and seventy-four women) who performed the BIS-11 and the BART. These two classes had the same in- and exclusion criteria's as group 1 and were recruited on the same way.

All participants give informed consent before starting the tests. Summary of the different groups is showed in figure 4.

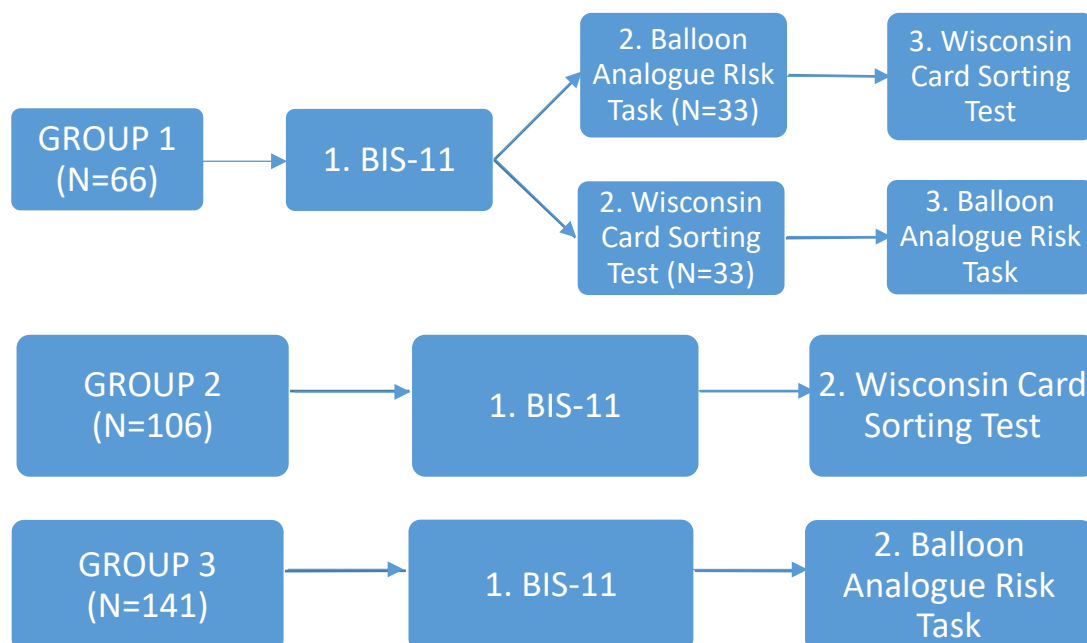


Figure 4: Summary different test groups

#### 4.2. Explanation of the different tests used in this study

The research questions addressed in this study contain 3 main concepts: impulsivity, risk behaviour and cognitive flexibility. Each of these concepts can be explained and tested by a specific test, namely:

1. Impulsivity → Barratt Impulsiveness Scale (BIS-11)
2. Risk behaviour → Balloon Analogue Risk Task (BART)
3. Cognitive flexibility → Wisconsin Card Sorting Test (WCST)

##### **4.2.1 Wisconsin Card Sorting Test (WCST)**

The Wisconsin Card Sorting Test is a measurement instrument for the assessment of cognitive flexibility (Romine et al., 2004). The participants receive a mixed stack of cards, sixty-four in total. Every card contains three characteristics: colour, number and form.

- Colour: red, yellow, green or blue
- Number: one, two, three or four
- Form: cross, triangle, circle or star

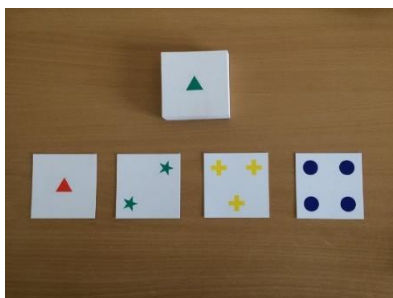


Figure 5: Starting position

In front of the participant are four different standard cards and a mixed stack of cards (Figure 5). The participant has to sort the cards one by one but does not know the sorting rule. The researcher is informed in advance about this sorting rule. The participant can sort by colour (Figure 6), by form (Figure 7) or by number (Figure 8). The researcher only tells the participant if the card is placed correct or wrong. When the participant sorts ten cards without making a mistake, the sorting rule changes to form. When he now sorts ten cards by form without making a mistake the sorting rule changes to number.

This continues until the sixty-four cards are all sorted. The following outcome measures are used: (1) total correct, (2) total errors, (3) perseverative responses, (4) perseverative errors, (5) non-perseverative errors, (6) categories completed and (7) failure to maintain set.

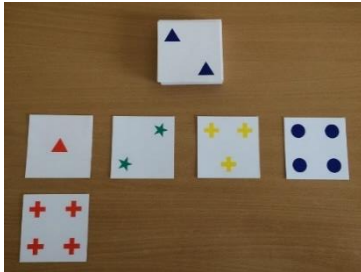


Figure 6: Sorting by colour

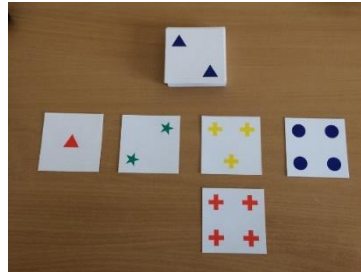


Figure 7: Sorting by form

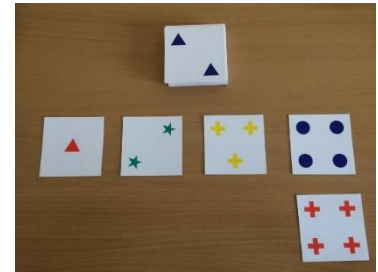


Figure 8: Sorting by number

#### 4.2.2 Barratt Impulsiveness Scale (BIS-11)

The Barratt Impulsiveness Scale is a self-report measurement instrument consisting of 30 items. The BIS-11 is over the last 50 years the most commonly used self-report instrument for the assessment of impulsiveness (Stanford et al., 2009). The scoring of the questionnaire is ranging from 1 (= never) to 4 (= very frequently) and consists three main dimensions of impulsive behaviour, (1) motor impulsiveness (= actions without thinking), (2) attentional impulsiveness (= thinking about the future and coping stability) and (3) non-planning impulsiveness (= attention to details) (Malloy-Diniz et al., 2015). Template of BIS-11 is showed in appendix 2.



### 4.2.3 Balloon Analogue Risk Task (BART)

The BART (Lejuez et al., 2002) is a computer-based measure for risk taking. In previous studies with young adults (18-25 years) they found that risk behaviour measured with the BART is related to real-world risk behaviour such as smoking, stealing, not wearing a seatbelt (Lejuez, Aklin, Zvolensky, & Pedulla, 2003).

The participant looks at a computer screen with a small simulated balloon (Figure 9). In total there are 30 balloons that needed to be inflated. The participant must inflate the balloon one by one, by choosing a number between 0 and 127. Every balloon has an individual explosion point. For each pump the participant receives \$0.05 in a temporary reserve (potential earnings). When the balloon did not reach his individual explosion point the money transfers to a permanent bank (total winnings).

But when the balloon reaches his individual explosion point, the participant loses the money in the temporary reserve and the next uninflated balloon appears on the computer screen. The following outcome measures are used: (1) number of exploded balloons, (2) total earned money, (3) average of pumps for the balloons that did not explode.

Enter how many times you want to pump up this balloon

Remember: anything higher than 127 and the balloon SURELY pops

Continue



Number of wanted pumps: 0

Potential earnings: \$0.00

Balloon number: 1 of 30

Number of current pumps: 0

Total Winnings: \$0.00

Figure 9: Screenshot of the Balloon Analogue Risk Task

### 4.3 Procedure

Group 1: Before taking the BART and/or the WCST, all participants filled in the BIS-11 and a form with general questions. The form with general questions had also a list incorporated with in- and exclusion criteria. Some of the in- or exclusion criteria on the list could interfere in the privacy of the subjects. For this reason personal and not personal questions which could lead to an exclusion of the experiment were combined in a list. When the subject meet one of these listed criteria, they said 'yes, I meet with one or more of the following criteria' and they were excluded. In this way they did not have to tell which one they meet, so we could assure the privacy of the subjects by grouping this criteria. We included the following criteria: (1) age lower than 18 years or older than 25 years, (2) psychological or cognitive impairment, (3) the use of medication that influences the brain function, (4) previous experience with the BART or the WCST, (5) dependence of drugs and/or alcohol. We considered someone dependent when he/she consumes more than one time a day.

Half of the participants started with the Balloon Analogue Risk Task while the other half started with de Wisconsin Card Sorting Test. The order of the tests was pseudorandomised to avoid bias.

To make sure all information and data of the participants remained private, we saved the data files with only the initials of the participants. We have also secured the documents, in this way that when someone wants to open a file, he has to enter a password.

This study uses the following primary outcome measures:

- BART: (1) number of exploded balloons, (2) total earned money, (3) average of pumps for the balloons who did not explode.
- WCST: (1) total correct, (2) total errors, (3) perseverative responses, (4) perseverative errors, (5) non-perseverative errors, (6) categories completed and (7) failure to maintain set.
- BIS-11: (1) total score

Group 2: All participants filled in the BIS-11 before starting the WCST. This group had the same in- and exclusion criteria as group 1. The only difference with group 1 is the used form of the WCST. Group 2 used 128 cards while group 1 used 64 cards. Because of this we can set up a new research question: Is there a difference between WCST 128 and WCST 64? Primary outcome measures in this research group are:

- WCST: (1) total correct, (2) total errors
- BIS-11: (1) total score

Group 3: first all participants filled in the BIS-11 before starting the BART. This group had the same in-and exclusion criteria as group 1. Primary outcome measures in this research group are:

- BART: (1) average of pumps for the balloons who did not explode
- BIS-11: (1) total score

#### 4.4 Data analysis

The statistical analysis was performed with JMP Pro. Data in each group has an independent and normal distribution  $N > 30$ . For the within variances the Brown-Forsythe test is used with a significance level  $p < 0.05$ . Only the outcome measure: average of pumps for the balloons that did not explode did not meet the Brown-Forsythe test. To evaluate the differences between men and women for each test, a t-test with significance level  $p < 0.05$  was performed. For the average of pumps for the balloons that did not explode, the Welch test was used with a significance level  $p < 0.05$ . See flowchart statistical analysis in appendix 3.

## **5. Results**

### 5.1 Group 1

The values of the subscales of the BIS-11 showed no significant difference between men and women on impulsivity ( $p = 0.9317$ ). By the scores of the BART there was only a significant difference between men and women by the score average of pumps for the balloons who did not explode  $p = 0.0325$ . The scores of total earned money ( $p = 0.8570$ ) and number of exploded balloons ( $p = 0.1317$ ) had no significant difference. No significant difference was found between men and women by the WCST (failure to maintain set ( $p = 0.8528$ ), categories completed ( $p = 0.9250$ ), non-perseverative errors ( $p = 0.4814$ ), perseverative errors ( $p = 0.7119$ ), total errors ( $p = 0.8160$ ), total correct ( $p = 0.8160$ )).

The correlations between the tests without taking gender into account showed a significant correlation between: (1) total earned money x number of exploded balloons  $p < 0.001$ , (2) average of pumps for the balloons who did not explode x number of exploded balloons  $p < 0.001$ , (3) score BIS-11 x number of exploded balloons  $p = 0.0084$ , (4) perseverative responses x number of exploded balloons  $p = 0.0214$ , (5) average of pumps for the balloons who did not explode x total earned money  $p = 0.0021$ , (6) score BIS-11 x total earned money  $p = 0.0282$ , (7) total errors x total correct  $p < 0.001$ , (8) perseverative responses x total correct  $p = 0.0008$ ,

(9) perseverative errors x total correct  $p < 0.0001$ , (10) non-perseverative errors x total correct  $p < 0.0001$ , (11) categories completed x total correct  $p < 0.0001$ , (12) perseverative responses x total errors  $p = 0.0008$ , (13) perseverative errors x total errors  $p < 0.0001$ , (14) non-perseverative errors x total errors  $p < 0.0001$ , (15) categories completed x total errors  $p < 0.0001$ , (16) perseverative responses x perseverative errors  $p < 0.0001$ , (17) categories completed x perseverative responses  $p = 0.0011$ , (18) categories completed x non-perseverative errors  $p < 0.0001$ , (19) categories completed x failure to maintain set  $p = 0.0035$ .

The correlations between the tests for men showed a significant correlation between: (1) score BIS-11 x total earned money  $p = 0.0195$ , (2) total correct x total errors  $p < 0.0001$ , (3) total correct x perseverative responses  $p = 0.0009$ , (4) total correct x perseverative errors  $p < 0.0001$ , (5) total correct x non-perseverative errors  $p < 0.0001$  (6) total correct x categories completed  $p < 0.0001$ , (7) total errors x perseverative responses  $p = 0.0009$ , (8) total errors x perseverative errors  $p < 0.0001$ , (9) total errors x non-perseverative errors  $p < 0.0001$ , (10) total errors x categories completed  $p < 0.0001$ , (11) perseverative responses x perseverative errors  $p < 0.0001$ , (12) perseverative responses x categories completes  $p = 0.0026$ , (13) perseverative errors x non-perseverative errors  $p = 0.0109$ , (14) perseverative errors x categories completed  $p < 0.0001$ , (15) non perseverative errors x categories completed  $p < 0.0001$ , (16) non-perseverative errors x failure to maintain set  $p = 0.0403$ , (17) categories completed x failure to maintain set  $p = 0.0020$ , (18) number of exploded balloons x total earned money  $p = 0.0129$ , (19) number of exploded balloons x average of pumps for the balloons who did not explode  $p < 0.0001$ .

The correlations between the tests for women showed a significant correlation between: (1) score BIS-11 x number of exploded balloons  $p = 0.0387$ , (2) total correct x total errors  $p < 0.0001$ , (3) total correct x perseverative errors  $p < 0.0001$ , (4) total correct x non-perseverative errors  $p < 0.0001$ , (5) total correct x categories completed  $p < 0.0001$ , (6) total errors x perseverative errors  $p < 0.0001$ , (7) total errors x non-perseverative errors  $p < 0.0001$ , (8) total errors x categories completed  $p < 0.0001$ , (9) perseverative responses x perseverative errors  $p = 0.0005$ , (10) perseverative errors x categories completed  $p < 0.0001$ , (11) non-perseverative errors x categories completed  $p < 0.0001$ , (12) number of exploded balloons x total earned money  $p < 0.0001$ , (13) total earned money x average of pumps for the balloons who did not explode  $p = 0.0076$ .

Table 1 and 2 show the different strategies the participants used on the BART by using the outcome measurement: average pumps for the balloons that did not explode. This outcome measurement was used because it had a significant difference between men and women. Table 1 shows the upper 25% performances on the BART and table 2 shows the lower 25% performances on the BART. The tables show what the participants did after an explosion, they had 3 options: raise (+), lower (-) or stay the same (/). The tables also show how many pumps the participants raised or lowered. When looking at the strategies of men within these two groups (Figure 10 in Appendix 5), our data demonstrated that an average of 28.8% raised their number of pumps after an explosion while an average of 38.3% lowered and an average of 33.5% stayed the same. Comparing this to the strategies of women within these two groups (Figure 11 in Appendix 5), our data demonstrated an average of 27.4% raising the number of pumps after an explosion while 55.9% lowered and 17.2% stayed the same. All calculations have been rounded up.

For an overview of all calculations see: Appendix 4.

Table 1: lower 25% performances on the BART  
 (based on average pumps for balloons that did not explode)

48.87	48.67	48.41	47.77	47.65	46.67	44.77	44.63	44.06	43.00	42.78	42.06	41.67	40.88	40.00	39.75
♀	♀	♀	♂	♀	♀	♀	♂	♂	♂	♀	♂	♀	♀	♂	♀
-40	-29	/	+24	-33	-20	+40	-4	-25	/	-5	+8	-34	-30	-80	+5
/	+5	-1	-35	-20	-21	-90	-14	-37	/	+15	-22	+70	+56	-20	-25
-20	-10	+26	-65	+5	-29	+23	/	-36	/	/	-33	-56	-60	-20	-10
+40	+15	/	+38	+30	-50	-101	+30	+74	/	-15	-34	+15	-18	+40	-20
-40	-35	+5	-20	+9	/	+31	-6	-54	+20	/	+22	-39	+87	+30	-10
-20	+15	/	-30	-39	-10	+9	/	-28	-80	-30	-55	+14	/	/	-10
-45	/	/	-20	-26	/	-44	-34	/	/	+45	-60	-44	-58	-60	-10
-20	+5	+56	+10	+26	-25	-85	-10	-55	+60	-35	+59	-5	+1	-40	-10
-31	-20	/	+5	-28	-5	-44	-10	-10	-70	+5	-34	-30	+57	-30	+10
-14	-35	/	-27	+27	-50	-12	-10	+15	-14	-20	+46	/	-88	+59	
-32	/	+35	-40	-29	-20	-44	/	-29	-40	/	+24	/	/	-29	
-31	+10	/	+33	-10	/	-35	-30	+20	/		-3	+19	-10	-40	
-32	-25	+25	-34	-20	-9	-51	-34		/		+30	/	/	/	
-33	-5		+57		-41	-68			/			+34	-50	/	
			-22			-68			/				+46		
			+18			+22							/		
													-34		
													+34		
													/		
													/		
													/		

Table 2: upper 25% performances on the BART  
 (based on average pumps for balloons that did not explode)

80.00	79.55	77.58	75.83	74.00	72.30	72.09	70.77	68.85	66.77	66.40	65.19	64.58	64.57	64.47	63.46
♂	♂	♂	♂	♀	♂	♂	♂	♂	♂	♀	♀	♂	♂	♂	♀
/	/	/	-1	-36	-10	/	-10	-30	-2	+10	/	+6	-4	-15	-21
/	+5	-10	-27	-10	/	-3	+40	/	-2	+50	-25	-6	/	-24	+10
/	/	+22	-50	+25	/	/	-50	-60	/	+9	+20	+40	/	+11	-9
/	/	+63	/	+36	/	/	+20	+50	-2	+7	/	+6	-27	+1	+30
/	/	-30	+11	-30	/	+14	+50	+40	-1	+15	-14	-30	-10	+10	-10
/	/	+27	-25	-10	-20	+10	-40	-20	/	-4	-6	+25	-6	-27	-15
/	/	-30	+16	+20	/	/	+20	/	/	-44	+5	-35	/	+27	/
/	/	/	+10	-36	/	/	/	-30	/	/	-35	/	/	+11	-5
/	/	+25	+5	+56	+10	/	+24	+14	-30	-24	-2	/	-4	-28	-40
/	/	-24	+10	-39	-40	-5	+26	+36	-30	-21	-25	/	/	-80	-10
/	-10	+12	-45	+40	-10	-12	/	-20	-2	-24	-10	/	/	-30	/
/	/	+2	-1	-25	/	/	+40	+15	/	-10	-40	+20	/	-40	+5
/	/	+19	/	+53	/	/	/	-50	/	-48	+20	-7	/	+42	/
-10	+10	+30	/	+10	-10	-40	+10	+10	/	-1	/	+6	/	/	/
+10	-10	+11	/	/	/	/	/	-40	+2	/	/	+16	/	/	-10
/	-5	+10	-10	-33	+10	/	+10	+20	+2	/	/	-16	/	/	/
/	/	+19	+17	/	+10	+22	/	/	/	/	/	+20	/	/	/
+20	/	/	/	-27	/	/	/	/	/	/	/	/	/	/	/
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### 5.2 Group 2

Data analysis of the BIS-11 showed no significant difference between men and women ( $p=0.9126$ ). The results of the WCST showed no significant difference between men and women: total correct  $p=0.9388$ ; total error  $p=0.9218$ . The correlation test between the BIS-11 and the WCST (total correct) showed no significant correlation ( $p=0.6725$ ).

### 5.3 Group 3

Data analysis showed no significant difference between men and women on the BIS-11 ( $p=0.9852$ ). On the BART, a significant difference ( $p<0.0001$ ) between men and women was found for the average number of pumps for balloons that did not explode. The correlation test without taking gender into account, between the BIS-11 and the BART, showed no significant correlation ( $p=0.0552$ ).

## **6. Discussion**

By comparing the upper 25% and lower 25% performances on the BART, data shows us that participants use different strategies. In the upper 25% group there is a higher adjusted average of pumps in comparison with the lower 25% group. The upper 25% group consisted in 75% males and 25% females, while the lower 25% group consisted in 63% females and 37% males. Nearly all subjects in both groups used mixed strategies after an explosion, except for 2. They only used the lowering strategy. Our data demonstrated that people from the lower 25% group, used the lowering strategy more after an explosion than the people from the upper 25% group. This can be explained by the amount of women and men in each group. Because our data demonstrated that the strategy most used by women is an average of 55.9% for lowering the number of pumps after an explosion, while men only chose for this option in 38.3% of the times after an explosion. Men mostly chose to stay at the same explosion point as their previous choice (33.5%) while women only chose this option in 17.2% of the options after an explosion. Both sexes raised more or less the same amount after an explosion (men: 28.8%; women: 27.4%). Men are more likely to choose the same amount of pumps after an explosion, therefore it could be that they are less flexible and more rigid in their choices. On the other side we can suggest women are more precautious, because they choose a lowering strategy in most of the cases.



A significant difference between men and women was found with the BART, only for the outcome measure: average pumps for balloons that did not explode. This was demonstrated by the data of group 1 and 3. But this is in contrast with the study of Lejuez et al. (2003) where they found no significant difference on this outcome measure. The BIS-11 and the WCST showed no significant difference between the two genders in group 1 and 2. Because risk taking is different in men and women, this could suggest that there is a connection between the higher amount of risk taking and a higher percentage of car accidents in men's population. (Vias)

The data of group 1 demonstrated a significant correlation between the BIS-11 and the BART, this was in contrast with the findings of group 3. Our data demonstrates a relation between impulsivity and risk taking in general. The study of Romer et al. (2009) confirms this theory. The correlation test of group 1 between the BART and the WCST showed a significant correlation, this corresponds with the findings from Campbell, Samartgis, and Crowe (2013). This demonstrates that there is a relation between risk taking and cognitive flexibility. The data of group 1 and 2 showed also no significant difference between the BIS-11 and the WCST, in contrast to the study of Leshem and Glicksohn (2012).

Our data shows us that there could be a possible influence from the one test to the other (BART and WCST). This finding can be indicated by the fact that the averages of the BART (group 1 and group 3) significantly differ per test ( $p < 0.0001$ ). By comparing the data of group 1 and 2, no significant difference ( $p = 0.9553$ ) was found between the WCST 64 and WCST 128. For future research this means that there is no difference in the usage of WCST 64 or WCST 128. Both tests give an equal overview of the cognitive flexibility of the participants.

All tests were taken by different researchers, so there might be an experimenter bias. Group 1 had two researchers while group 2 and 3 had each thirteen researchers. Because we had three different research groups in this study, not all tests were done in the same environment. This could possibly influence the focus and concentration of the participants. Strengths of this study are: relatively large sample size, pseudo randomisation of the subjects and the order of the tests, diversity of subject population, all subjects were independent measures, so there were no family connections between subjects that could interfere with the results.

## **7. Conclusion**

In conclusion to our first hypothesis, our findings demonstrate that there is a significant difference between men and women based on risk behaviour (BART), no significant differences were found on impulsivity and cognitive flexibility. For our second hypothesis, a significant correlation between the BIS-11 and the BART and between the BART and the WCST, was demonstrated with our data. Data showed different strategies between participants with a higher and lower risk behaviour. In particular: the strategy most used by women is lowering the number of pumps after an explosion, while men mostly chose to stay the same. This formulates an answer to our third hypothesis. The data of this study can contribute to further research concerning risk behaviour, impulsivity and cognitive flexibility in young adults.

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## 9. Appendix

### 9.1 Approval ethical committee

<p>www.uhasselt.be Campus Hasselt   Martelarenlaan 42   BE-3500 Hasselt Campus Diepenbeek   Agoralaan gebouw D   BE-3590 Diepenbeek T + 32(0)11 26 81 11   E-mail: info@uhasselt.be</p>	
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#### Definitief gunstig advies

**Faculteit Geneeskunde en Levenswetenschappen**  
**Comité voor Medische Ethiek**  
**Voorzitter:** prof. dr. Ivo Lambrechts  
**Secretariaat:** Marleen Missotten  
**Tel.:** 011 26 85 02  
**Fax:** 011 26 85 99  
**E-mail:** cme@uhasselt.be

ons kenmerk  
**CME2018/032**

uw kenmerk

Diepenbeek  
09/05/2018

Titel protocol                    **Exploratief onderzoek naar gender gerelateerde verschillen van risicogedrag, cognitieve flexibiliteit en impulsiviteit bij jongeren**

Nummer protocol  
Opdrachtgever                    Universiteit Hasselt  
Eudractnummer                    NVT  
Belgisch nummer                    **B9115201836555**  
Onderzoeker                        *Dr. Koen Cuypers, prof. dr. Raf Meesen*

Geachte collega,

Tijdens de vergadering van 16 januari 2018 werd het hierboven vermeld dossier besproken.

Na inzage van de bijkomende informatie en/of aangepaste documenten met betrekking tot dit dossier is het Comité voor Medische Ethiek UHasselt van oordeel dat de voorgestelde studie, zoals beschreven in het protocol, wetenschappelijk relevant en ethisch verantwoord is.

Het definitief gunstig advies betreft de volgende documenten:

- Protocol versie 2; 23/04/2018
- Informatie en toestemmingsformulier versie 1,2, 23/04/2018
- Bewijs van 'No-fault' verzekering, /05/2018
- Vragenlijsten
- Flyer, versie 1
- CV's dr. Koen Cuypers, prof. dr. Raf Meesen

Het Comité voor Medische Ethiek van UHasselt handelt volgens de geldende richtlijnen van de 'International Conference of Harmonization (ICH) Good Clinical Practice (GCP)' en volgens alle geldende en van toepassing zijnde wetten en reglementen.

Dit gunstig advies houdt niet in dat het Comité de verantwoordelijkheid voor de geplande studie op zich neemt. De onderzoeker blijft zelf verantwoordelijk hiervoor. Bovendien dient u er over te waken dat uw mening als betrokken onderzoeker wordt weergegeven in publicaties, rapporten voor de overheid enz., die het resultaat zijn van dit onderzoek.

Het comité vraagt aan de onderzoeker op de hoogte te worden gehouden wanneer de studie wordt gestart of wanneer ze wordt afgesloten of vroegtijdig onderbroken (met opgave van redenen)

Indien de studie niet binnen het jaar beëindigd is dient de onderzoeker een jaarlijks rapport met het verloop van de studie te bezorgen aan het CME UHasselt.

Bij Serious Adverse events (SAE's) dient de onderzoeker het comité hiervan op de hoogte te brengen.

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Campus Hasselt | Mantelarenlaan 42 | BE-3500 Hasselt  
Campus Diepenbeek | Agoralaan gebouw D | BE-3590 Diepenbeek  
T + 32(0)11 26 81 11 | E-mail: [info@uhasselt.be](mailto:info@uhasselt.be)



**UHASSELT**

KNOWLEDGE IN ACTION

Wijzigingen in het studieprotocol, informatie en toestemmingsformulier, onderzoeksteam) dienen te worden goedgekeurd door het Comité via een amendement.

Wanneer een studie beëindigd wordt dient de onderzoeker een studierapport op te maken met het verloop van de studie (startdatum, einddatum, aantal geïncludeerde patiënten, aantal drop-outs, aantal patiënten die de studie volledig doorlopen hebben, eventuele adverse events, ...

Met oprechte hoogachting,

Prof. dr. Ivo Lambrichts  
Voorzitter Comité voor Medische Ethiek

Cc:

FAGG - Research & Development department, Victor Hortaplein 40, bus 40, 1060 Brussel

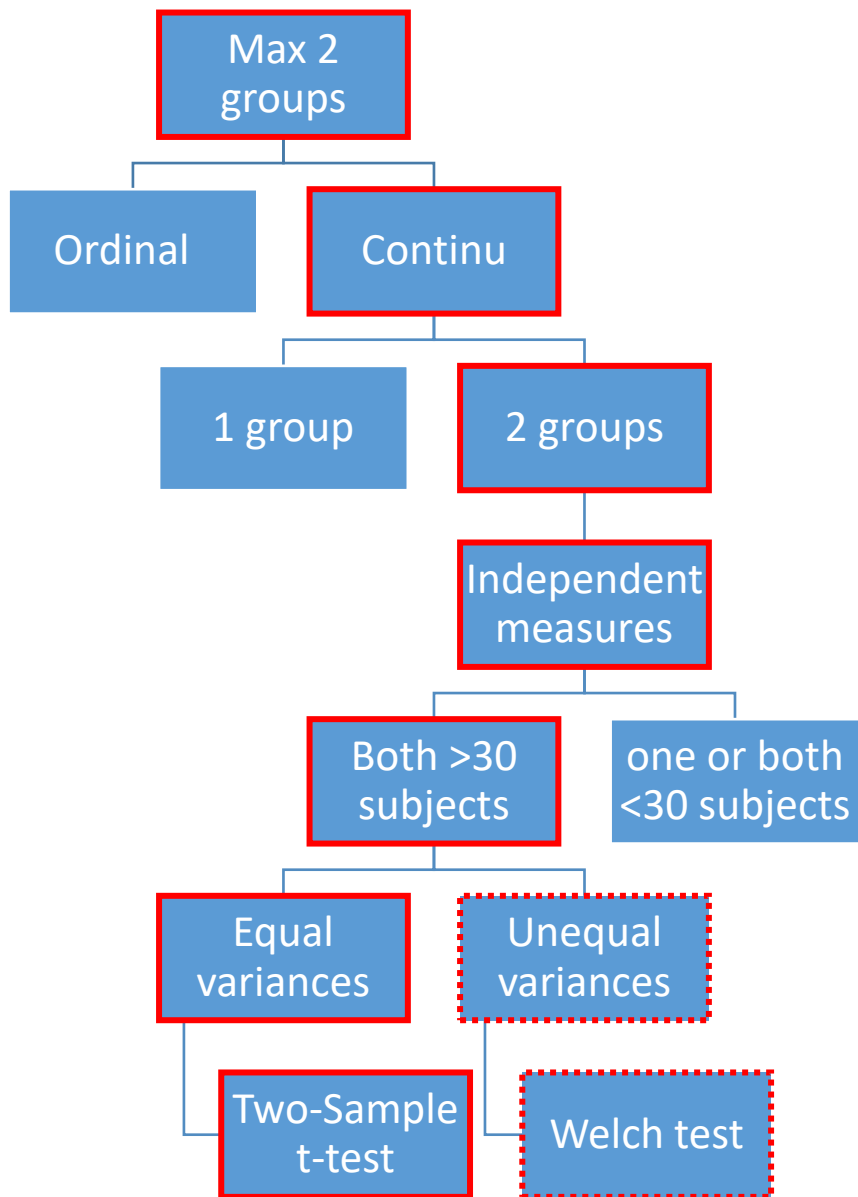
9.2 Barratt Impulsiveness Scale (BIS-11)

**Persoonlijke evaluatie: BIS-11**

Naam: \_\_\_\_\_ Datum: \_\_\_\_\_

<u>Instructie:</u> Mensen verschillen in de manier waarop ze in verschillende situaties handelen en denken. Deze test meet een paar van die manieren van handelen en denken. Lees elke zin zorgvuldig en <b>MAAK HET RONDJE VAN UW KEUZE RECHTS VAN DE ZIN ZWART</b> . Antwoord snel en naar waarheid.		Zelden/nooit	Soms	Vaak	Bijna Alrijd
1.	Ik plan taken zorgvuldig.....	0	0	0	0
2.	Ik doe dingen zonder na te denken.....	0	0	0	0
3.	Ik neem snel een beslissing.....	0	0	0	0
4.	Ik leef zorgeloos.....	0	0	0	0
5.	Ik houd mijn aandacht er niet bij.....	0	0	0	0
6.	Mijn gedachten razen door mijn hoofd.....	0	0	0	0
7.	Ik plan uitjes ruim van te voren.....	0	0	0	0
8.	Ik heb mezelf onder controle.....	0	0	0	0
9.	Ik kan mij gemakkelijk concentreren.....	0	0	0	0
10.	Ik spaar regelmatig.....	0	0	0	0
11.	Ik kan niet stil blijven zitten tijdens toneelstukken en lezingen.....	0	0	0	0
12.	Ik denk zorgvuldig na.....	0	0	0	0
13.	Ik zorg dat ik een baan behoud.....	0	0	0	0
14.	Ik zeg dingen zonder eerst na te denken.....	0	0	0	0
15.	Ik houd ervan om over ingewikkelde dingen na te denken.....	0	0	0	0
16.	Ik verander van baan.....	0	0	0	0
17.	Ik handel impulsief.....	0	0	0	0
18.	Ik verveel mij snel als ik in gedachten iets moeilijks moet oplossen.....	0	0	0	0
19.	Ik doe dingen in een opwelling.....	0	0	0	0
20.	Ik verander van gedachten.....	0	0	0	0
21.	Ik verhuis.....	0	0	0	0
22.	Ik koop dingen in een opwelling.....	0	0	0	0
23.	Ik kan maar over één ding tegelijk nadenken.....	0	0	0	0
24.	Ik verander van hobby.....	0	0	0	0
25.	Ik geef meer uit dan ik verdien.....	0	0	0	0
26.	Mijn gedachten worden onderbroken door andere gedachten.....	0	0	0	0
27.	Ik ben meer geïnteresseerd in het heden dan in de toekomst.....	0	0	0	0
28.	Ik ben rusteloos tijdens lezingen en praatjes.....	0	0	0	0
29.	Ik ben gek op lastige problemen.....	0	0	0	0
30.	Ik plan voor de toekomst.....	0	0	0	0

9.3 Flowchart statistical analysis



9.4 Overview of calculations of strategies

	RAISED (%)	LOWERED (%)	STAYED THE SAME (%)
<b>TOP 25% MEN</b>			
	11	6	83
	11	17	72
	65	24	12
	26	35	39
	16	32	53
	18	24	59
	56	19	25
	44	38	13
	13	44	44
	47	24	24
	0	33	67
	46	54	0
<b>LOWER 25% MEN</b>			
	44	56	0
	8	69	23
	25	67	8
	13	27	60
	46	54	0
	25	67	21
<b>AVERAGE MEN</b>	<b>≈ 28.8%</b>	<b>≈ 38.3%</b>	<b>≈ 33.5%</b>



	<b>RAISED (%)</b>	<b>LOWERED (%)</b>	<b>STAYED THE SAME (%)</b>
<b>TOP 25% WOMEN</b>			
	39	50	11
	36	57	7
	23	62	15
	19	50	31
<b>LOWER 25% WOMEN</b>			
	7	86	7
	36	50	14
	39	8	54
	39	62	0
	0	79	21
	31	69	0
	27	50	27
	36	43	21
	29	38	33
	22	78	0
<b>AVERAGE WOMEN</b>	<b>≈ 27.4%</b>	<b>≈ 55.9%</b>	<b>≈ 17.2%</b>

9.5 Pie chart strategies on the BART

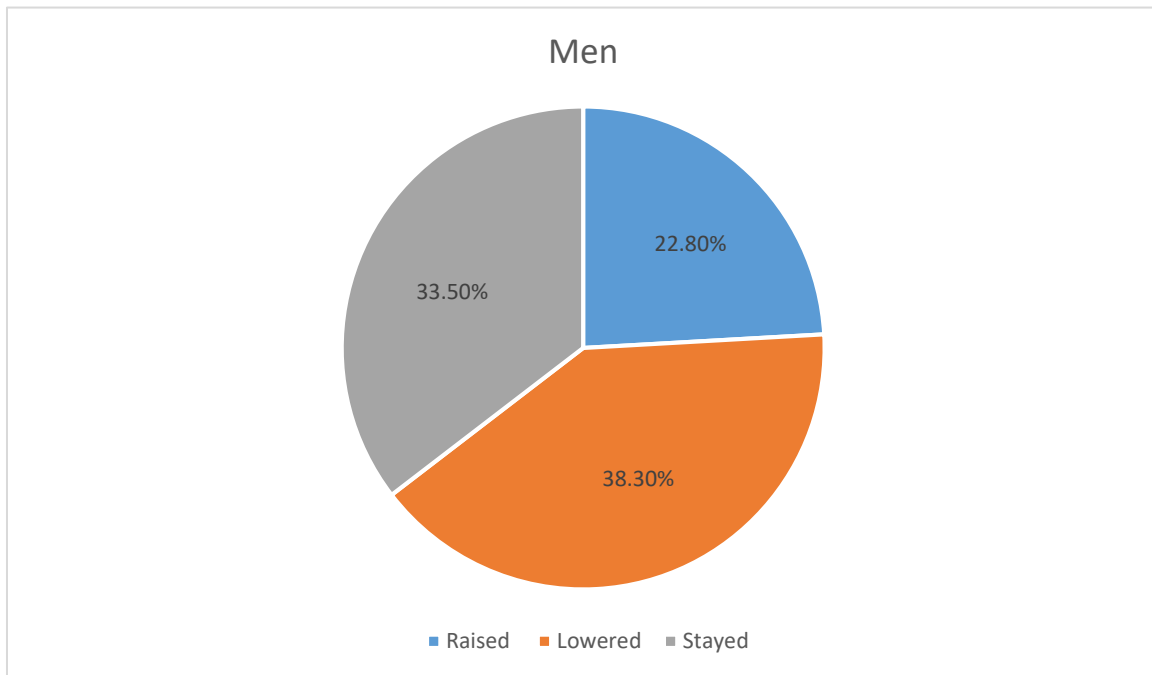


Figure 10: Averages of strategies of men on the BART

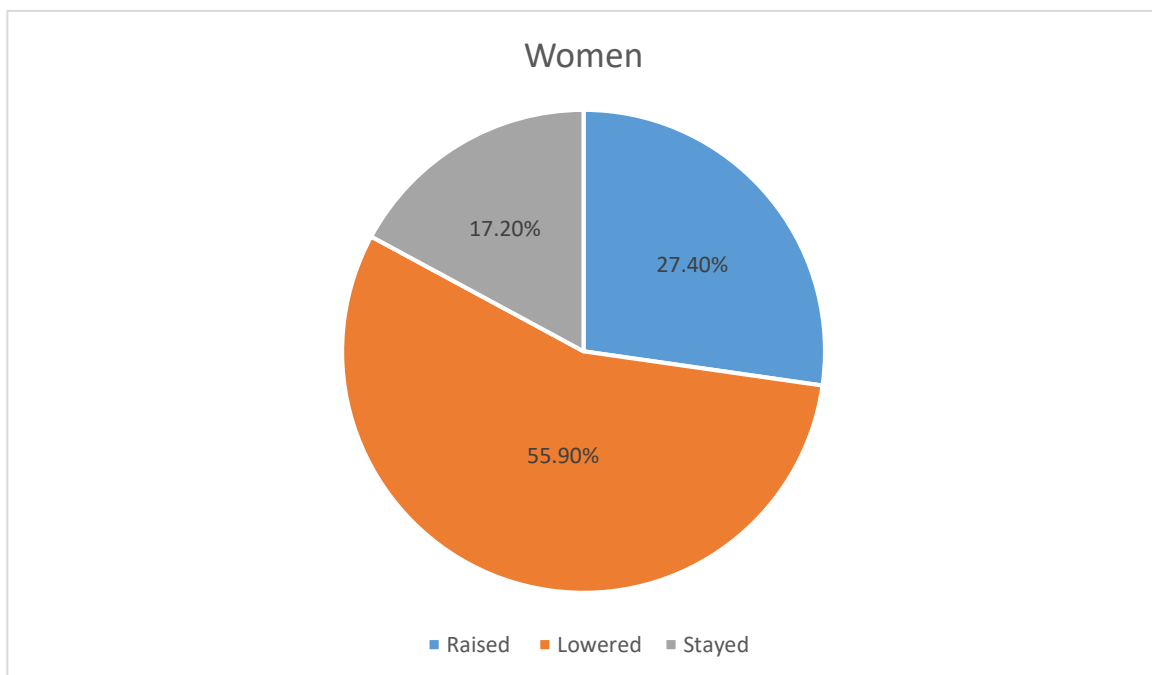


Figure 11: Averages of strategies of women on the BART

