Do Men and Women Perform Equally At Multitasking?

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ABSTRACT

Multitasking is one of the most efficient ways to getting things done. So much so that it can be considered as a career ready soft-skill. Multitasking ensures multiple benefits such as time management, money management, improved productivity and focus. Although multitasking offers several advantages, it doesn't come as naturally to some as it may come to others. The age-old "Men v. Women" war has found yet another battlefield here too. It's no secret that male and female brains are wired differently.[1] Traditional gender roles have established a common belief that women are better than men at multitasking. This project will aim to test that very hypothesis; are women better than men at multitasking? We expect to have enough evidence to show that women are better multitaskers than men. We will be using Multivariate Analysis of Variance (MANOVA) to analyze the performance of 40 men and 40 women. The findings reveal that the most significant variable in this study is the folding and dribbling quality. On comparing the means of quality for women and men, we find that women are better than men with an average quality score of 4.5 against 3.4. Hence, our myth is busted, and we find that women are better than men at multitasking.

Authors Keywords

Multitasking, men, women, brain, gender, ANOVA, MANOVA

INTRODUCTION

In today's fast paced world, multitasking poses to be the norm. You can be checking your email one second, switching to watching a movie the next and then drafting an elaborate Tweet about it a couple seconds after. In this project, we will conduct hypothesis testing to analyze multitasking from a gender perspective.

Multitasking can encompass two types – simultaneous and non-simultaneous. Simultaneous involved doing multiple tasks at the same time. An example of simultaneous multitasking is folding clothes and reading a book at the same time. Non-simultaneous multitasking involves doing tasks one after the other in rapid succession. An example is perhaps taking calls and making notes after.

MOTIVATION

There is a certain belief in today's society that women are better than men at multitasking[2]. They must work, they must manage a household, they must look after the children, etc.; it is a common belief in many countries. Therefore, this was our motivation behind choosing the topic. We wanted to dig deep into this myth and see for ourselves, if there is any difference in the multitasking abilities of women and men.

STUDY DESIGN

This study is an observational study where we shall be observing how efficiently a man and woman can complete the same tasks that are given to them.

The following are the attributes for our study:

Population: All males and females

Sample: Students from University of Maryland

HYPOTHESIS TESTING

The hypotheses testing for our study is as follows:

Null hypothesis: There is no difference in the multitasking abilities of men and women

Alternative Hypothesis: There is a difference in the multitasking abilities of men and women.

Symbolically,

H_0: $\mu_M = \mu_F$

H_A: $\mu_M \neq \mu_F$

DATA COLLECTION

It was crucial to design tasks that were not biased and at equal difficulty for both men and women. So, we decided to select two tasks such that one was male-centric, and the other was female-centric.

The tasks are structured are as follows:

Task 1:

Read a passage (260 words) while folding clothes (5 pieces; a mix of t-shirts, shirts, pants and a skirt) at the same time.

Task 2:
Dribble a ball by hand while answering 10 questions about math and general knowledge.

Traditional gender roles have led a precedent that women are better at general housework. For example, British women do 60% more housework than men[3]
We wanted to keep the tasks gender-balanced and so, came up with 2 multitasking activities for the study. Task 1 was a female centric task because women are believed to be better at folding clothes than men[4] and Task 2 was male centric because a conventional belief is that men are better at sport-activities than women. In this way, we ensured that both the genders were at equal advantage.

In order to assure that the observations are independent, the quiz in Task 2 was carried out by having 5 sets of 10 questions each belong to the same difficulty level. These quizzes were based on general trivia questions and simple mathematical calculations.

Scoring Rubric:

Task	Variables collected	Scoring criteria
Task 1	Gender	Male/Female
	Time taken	In seconds
	% of words read	% words read/ total words
	Quality of folding clothes	Rated from a scale of 5
Task 2	Gender	Male/Female
	Time taken	In seconds
	% of correctly answered questions	% correct answers/total questions
	Quality of dribbling	Rated from a scale of 5

Data Collected:

Gender	T1(time)	T1(qual)	T1(folding	T2(time)	T2(qual)	T2(dribblin
M	88	100	3	44	70	5
M	62	53	2.8	32	70	4.25
M	49	53	3.5	65	60	5
M	57	42	2.75	34	80	3.25
F	45	57	4.75	33	90	4.5
M	47	37	1.8	32	90	3.2
F	50	48	4.34	34	90	4
F	59	40	4.25	57	50	4.25
F	64	47	4.15	43	80	4.2
F	51	71	4.45	46	100	4.1
M	106	100	2.5	45	90	4.35

Fig 1. Snapshot of original data collected

The Quality scores for each task were calculated as the average results given by both the judges. Judges 1and 2 scored the quality independently and the average was calculated. An interesting factor to assess here was the intra-rater test. The intra-rater reliability test is designed to calculate the degree of agreement among raters. It is the consistency in ratings given by different judges for the same tasks. The intra-rater test we conducted gave us a score of 84.3% i.e. the judges who calculated the quality scores agreed with each other 84.3% of the time.

Each row in the 'original data' represents one particular individual who performed both the tasks. Thus, we combined the variables from both the tasks by calculating the average time taken to complete both the tasks, the average percentage of words read + correctly answered questions and the average quality scores for folding clothes + dribbling ball.

Thus, the refined data was as follows:

Gender	Avg time	Avg quality	Avg percent
M	66	4	85
M	47	3.53	61
M	57	4.25	57
M	46	3	61
F	39	4.63	73
M	39	2.5	63
F	42	4.17	69
F	58	4.25	45
F	54	4.18	63
F	49	4.28	85

Fig 2. Refined Data

Thus, in this study the independent and dependent variables are as follows:
Independent variable: Gender
Response variable: Time, Quality points, Score Percent

METHODOLOGY AND APPROACH

The MANOVA (multivariate analysis of variance) is a type of multivariate analysis used to analyze data that involves more than one dependent variable at a time. MANOVA extends the capabilities of analysis of variance (ANOVA) by assessing multiple dependent variables that are correlated, simultaneously. ANOVA statistically tests the differences between three or more group means. For example, if you have three different teaching methods and you want to evaluate the average scores for these groups, you can use ANOVA. However, ANOVA does have a drawback. It can assess only one dependent variable at a time.

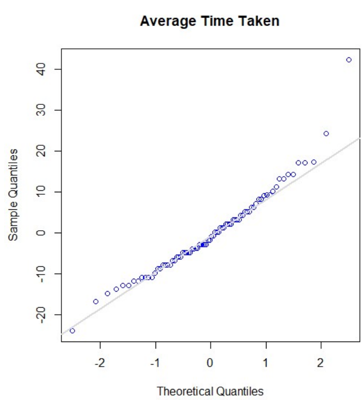
MANOVA provides a solution for situations when we want to find relationship between multiple dependent variables at the same time. By doing so, MANOVA can offer several advantages over ANOVA.

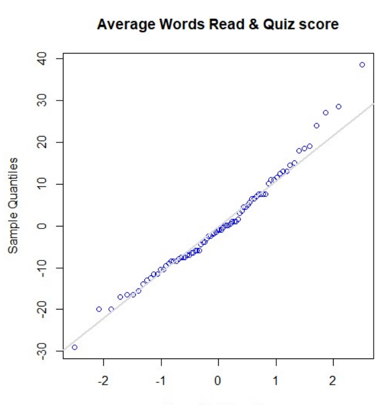
In our study, we have:
Independent variable : Gender
Dependent variables : Time, Quality points and Percent score.
Thus, we decided to use MANOVA for conducting data analysis.

MANOVA comes with three assumptions as follows:

1. **Normal Distribution**: The dependent variable should be normally distributed within groups
2. **Linearity:** All pairs of dependent variables, covariates and dependent variable - covariate should have linear relationships.
3. **Homogeneity of Variances:** The dependent variables exhibit equal levels of variance across the range of predictor variables.

To check for a normally distributed variable, we can use the qqnorm() function in R.





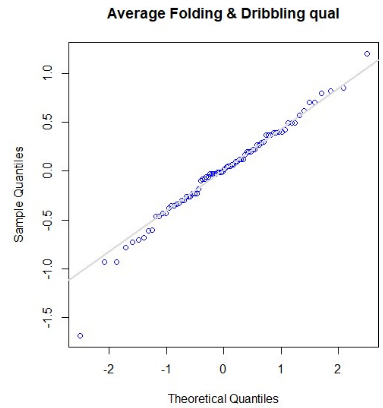
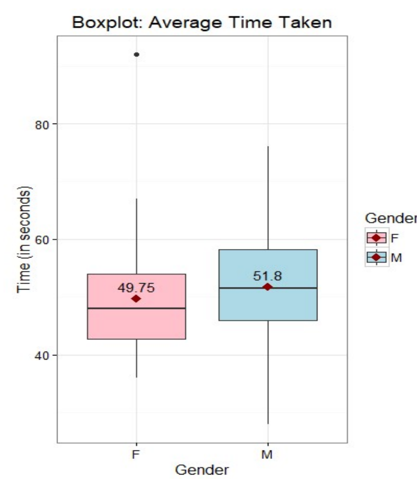
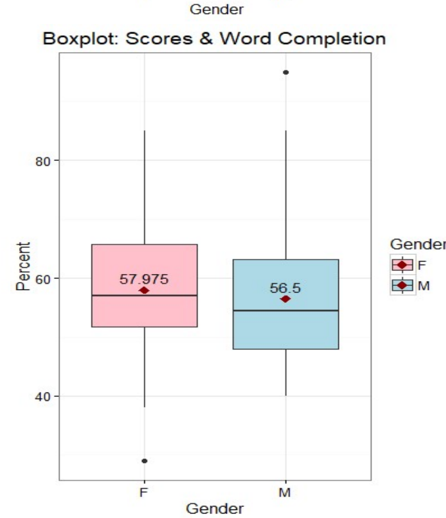


Fig 3. Checking normal distribution of variables

We observe that the predictor variables are almost normally distributed.

We, then plot the boxplots for each variable to get a closer look at relationship of each variables with reference to gender.





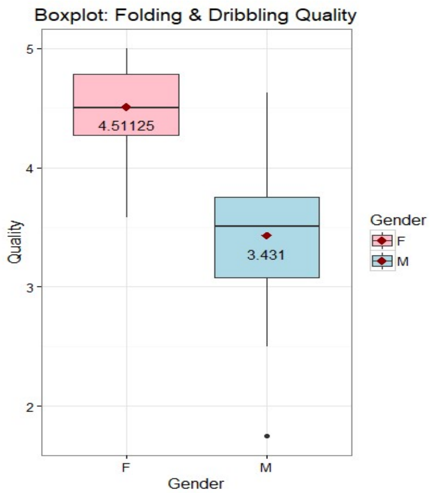


Fig 3. Relationship of predictors with reference to gender

Variable	Mean	Std Deviation
Average Time taken	50.78	10.2
Average Quality	3.971	0.72
Average Score Percent	57.24	11.95

Table 1: Descriptive Stats of the predictor variables

In MANOVA, the hypotheses are set as follows:

H_0: $\mu_M = \mu_F$

H_A: $\mu_M \neq \mu_F$

In order to see the MANOVA summary() we specify the Wilks' Lambda test statistic. Wilks' lambda is a direct measure of the proportion of variance in the combination of dependent variables that is unaccounted for by the independent variable. It is the widely used statistic in MANOVA.

	Df	Wilks	Approx F	Pr(>F)
Gender	1	0.358	45.25	<0.01
Residuals=78				

Fig 7: MANOVA Results

The p-value is significantly lesser than the level of significance 0.05 and the F statistic, 45.249 signifies that the variability between sample means is greater than the variability within sample means. Since the p-value is small (less than α=0.05), we reject H_0. Thus, we found enough evidence to say that there is a difference in the abilities of men and women.

To analyze the effect of gender on the different responses, we run the summary() function again.to look at each effect individually. We use ANOVA to for assessing the relationship between the independent variable (gender) and dependent variables:

Avg Time

	Df	Sum Sq	Mean Sq	F	Pr(>F)
Gender	1	84.0	84.05	0.80	0.37
Residuals =78		8171.9	104.77		

Avg Score Percent

	Df	Sum Sq	Mean Sq	F	Pr(>F)
Gender	1	43.50	43.51	0.30	0.58
Residuals =78		11231.0	143.98		

Avg Quality

	Df	Sum Sq	Mean Sq	F	Pr(>F)
Gender	1	23.339	23.338	106.25	<0.01
Residuals =78		17.134	0.219		

Fig 8: Results of ANOVA for each variable

We can see that Gender affects the quality variable significantly because of the p-value(3.245 x e-16) being lesser than the level of significance(0.05). The response variable 'Average Quality of Folding Clothes and Dribbling' has a significant impact on the results since the it is the only variable with a p-value lower than the significance value.Thus, the data provide convincing evidence that at least one mean is different from the other.

To develop a better understanding of how much this difference is we calculate the effect size.

Effect size is a value which allows you to see how much your independent variable has affected the dependent variable. When using effect size with

ANOVA, we use η² (Eta squared), rather than Cohen's d with a t-test.

ANOVA

Avgquality

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	23.339	1	23.339	106.246	.000
Within Groups	17.134	78	.220		
Total	40.473	79			

Fig 7. Effect size calculated in SPSS

Effect Size η² = Treatment Sum of Squares/Total Sum of Squares

= 23.339/40.473

= 0.57

According to Cohen's guidelines this is deemed as a large effect size.

Power:

Power of a test is the probability of correctly rejecting H_0. Since, the dependent variable '*Average Quality*' has a large effect, it is the most significant variable. Thus, we calculate the power test on this response variable as:

```
> pwr.anova.test(k=2, n=40, f=0.57, sig.level=0.05)

     Balanced one-way analysis of variance power calculation

              k = 2
              n = 40
              f = 0.57
      sig.level = 0.05
          power = 0.9989462

NOTE: n is number in each group
```

Fig. Power test based on Response variable: 'Average Quality'

Thus, we found that the power is significantly high with 99%.

CONCLUSION

Since the p-value is significantly lower than the significance value and the F-statistic value is large, we rejected the null hypothesis. Thus, we found significant difference in the two means of the groups (male and female). The response variable *'Average Quality of Folding Clothes and Dribbling'* has a significant impact on the results since the it is the only variable with a p-value lower than the significance value. We further calculated the effect size (0.57) and the power analysis (99%) of this response variable and found that its significantly large.

To see who really won, we look at the significant variable: Quality Scores for folding and dribbling

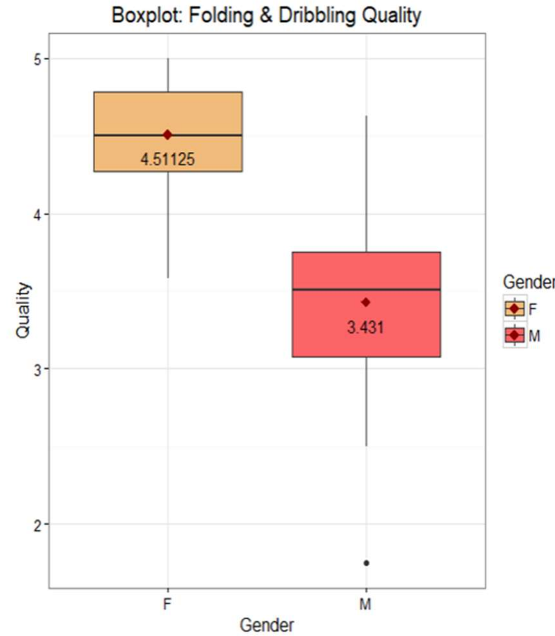


Fig 8. Results of ANOVA for significant variable : 'Quality Score'

Since, the mean for female quality score is 4.51 and the male quality score is 3.43 with 5 being the highest score, we clearly see a significant difference and find that the females won! Thus, it is safe to say that the myth that 'Women are better than men at multitasking' is confirmed.

LIMITATIONS

- Obvious Bias:

This test was conducted by two females. Thus, no matter how fair and unbiased they were expected to be, it is highly likely that they were rooting for the females to perform better than the men.

- Attention spans can differ - different genders can prefer different tasks

Since one task was male centric and the other was female centric, its is possible that the females paid more attention on dribbling the ball rather than answering the questions and the males paid more attention on folding the clothes rather than reading the paragraph.

- Multiple gender identities

The data that we have collected includes individuals who identify as male and female only. It doesn't consider individuals who identify as other than the binary system.

- Convenience sampling

Since the participants in this test were students from the University of Maryland in the age range of 18-30, we cannot say that this sample is a representative of the entire population.

- Nature of environment

While conducting the tests, the windy and chilly weather made it slightly tougher to fold clothes efficiently and thus took a little longer time.

- Other

There were very few rare instances when the participants couldn't hear the questions properly because of certain external factors and we had to repeat the questions. This might have caused certain time delays.

For the reasons stated above, further research must be conducted in order to ensure full inclusivity on all fronts.

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