

Gender differences in the Choice of Research Area Selection

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Abstract— The present study was focused to find out whether gender influences the choice of research topic, a researcher takes. To achieve this, published papers of research work from the 2014 to 2015 was collected. Based on the topic of study, the researches were classified into either of the following stereotype-classes, technology, natural sciences, vehicles, health & diet, fashion & shopping and Humanities and analyzed to find out whether gender had any role in the selection of the topic of research. It was found that there was fair presence of both the genders on research activity every year. Both the male and female researchers mainly selected research topics related to Humanities. There was no specific stereotype-class which was highly dominated by either of the genders. Thus, we concluded that, gender of the researcher did not have major significant influence on the topic of research that they select for the study.

Keywords— Gender, Natural sciences, Research, Stereotype-class, Technology.

I. INTRODUCTION

Education of a person goes beyond the formal educational institutions, to social interactions with people (Tawil, 2013; Ghebru and Lloyd, 2020) and nature (Durmus and Yapicioglu, 2015; Horká, 2015; Otto and Pensini, 2017). The education should help in making people tolerant and equip them to face the challenges upcoming to face (Tawil, 2013). It should develop in them critical, independent and creative thinking (Durmus and Yapicioglu, 2015), which in turn decides the future environment of the world (Otto and Pensini, 2017; IPCC, 2014). Thus, higher level of education will help people conducting fundamental, applied and technology transfer researches to meet the needs of the society and there by promoting economic development (Senthilkumar and Arulraj, 2011; Banciu *et al.*, 2015; Padlee *et al.*, 2019). Studies have proved that there is a positive correlation between higher education and innovation (Laursen and Salter, 2004; Lederman and Maloney, 2003).

Universities of the world today are following a multisided, in addition to the traditional teaching method, they have added active research, entrepreneurship (Etzkowitz *et al.*, 2000; Siegel *et al.*, 2003; Bercovitz and Feldman, 2006; Siegel *et al.*, 2007; Bishop *et al.*, 2011; Perkmann *et al.*, 2011a, 2013; Audretsch, 2012; Hvide and Jones, 2016; Belitski *et al.*, 2018), research collaboration,

patenting commercial products (Gulbrandsen and Smeby, 2005; Padlee *et al.*, 2019) and technology transfer to promote research commercialization (Lockett *et al.*, 2003; Lockett and Wright, 2005). Universities are the source for sprouting innovative research concepts (Etzkowitz *et al.*, 2000; Salter and Martin, 2001; Jacobsson, 2002; Laursen and Salter, 2004; Gulbrandsen and Smeby, 2005; Bishop *et al.*, 2011; Padlee *et al.*, 2019), fiber optics, computers and the internet and advancements in medical field relating to Hepatitis B, AIDS and stem cell research (Padlee *et al.*, 2019). Often the innovative ideas in universities are put forward by student researchers from both the genders.

It was clear that, there is a marked difference between the subject choices for higher education and carrier by both the genders (Lubinski and Benbow, 1992; Ceci *et al.*, 2009; Su *et al.*, 2009; Thelwall *et al.*, 2019; Finger *et al.*, 2020). This difference in choice is illustrated by the male gender domination in physical sciences, engineering (Su & Rounds, 2015; Britton, 2017; Stockard *et al.*, 2018; Thelwall *et al.*, 2019), Technology, Mathematics (Su *et al.*, 2009; Ceci *et al.*, 2009; Su and Rounds, 2015; Thelwall *et al.*, 2019) Physics, computer science, dentistry and surgery, (Thelwall *et al.*, 2019), while the female gender dominate medicine (Su and Rounds, 2015; Britton, 2017; Stockard *et al.*, 2018; Thelwall *et al.*, 2019) and life sciences (Ceci *et al.*, 2009; Su and Rounds, 2015; Thelwall *et al.*, 2019). The

selection of subject groups by gender is found to be as a result of differing abilities, satisfy personal goals and social impact (Yang & Barth, 2015; Pezzuti *et al.*, 2020). Many studies, such as, Charles & Bradley, (2009), Ceci, *et al.*, (2009), Jonsson, (1999), Lörz *et al.*, (2011) and Ochsenfeld, (2016), have concluded that male and female have different preference, while selecting the major subject to study in universities. Thus, it would also be interesting to know whether a similar trend is followed by the genders while selecting their topic of research topic. The papers thus try to find out whether there is any special likes and dislikes among the genders while selecting a research topic.

II. METHODOLOGY

The research samples selected for the study were grouped under 6 stereotype-classes. Stereotype-classes were technology (T), natural sciences (NS), vehicles (V), health & diet (HD), fashion & shopping (FS) and Humanities (H). The topics that cover under each stereotype-class were:

- (a) **Technology:** The study for practical purposes, especially in industry, machinery and equipment developed and evaluation.
- (b) **Vehicles:** The study related to machine, usually with wheels and an engine, used for transporting people or good on land, especially on roads.
- (c) **Natural sciences:** The study on subjects such as biology, physics, and chemistry in which things that can be seen in nature are studied.
- (d) **Health and diet:** The study related to the condition of the body and the degree to which it is free from illness, or the state of being well and the food and drink usually eaten or drunk by a person or group.
- (e) **Fashion and shopping:** The study related to a style that is popular at a particular time, especially in clothes, hair, make-up, etc. and the activity of buying things from shops.
- (f) **Humanities and social sciences:** The study related to literature, language, history, philosophy, economics, sociology and the study of society and the way people live

The sample of the published papers collected were first sorted year wise, and then based on the gender of the first author. If the names were ambiguous, we used an internet database Namepedia to check if there is a gender commonly related to the name. If this still didn't give us a clear answer, we assigned 'NA' to the student and didn't use it in our statistical analysis. The data such as year of publication, gender of the first author, name of the first

author, title of the study and the stereotype-class was observed and tabulated on the spread sheet. This tabulated data was called as the master data. The master data was then given to two examiners without gender in it. The stereotype-class was selected based on the highest proportion of votes by the examiners. If there were any unambiguous results, such as each examiner choosing the topic into different stereotype-class, then it was given three random people to evaluate the title in the same manner.

The data was analyzed using R (version 3.6.1, R Core Team 2019). In addition to the base R packages DHARM package (Hartig-2018) was used for model diagnostics. To test the correlation between a student's gender and their topic choice, Chi-squared test was performed and further used a linear regression model (Stereotype class by gender ~ Student gender + Year) to test the interrelationship of a student's gender and their topic of choice.

It was also found that the researches usually published papers in groups. Thus, we also grouped them according to their collaboration and found out their dominant area of work among the selected stereotype-classes. We also checked the dominance of gender in each group, to find out whether its male dominant or female dominant. If the gender distribution was found to be equal in a particular group, the group was classified as mixed and if we were not able to identify the genders of the group, it was classified under not available.

III. RESULTS AND DISCUSSION

a. Distribution of collected researches

A total of 317 studies starting from the year 2014 to 2018 were collected from the Cambridge dictionary for the present study. Taking into consideration the year wise distribution, we were able to collect 68 (21.45 %) studies from the year 2014, 74 (23.34 %), 53 (16.72 %), 66 (20.82) and 54 (17.03 %) respectively from the years 2015, 2016, 2017 and 2018. Though the number of studies by researchers during the years 2016 and 2018 were comparatively lesser when compared to 2014, 2015 and 2017, but the numbers were still was on the fairer side. Taking into consideration the groups, we could identify that there were 75 groups.

The gender wise distribution of the researches selected for the study is portrayed in figure 1 and 2. Taking into consideration the total pool (Figure 1), we had a total of 157 (49.5 %) male, 145 (45.7 %) female, and 15 (4.7 %) of unidentified researchers. Seeing the figure, we cannot say that one particular gender is more active in research. We should take into consideration the unidentified people. We can only conclude that both the genders are almost equally

active in research. Taking into consideration the year wise distribution, apart from the year 2016, the remaining years both the genders are almost equally active in research showing a very marginal majority towards the male gender. In the year 2016, the female gender was found to be involved more in research than males. The number of males higher than female were respectively 5 (17.14 %), 9 (12.16 %), 1 (1.52 %) and 8 (14.81 %) for the years 2014, 2015, 2017 and 2018. In the year 2016 females dominated males by 11 (20.75 per cent). It should also be taken into consideration the amount of unidentified gender, 3 (4.23 per cent), 1 (1.35 per cent), 8 (15.09 per cent) and 3 (4.55 per cent) respectively for the years 2014, 2015, 2016 and 2017. Correctly identifying the gender of the unidentified group may change the status.

Figure 3 and 4 describes the gender dominance of groups. Taking into consideration the total groups taken for the study (Figure 3), we can conclude that the groups are mainly male dominated (31 Nos., 41.33per cent) ones. The strength of the female dominated ones (24 Nos., 32 per cent) are also not so weak. The presence of a fair amount of mixed group (14 Nos., 18.67 per cent) indicates the cooperation between the genders in research activities. We were not able to identify the gender dominance of 6 (8 %) groups.

Considering the gender dominance among the groups, year wise (Figure 4), there was an equal number (6 Nos., 32.29 %) of male and female dominated groups, while the remaining were mixed. In the year 2015, the male dominated groups (10 Nos., 58.82 %) were comparatively more when compared to the female dominated ones (4 Nos., 23.53 %). Considering the year 2016, It was found that 33.33 per cent (4 Nos.) of the groups were female dominated, while 25 per cent (3 Nos.) were male dominated. It should also be considered that 33.33 per cent (4 Nos.) of groups' gender dominance could not be identified. In the year 2017, 41.18 per cent (7 Nos.) were male dominated, 35.29per cent (6 Nos.) were female dominated, 11.76 per cent (2 Nos.) were mixed and 11.76 per cent (2 Nos.) groups gender dominance could not be identified. In the year 2018, 41.67 per cent (5Nos) were male dominated, 33.33 per cent (4 Nos.) were female dominated and the remaining 25 per cent (3 Nos.) were mixed ones. The maximum number of mixed groups was found in the year 2014; the remaining years had fewer numbers.

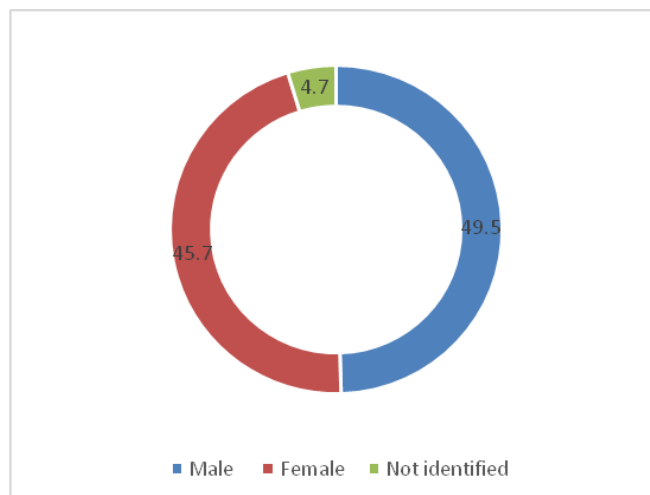


Fig.1: Total gender distribution

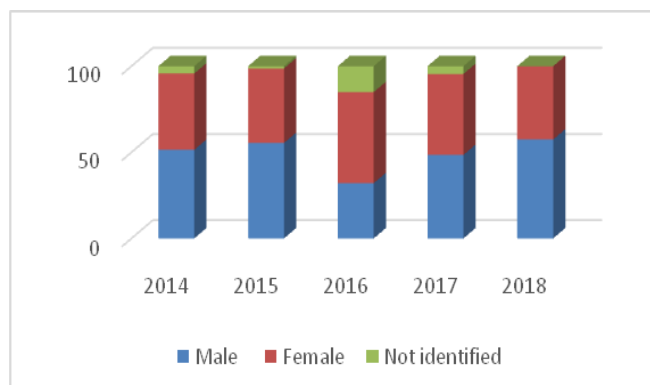


Fig.2: Gender distribution year wise

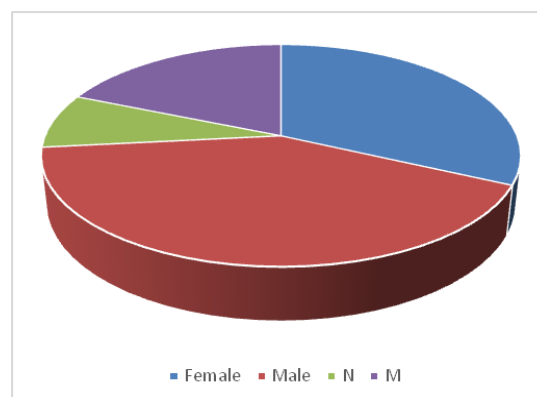


Fig.3: Gender dominance in groups

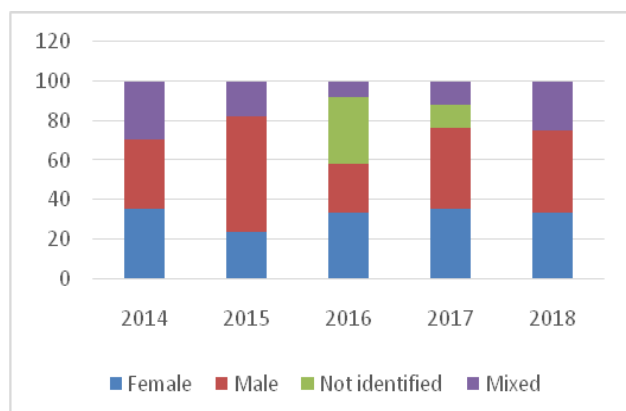


Fig.4: Year wise gender dominance in groups

b. Distribution of Stereotype-classes among individual and group researchers

Taking into consideration the total pool of data, the preference of the Stereotype-classes by initial and group researchers are detailed in table 1. The Stereotype-classes are depicted as FS, H, HD, T, V, NS and NA, respectively for Fashion & Shopping, Health & Nutrition, Humanities, Technology & Electronics, Vehicles, Natural sciences and Not Applicable. The stereotype-class NA is used for a group when they diversify their study and does not mainly concentrate on a particular field.

Considering individual male researchers, 9.5 per cent of them are interested in FS, 56.69 per cent in H, 10.19 per cent in HD, 0.63 per cent in T, 4.46 per cent in V and 18.47 in NS, while the preference was 8.97 per cent, 54.48 per cent, 16.55 per cent, 0 per cent, 4.83 per cent, and 15.17 per cent respectively for FS, H, HD, T, V and NS among the female researchers. Analysing the results, it was clear that both the male and female researchers prefer to do studies under the stereotype-class Humanities. Both the male and female researchers showed almost similar pattern of interest on all stereotype-class except the fact that none of the female researcher, selected for the study showed interest in the stereotype-class Technology & Electronics. It was also found that even males are also not much interested in Technology & Electronics, apart from a very few. Both Male and female researchers showed the highest interest on the stereotype-class Humanities and though low but similar interests on the stereotype-classes Fashion & Shopping, Health & Nutrition, Vehicles and Natural sciences. The group of researchers whose gender was not identified also showed a similar pattern of interest.

Considering the groups, none of the groups showed interest on the stereotype class, Technology & Electronics, the preference to the stereotype class Humanities stood first. The most interesting outcome from the study was that the female dominated groups did not show any interest of the stereotype class Fashion & Shopping, while the male

dominated groups showed at least a very small interest. The mixed and unidentified gender research groups showed no interest on the stereotype class Technology & Electronics and Vehicles. The stereotype class Humanities was also their most preferred research area. They showed a very small interest in Natural sciences. Considering the inconsistency in research work areas, 6.45 per cent of the male dominated groups, 20.83 per cent of female dominated groups, 14.29 per cent of the mixed group and 7.14 per cent of the unidentified gender dominated group, were not repeating the same area of study more than once. This might be due to the fact that they wanted to study different areas to increase their knowledge bank or, they are still in the process of deciding their field of interest.

Table 1 Selection of Stereotype-classes by individual and group researchers

		Stereotype-class						
		FS	H	HD	T	V	NS	NA
Individual	Male	15	89	16	1	7	29	-
	Female	13	79	24	0	7	22	-
	Unidentified	1	5	2	0	4	3	-
Groups	Male dominated	1	20	2	0	1	5	2
	Female dominated	0	13	2	0	2	2	5
	Mixed	1	9	1	0	0	1	2
	Unidentified gender dominated	1	9	1	0	0	1	2

c. Year wise distribution of Stereotype-classes by individual researchers

The selections of different stereotype-classes by different researchers are portrayed in figures 5 to 7. The figure 5 displays the year wise selection of different stereotype-classes by researchers without considering the gender, while figure 6 and 7 displays for male and female researchers respectively. It is clear from the figures, apart from the year 2017, all the researchers showed more interest towards the stereotype-classes Humanities. It was only in the year 2017, the researchers gave almost equal importance to the other stereotype-classes, but still the stereotype-class Technology & Electronics was totally avoided. The pattern was similar in both among male and female researchers. It was only in the year 2015, there was

a research contribution to the stereotype-class T. The interest to the stereotype-class T in the year 2015 was shown by male researchers, while the female researchers kept themselves away from it on all years.

In the year 2014, 8.57 per cent, 72.86 per cent, 4.29 per cent, 1.43 per cent and 12.86 per cent of the researchers showed interest on the stereotype-class FS, H, HD, V and NS respectively. Considering the interest of male researchers with respect to the overall average, the interest showed on FS was 3.01 per cent lesser, on H was 2.14 per cent higher, on HD was 1.51 per cent lesser, on V was 1.35 per cent higher and 1.03 per cent higher on NS. The female researchers showed 3.93 per cent and 1.96 per cent higher interest on FS and HD respectively and 0.98 per cent, 1.43 per cent and 3.48 per cent lower interest on H, V and NS respectively, when compared to the overall average.

In the year 2015, neither male nor female researchers showed interest on the stereotype-class FS. Though the stereotype-class H was the highly selected, but was 13.4 per cent lower than the year 2014. Similarly, the researchers showed 9.13 per cent and 9.92 per cent higher interest on HD and NS respectively, when compared to the year 2014. Comparing the interests of male researchers with the year's average, it was found that it was almost similar in the case of the stereotype-class H, 2.96 per cent and 1.67 per cent lower in the case of HD and V respectively and 3.54 per cent higher in case of NS. Comparing the interests of female researchers with the year's average, a similar trend as of the male researchers was seen in the case of the stereotype-class H. They showed 4.64 per cent lesser when compared with the years and 8.18 per cent lesser when compared with the male researcher's interest towards NS. It was found that the female researchers showed 3.87 per cent higher interest on V when compared with the male researchers. With the case of HD, the females showed 3.89 per cent and 6.85 per cent higher when compared with the year's average and male researchers' interest respectively.

The year 2016 was almost similar with the other years. Though the interest was higher towards the stereotype-class H, but still there was a lighter fare amount of interests on FS, HD and NS respectively. Both male and female researchers completely neglected the stereotype-classes T and V. Comparing the interests between the female and male researchers, it was found that the males showed 9.24 per cent higher interest on FS and 9.67 per cent, 1.26 per cent lesser interest on HD and NS respectively when compared to females.

The year 2017 was unique when compared with the others years. The researchers showed a fare amount of interests on all stereotype-classes except T. Though still

most of the people closed H, but was closely followed by NS. Comparing the choice of research among the male and female researchers, it was found that both showed similar trends with very minor variations.

Comparing the year 2018 with 2017, it was found that the researchers gave more interests in selecting the stereotype-classes H. It was found that there was an increase of 35.35 per cent in H, and decrease in 7.69 per cent, 1.86 per cent, 16.67 and 9.09 per cent respectively for stereotype-classes FS, HD, V and NS, when compared to the year 2017. Comparing the choices between the genders in the year 2018, it was found that 12.9 per cent of the male researchers were interested in FS, while none of the females chose FS and the females showed higher interest on H and HD, while the male researchers led the females in NS.

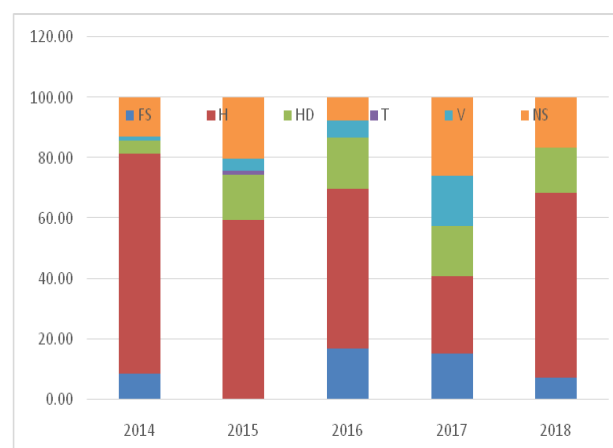


Fig.5: Year wise distribution of Stereotype-classes

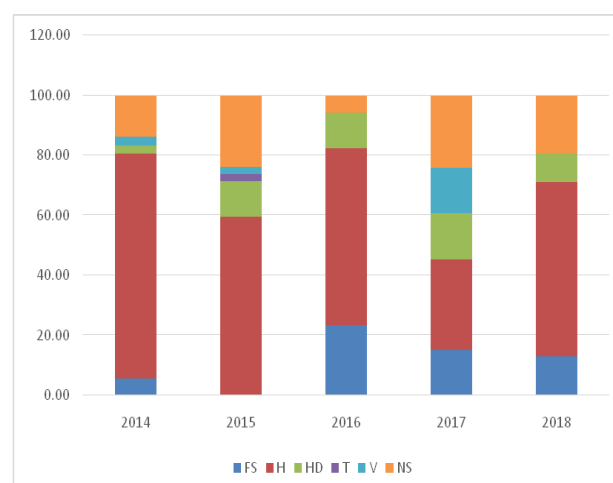


Fig.6: Year wise distribution of stereotype-classes Selected by male researchers

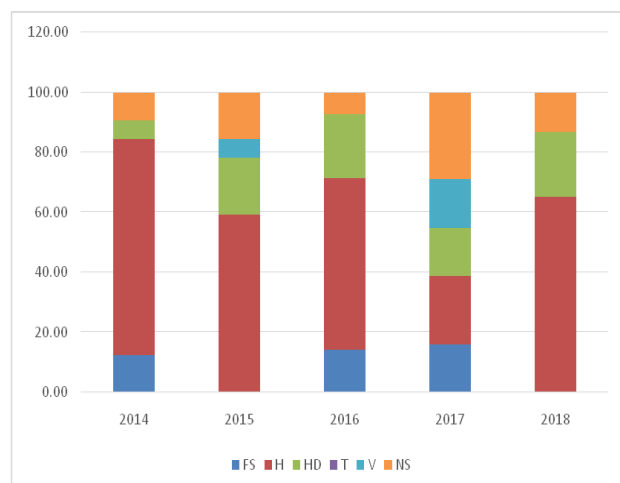


Fig.7: Year wise distribution of stereotype-classes Selected by Female researchers

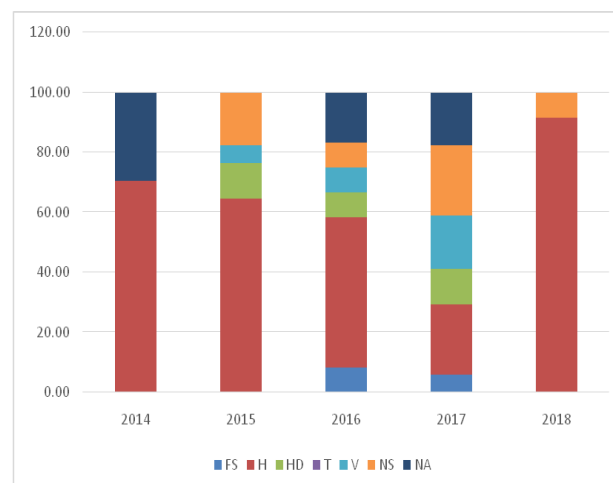


Fig.8: Year wise distribution of stereotype-classes Selected by groups

d. Year wise selection of Stereotype-classes by groups

The research topic selection behaviour of groups is described in figure 8 and 9. Figure 8 details the selection behaviour of groups year wise and figure 9 details the year wise selection behaviour of groups based on gender dominance. From the figure 8, it's clear that, it was only on the year 2015, 2016 and 2017 that the people selected all the stereotype-classes except T. Better distribution of the stereotype-classes was seen in the year 2017. I was also clear that no group showed a dominated interest on the stereotype-class T. In the year 2014, 70.59 per cent of the groups opted for H and the remaining 29.41 per cent did not stick on to a particular area. In the 2015, though there was representation on most of the stereotype-classes, the stereotype-class H (64.71 %) dominated, followed by 11.76 per cent, 5.88 per cent and 17.65 per cent respectively for HD, V and NS. The groups in the years 2018 showed dominated interest only in two stereotype-classes, H (91.67 %) and NS (8.33 %).

Comparing the topic selection of groups considering the gender dominance among the groups showed somewhat similar results. In the year 2014, the interest towards the stereotype-class H was more (83.33 %) for male dominated group, followed by female dominated (66.67 %) and mixed (60 %) groups.

In the year 2015, the groups preferred H, HD, V and NS stereotype-class. The male dominated groups preferred H (60 %), followed NS (30 %) and HD (10 %). The female dominated groups did not prefer NS but instead opted for V (25 %). The mixed group preferred to work only on the stereotype-class H.

In the year 2016, the mixed group preferred to work only on HD, while the male dominated groups chose FS and H. The female dominated group, 50 per cent of them prepared H, while the remaining 50 per cent did not stick on to a particular field of study. In the year 2017, the male and female dominated groups gave almost equal preference to all stereotype-classes apart from T. The mixed groups were either interested in V, or else did not stick on to a particular field of study. In the year 2018, the male dominated and the mixed groups were only interested in the stereotype-class H, while the female dominated ones showed 75 per cent on H and 25 per cent on NS.

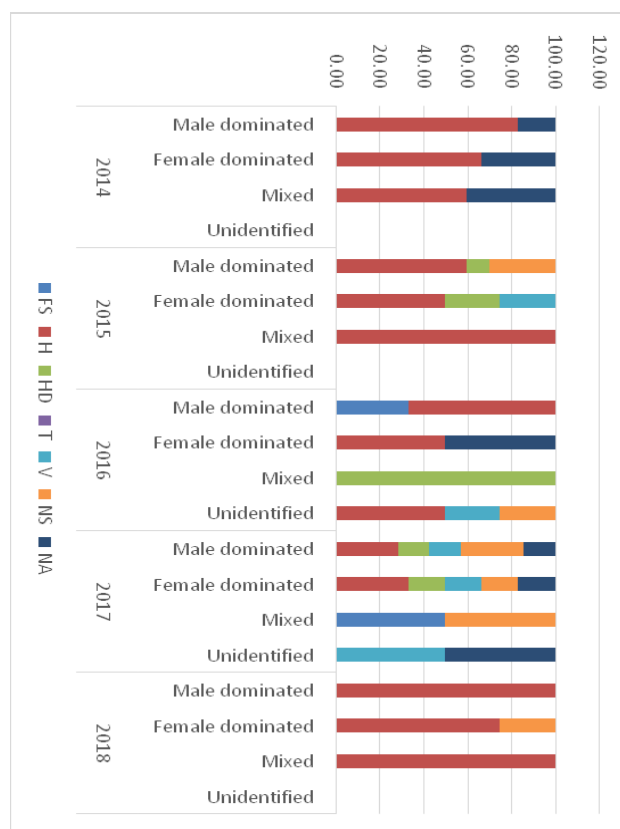


Fig.9: Year wise distribution of stereotype-classes Selected by groups based on gender dominance

IV. DISCUSSION

Thelwall *et al.* (2019), was of the view that the titles of the published research work fully explain the content of the study that the researcher has done. Thus, we have also used the title of the published research works of the researchers from the year 2014 to 2018 to classify the area of interest of the researchers.

The demand for qualified scientific-technical personnel is growing and the representation of females in this area is less (Buccheri *et al.*, 2011). In the year 2012, females contribute 28 per cent of PhD graduates in engineering, manufacturing and construction and 21 per cent from computing in the EU. Men mostly choose engineering, manufacturing and construction, whereas women mostly like to pursue an education degree. Women as scientists and engineers are up to 2.8 per cent of the total labour force in 2013, whereas men are up to 4.1 per cent, but the growth of women in these areas are growing at a faster rate than men. (EU Directorate 2016). In USA females continue to be under represented in math-intensive fields of Science, Technology, Engineering, and Mathematics. Research from the last 30 years from the fields of psychology, sociology, economics, and

education, found that the possible factors are (a) cognitive ability, (b) relative cognitive strengths, (c) occupational interests or preferences, (d) lifestyle values or work-family balance preferences, (e) field-specific ability beliefs, and (f) gender-related stereotypes and biases (Wang and Degol, 2016). The imbalances of genders in the field of science, technology, engineering and mathematics are partly due to greater male interests in these fields. Thus, there is a need to motivate females, thus providing high performers in science or mathematics and pursue scientific careers of special interest. The gender specificity and gender inequity in science education is and international problem (Buccheri *et al.*, 2011). According to our study, the results obtained by the above researchers are partially supporting our outcome. It was clear from our study that the male gender was more than the female gender, but the difference among them was not much. The lack of interest in science and technology by the female gender was also shown in our study, but the males were also found to be not much interested in these areas. The interest of males and females were found to be almost similar with marginal difference among the genders.

Females are especially interested in human biology and thus overrepresented in medicine, whereas males are being equally interested in chemistry and physics and significantly less interested in human biology. Thus, they are underrepresented in medicine and overrepresented in vocations such as engineering, architecture, physics, chemistry, technology, and computer sciences (Buccheri *et al.*, 2011). Females are interested in veterinary science and cell biology, while the males are interested in abstraction, patients, and power/control fields, such as politics and law, taking into consideration the career to provide status (Thelwall *et al.*, 2019). The above results by the researchers did not support our findings fully. We were not able to find much female researchers interested in the area of human biology and not much males interested in the area of science and technology. Vast majority of both the sexes were interested in research related to humanities.

Shopping is considered as major source of relaxation in females; they visit shopping centres more than men. In fact, they are the ones who often buy cloths for men. Surveys indicate that females play a very significant role in shopping activities, particularly shopping for household groceries. Although in general females play a dominant role in household shopping, the male's role is not insignificant (Dholakia, 1999). One of the most common forms used in segmentation by the marketers is gender and women have higher levels of brand commitment than men. However, there is not enough data collected so far with regard to the study on gender differences and consumer

behaviour. All though it is an important topic to be researched, but has attracted only limited research attention (Tifferet and Herstein 2012). Our personal observations also support the finding of the above research outcomes. Though females are found to be interested in shopping of fashionables, health and diet products, we could find only a very few people interested in doing research on topics related to this area. In fact, we found more males doing research on topics related to this area. This made us to conclude that though females are interested in shopping fashionables, health and diet products, males are more interested in doing research in this area than females.

People at first sight itself determine gender for specific scientific interests and vocational choices internationally. This is discouraging, considering the political and educational efforts to enforce gender equity (Buccheri *et al.*, 2011). Studies suggest that necessary steps are needed for eliminating explicit and implicit gender bias in academia and making fields more attractive to minority genders. (Thelwall *et al.*, 2019). We support the finding of Buccheri *et al.* (2011) as were also of the similar thought while setting our 6 stereotype-classes, though the outcome of our study was different. We also support the suggestion of Thelwall *et al.* (2019) as we also found some gender inequality, though not much large. Thus, steps are necessary to attract more females into the different branches of research as their suggestions can play a very vital role.

V. CONCLUSION

The conclusions of our study are listed below:

- a) Out of the total samples selected for the study, though the male gender was greater than the female gender, the difference was very small. Thus, we conclude that, there is no male supremacy in research at large.
- b) It was found that there was a healthy presence of both the genders throughout the period selected for the study. This brings us to a conclusion that, there is a fair contribution of both the genders in research activity every year.
- c) Analysing the results, it was clear that both the male and female researchers prefer to do research under topics related to Humanities. Apart from one case, none of the researchers have selected to do research in the area of Technology & Electronics throughout the period selected for the study. It was also found that the females though interested in fashion and shopping more than males, but were not interested in doing research on topics related to Fashion & Shopping and Health & Nutrition, compared to males. The same

trend was shown by both the genders for every year selected for the study.

From the study, we conclude that, gender of the researcher has no major significant influence on the topic of research that they select for the study.

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