Correlation Between Dominant Sensory Mechanisms During Interaction Processes With Virtual Products and Gender

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ABSTRACT

Through the exploration of Human Behavior with the use of networks as well as the Tetrachoric Coefficient (TC) it was sought the relationship between the active Dominant Sensory Mechanisms (DSM) during the interaction processes with 3 Virtual Products (VP) in 3 groups of users., and the gender of the persons like users. The DSM of each user was obtained from the number of repetitions of the SM observed in networks. In this sense, attention was focused on the Women's sector (W). The results obtained suggest the existence of a low dependence in the dichotomy: Dominant Sensory Mechanisms and the Women's sector. Likewise, the results obtained from the Tetrachoric Coefficient (TC) show a directly proportional relationship between the activation of the DSM and gender. In this sense, the results show that the higher the DSM, the greater the probability of the presence of interaction in the women's sector, and the lower the domain of a DSM and the less dominance of an DSM, the less probability of interaction in the women's sector. This was perceived in the 3 groups of users considering mixed groups. Therefore, a possible relationship between the activation of sensory mechanisms and the gender is appreciated.

Keywords: Human interaction, Dominant sensory mechanism, Virtual products, Gender

INTRODUCTION

There have been several studies that observe differences in the interaction processes with different objects linked to gender, but there is still no precise answer regarding these results. Therefore, the present study aims to observe the results obtained, possible new contributions, and similarities with results obtained by other colleagues. The study aims to investigate the possible correlation between Dominant Sensory Mechanisms (DSMs) during the process of interaction with Virtual Products (VPs) and gender.

Gender was classified into two groups: men's sector and women's sector, which integrated Mixed User Groups (G). Three VPs were used with three different work systems, all of them with flat screen technology. Specifically,

the DSMs were identified between user groups during the processes of interaction. Similarities were found between sectors of users in which pairs of sensory mechanisms were identified. However, variations were observed in relation to the DSMs and the qualities of the VPs.

GENDER AN SPATIAL HABILITIES

In previous studies, a fundamental characteristic of VPs was observed and can be described as follows: it requires precise visuo-spatial location by the user (Tejeda and Pineda, 2022). However, differences were found in the activation of sensory mechanisms by gender in relation to the qualities of VPs and their work system. These findings, explored through network analysis, are correlated with studies conducted using other methods, such as Halpern (2000), Voyer and Bryden (1995), Linn & Peterson (1985), Harris (1981), and McGee (1979). These researchers observed gender differences in spatial abilities, with mental rotation and visualization standing out. The causes of these differences still do not have a precise answer, although some authors attribute them to nutritional factors such as McGee (1979), genetic factors as Barron-Cohen (2003), Kimura (1992), factors related to the person's experience as Alington, Leaf & Monaghan (1992), Connor, Serbin & Schackman (1977), among others. Nevertheless, this investigation provides a possible correlation between DSMs and spatial abilities.

METHODOLOGY

The exercise was carried out in Mexico within the context of a classroom in a public university. Participants, in turn, were classified within the young adult sector based on the National Institute of Statistics and Geography (INEGI) due to being in age ranges of 20 to 29 years old, The process was integrated in two phases. In the first phase, 3VPs were exposed in local environments with a general task assigned in 3 groups of mixed users: integrated by sectors of Men (M) and Women (W). The average age registered in men's sector was 27 years in G1; 24.57 in G2 and 28.6 in G3. The average age registered in women's sector was 23.33 in G1; 23.8 in G2 and 34.25 in G3. Each group was integrated by 12 persons without cognitive problems, comorbidity or visual problems, and without recent medication use. Group 1 was exposed to a personal Flat Screen Technology device with a VP that showed the highest demand for the spatial-fine location (G1). Likewise, the interaction with this VP and its work system was carried out in a short distance. Group 2 was exposed to a non-personal Flat Screen Technology device with a VP that showed the highest demand for the spatial-general location (G2) (Olmos and Gil, 2022). The interaction with this VP and its work system was carried out in a long distance. Group 3 was exposed to a work system considered as emerging technology because it is not common in general population, this VP showed the longest time recorded in focal attention (G3). Likewise, the interaction with this VP and its work system was carried out in a short distance. The method used to obtain data -once the task was assigned-

was non-participant observation from which the observable factors of interaction were registered in a matrix and visualized in a program package of large networks. Data of interest were those related to obtaining the DSMs starting out with the registration of iterations generated by each SM in every user. Likewise, information regarding to the gender of each person as a user was obtained from a survey where each user was free to register. In other studies it was mentioned that the interaction with virtual products requires control not related to reflex responses but to actions controlled by cognitive processes, this is based on studies developed by Posner & Petersen (1990). A factor of interest in relation to the aforementioned is that the controlled action is focused on the dichotomy: fine spatial location or general spatial location during the interaction with the VP. The use of networks helped to visualize the correlations between SM as well as processes involved in the user's interaction.

In the second phase, data was analyzed from the tetrachoric coefficient in order to explore the relationship between the active DSMs during the interaction processes in relation to the sectors of men and women with each VP. It is important to highlight that the processes of human interaction with VPs involve various Temporal Micro-Processes of Interaction (M-PTI). However, in these studies only behavior in the DSMs' relationship and gender were observed.

PROCESS DESCRIPTION

Net 1 shows an example of the relationship between sensory mechanisms (SMs) during the interaction process with three different VPs in the women's sector within the maximum time. Network 2 shows an example of the relationship between SMs in the men's sector, as well as the segmentation of the network during the maximum time of the attentional process. The networks allow us to observe the complex correlations that exist between factors of human interaction with every VP. In this sense, it was possible to detect the SMs that intervened to a greater extent throughout the process: gross motor interaction (Img) and visual interaction (Iv) in both sectors.
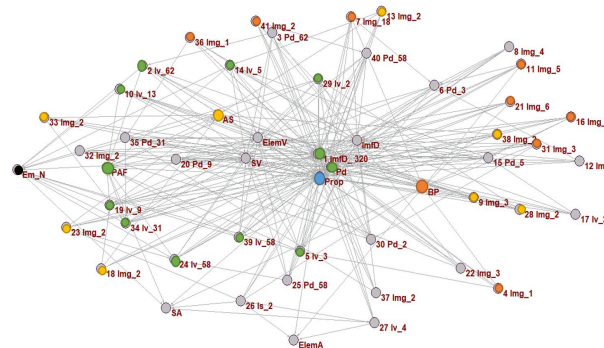
Net 1: Shows an example of the all Process of Interaction realized by one Woman. 300 secs. Normal Vision. G1. U = 3. (Elaboration Olmos P.L & Gil T.J. 2022.
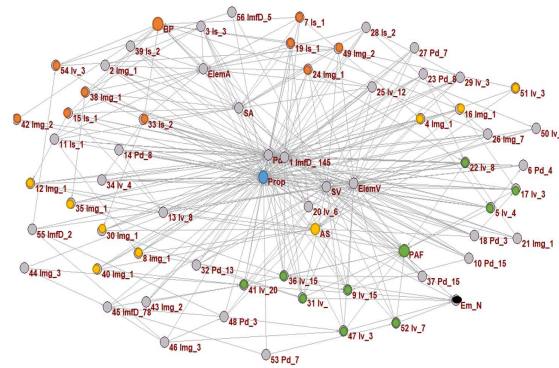
Net 2: Shows an example of the all process of interaction realized by one man. 300 secs. Normal vision. G1. U = 2. (Elaboration Olmos P. L. & Gil T. J. 2022.)

Table 1. Total time 300 secs. U = User; SM = Sensory Mechanism; G1 = Group 1; G2 = Group 2; G3 = Group 3. Gen = Gender; W = Woman; M = Man. (Elaboration Olmos P. L. & Gil T. J. 2022.)

G1				G2				G3			
U	SM	DSM	Gen	U	SM	DSM	Gen	U	SM	DSM	Gen
1	Img	42	W	1	Iv	201	W	1	Iv	234	W
2	Iv	136	W	2	Img	247	W	2	Iv	472	W
3	Img	107	W	3	Img	212	W	3	Prop	117	M
4	Iv	69	W	4	Iv	160	W	4	Iv	726	M
5	Iv	128	W	5	Iv	249	W	5	Img	310	M
6	Img	68	W	6	Img	233	M	6	Iv	108	M
7	Iv	43	M	7	Img	291	M	7	Img	189	M
8	Iv	162	M	8	Img	219	M	8	Img	57	M
9	Img	65	M	9	Img	128	M	9	Iv	148	W
10	Iv	94	M	10	Img	244	M	10	Img	371	W
11	Iv	82	M	11	Img	143	M	11	Iv	484	M
12	Iv	113	M	12	Iv	308	M	12	Iv	528	M

Aditionally, networks allows us to observe a complex interrelation of Temporary Interaction Micro-Processes that integrate the whole process. In order to observe the SMs in detail, the network had to be fragmented. However, for these studies we focused on detection of SM with the highest number of iterations considered as the most active during the process in relation to gender. Table 1 shows the DSMs of each user group.

G1 was integrated by 50% W and 50% M; G2 was integrated by 41.66% W and 58.33% M; while G3 was integrated by 33.33% W and 66.66% M. The dominant SM on three groups were very consistent, with Img and Iv like the most recurrent in the 3PVs, each with different qualities. However, differences were observed in relation to the domain of each SM by sector. In G1 in W sector a very similar SM activation was observed, however Iv was the most dominant with 333 correlations, in M sector an absolute dominance of Iv was observed with 494 correlations. Both sectors, although with notable differences in relation to the domain of SM, coincided in employ a

spatial location of greater precision executed by Iv. Being the sector of men the one that executed the highest percentage of precision with visuo-spatial location. In G2, in W sector, a very similar activation of SM was observed, however Iv was the most dominant with 610 correlations, but in M sector an absolute dominance of Img was observed with 1258 correlations. Both sectors, in relation to the VP and its work system, presented notable differences in relation to SMs domain, with W sector being the one that executed the visuo-spatial location of precision with the highest percentage and M sector executed the highest percentage domain with a non-precision spatial location through Img. In G3, in W sector, Iv was observed as dominant with 854 correlations, in M sector an equally domain of Iv with 1846 correlations was observed. Both sectors, in relation to VP and its work system, presented a similar behavior in relation to SM's domain, being visuo-spatial location the highest in domain. From these data, it is important to highlight that M sector in G1 and G2 maintained the activation of two dominant SMs., Similarly, the M sector in same groups showed an absolute dominance of one SM: in G1 was Iv and in G2 was Img. In relation to G3, both genders showed the absolute dominance of a SM, with Iv being the most active. In this sense, it is observed that W sector seems to have a balance in the activation of two SM in relation to similar qualities of VP and this activation changes in relation to the differences in the product. However, M sector seems to have a very clear dominance of certain SM in relation to VPs.

On the other hand, to analyze the tetrachoric coefficient (rt), the average of the dichotomy considered for this study was obtained for each user group based on Guilford and Fruchter (1984), the results for G sector were: G1 Iv = 92.4166, Gen = 0.5; the G2 Img = 219.583, Gen = 0.4166; the G3 Iv = 312, Gen = 0.3333. According to these data, information was visualized based on Abascal and Grande (2014) and displayed in Table 2.

Table 2. Total Time 300 secs. U = User; SM = Sensory Mechanism; G1 = Group 1; G2 = Group 2; G3 = Group 3. Gen = Gender. (Elaboration Olmos P. L. & Gil T. J. 2022.)

G1				G2				G3			
U	SM	DSM	Gen	U	SM	DSM	Gen	U	SM	DSM	Gen
1	Img	−	+	1	Iv	−	+	1	Iv	−	+
2	Iv	+	+	2	Img	+	+	2	Iv	+	+
3	Img	+	+	3	Img	−	+	3	Prop	−	−
4	Iv	−	+	4	Iv	−	+	4	Iv	+	−
5	Iv	+	+	5	Iv	+	+	5	Img	−	−
6	Img	−	+	6	Img	+	−	6	Iv	−	−
7	Iv	−	−	7	Img	+	−	7	Img	−	−
8	Iv	+	−	8	Img	−	−	8	Img	−	−
9	Img	−	−	9	Img	−	−	9	Iv	−	+
10	Iv	+	−	10	Img	+	−	10	Img	+	+
11	Iv	−	−	11	Img	−	−	11	Iv	+	−
12	Iv	+	−	12	Iv	+	−	12	Iv	+	−

Based on these results and using the Abascal and Grande method, the rt for each group was obtained, the results were: G1 rt = 0; the G2 rt = 0.2662553; the G3 rt = 0.1981962.

The results suggest the existence of a low dependency in dichotomy: Dominant Sensory Mechanisms and the Women's sector. This may indicate that the dominant mechanisms possibly depend on the qualities of VP and its work system, which cannot be observed through the rt. Likewise, the results obtained from the Tetrachoric Coefficient (rt) showed a directly proportional relationship between the activation of DSMs and gender. In this sense, it was observed that a greater presence of a multiplicity of Sensory Mechanisms is associated with a greater probability of being in the women's sector, while a lesser presence of various Sensory Mechanisms is associated with a lesser influence of the women's sector. This was perceived in three groups of users consisting of mixed genders.

CONCLUSION

From the exploration of the relationship between the activation of Dominant Sensory Mechanisms and gender, six interesting findings were obtained:

A) A low dependence was detected in relation to DSMs and gender. In this sense, it was possible to observe that the activation of DSMs in a sector of users without visual problems, cognitive impairments, and/or comorbidity is directly affected by the qualities of the VP and its working system.

B) A direct correlation was observed between active DSMs and gender. In this sense, subtle differences could be observed in relation to gender, one of them being the number of active SMs during task execution.

C) The W sector showed the greatest activation of SMs.

D) The activation of SMs, in general terms, is linked to the qualities of the VP.

E) A possible tendency was observed in the M sector to carry out precision spatial location activities in relation to VPs and their respective systems over short distances. Based on the exploration, it was observed that the male sector showed subtle differences in the activation of certain SMs in relation to the female sector. The most notable differences in the use of these SMs are their specialization: fine localization activities such as Iv and general localization activities such as Img.

F) In relation to VPs and their respective work systems that operate at a long distance, a possible tendency was observed in the women's sector to use precision spatial location. Subtle differences were also observed in the performance of the male and female sectors in relation to distance and the VP.

It is important to consider that these studies were conducted in controlled environments, and although they cannot be considered as conclusive results, they can provide a perspective on human behavior and possible gender differences in relation to certain virtual products.

REFERENCES

Abascal, E., & Grande, I. (2014). *Fundamentos y Técnicas de investigación comercial.* (12ª Edición ed.). Madrid: ESIC.

Alington, D., Leaf, R., & Monaghan, J. (1992). Effects of stimulus color, pattern, and practice on sex differences in mental rotations task performance. *Journal of Psychology, 126*, 539–553.

Baron-Cohen, S. (2003). *The essential difference. Men, women and the extreme male brain.* Allan Lane: Penguin Books.

Connor, J., Serbin, L., & Schackman, M. (1977). Sex differences in children_s response to training on a visualspatial test. *Developmental Psychology, 13*, 293–294.

Gil, Tejeda, J., & Olmos, Pineda, L. (2022). User Experiences Derived from Mass-Distribution Virtual Products are integrated by the Spatio-Temporal Component. (I. T. (Eds), Ed.) *Usability and User Experience, 39*, 119–125.

Guilford, J., & Fruchter, B. (1984). *Estadística aplicada a la Psicología y a la Educación.* Mc Graw Hill.

Halpern, D. (2000). *Sex differences in cognitive abilities* (3rd ed). Hillsdale, NY.: Lawrence Erlbaum.

Harris, L. (1981). *Sex variations in spatial skills. Spatial representations across the life span..* (A. H. In L. S. Liben, Ed.) New York: Academic Press.

Kimura, D. (1992). Sex differences in the brain. *Scientific American, 267*, 118–125.

Linn, M., & Peterson, A. (1985). Emergence and characterization of sex-differences in spatial ability: a metaanalysis. *Child Development, 56*, 1479–1498.

McGee, M. (1979). Human spatial abilities: psychometric studies and environmental, genetic, hormonal, and neurological influences. *Psychological Bulletin, 86*, 899–918.

Olmos, Pineda., L., & Gil, Tejeda., J. (2022c). 'Geometrical Construction of Shape by a Weak-Visual Person in a Physical Medium'. *Lecture Notes on Data Engineering and Communications Technologies, 146*, 221–227.

Posner, M., & Petersen, S. (1990). The Attention System of the Human Brain. *Annual Review of Neuroscience, Vol. 13*, 25–42. doi: https://doi.org/10.1146/annurev.ne.13.030190.000325

Voyer, D., Voyer, S., & Bryden, M. (1995). Magnitude of sex differences in spatial abilities: a meta-analysis and consideration of critical variables. *Psychological Bulletin, 117*, 250–270.