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Beyond Mars and Venus: An Integrative Framework for Gender Differences in Language Acquisition

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أعادة النظر في نموذج المريخ والزهرة: نحو إطار تكاملي لتفسير الفروق بين الجنسين في اكتساب اللغة

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المستخلص

أُفردت هذه الدراسة الى البحث في الفرق بين الجنسين في عملية اكتساب اللغة عبرَ نهج تكاملي يجمع بين العوامل الجينية والهرمونية والعصبية والبيئية. حيث تدرس بشكل نقدي أدلة تجريبية مستمدة من دور الجين FOXP2 والتغيرات الهرمونية وبنية الدماغ وظروف التنشئة الاجتماعية في تشكيل القدرات اللغوية عند الجنسين; متعديتاً بذلك الحجج و الطروحات الشائعة وغير الصالحة عملياً، كتلك التي يقدمها كتاب " *Men Are from* Mars, *Women Are from Venus*" . على الرغم من وفرة الدراسات التي تناولت التأثيرات البيولوجية و العصبية و الاجتماعية في اكتساب اللغة, فإن الأبحاث القائمة لا تزال الى حدً كبير متجزئة و أحادية البعد. و نتيجةٌ لذلك, يبرز نقص واضح في الدراسات التي تسعى لدراسة هذه العوامل مجتمعة بصورة منهجية ضمن اطار لغوي موحد, و لا سيما الأطر التي تربط بين تلك الفروق وتأثيراتها اللغوية في الجنسين. تعتمد الدراسة الحالية منهجاً وصفياً، و تتبنى فهم متعدد الأبعاد للفروق الجندرية , مؤكدةً على التفاعل الحيوي بين العوامل البيولوجية و العصبية و البيئية, بدلاً من النظر اليها بوصفها فروقاً ثابتة او هرمية.

Abstract

The present paper is devoted to gender variations in language acquisition through an integrative approach that integrates genetic, hormonal, neurobiological, and environmental approaches. The study critically examines the empirical evidence on the FOXP2 gene, hormones, brain structure, and socialization processes, and goes beyond mass-consumed but empirically invalid arguments, including the so-called "Men Are from Mars, Women Are from Venus" paradigm. Despite the fact that biological, neurological, and social determinants of language development have been widely studied areas of research, they are mostly fragmented and one-dimensional. Consequently, such variables have not been systematically integrated into a linguistically oriented framework, particularly one that determines how these differences translate into specific linguistic consequences. The article follows the descriptive method and it advocates a multidimensional conceptualization of gender inequalities in language acquisition that focuses on an interactive relationship among biology, neurology, and the environment, rather than a cross-categorical or hierarchical classification.**Keywords:** FOXP2, Testosterone and estrogen, Neurolinguistics, hormonal rhythms, socialization, and biopsychosocial approach.

1. Introduction

The most significant theory in the gender communication literature is the metaphor of the "Men Are from Mars, Women Are from Venus" that explains the difference in the communicative orientation of men and women. This framework is a central focus of critical analysis due to its widespread popularity and use. That is, the claim that men and women have different communicative styles became widely accepted in the 1990s, and the above publication supported it. In this metaphor, the Martian, which can be seen as a representation of men, is shown to be trying to fulfil his issues on his own, i.e., the competence and self-reliance are vital aspects of his self-concept. Any criticism or advice that is given to him can be interpreted as an insult to his self-image. On the other hand, the Venusian, who is the representative of women, is more willing to reveal feelings instead of

hastening solutions. Prescriptive advice, therefore, is considered counterproductive to offer in response to her frustrations (Gray, 1992)Hasan (2024, p. 557) argues that "emotion significantly impacts several cognitive functions in humans, such as perception, attention, memory, reasoning, and problem-solving." In this respect, therefore, women are more likely to use language to express emotions, whereas men see language as a battleground or a tool (Çakıcı, 2011)، Such patterns of communication reflect the deeply rooted scripts in our society, in which women are nurturers and men are providers، The social motives are influenced by role discourses such as seeking intimacy or gaining control. Also, hierarchical power structures shape the situation, with men traditionally occupying more socially advantaged roles (Lewis et al., 2008). However, the differences between languages are more likely to be explained by contextual variables and power relations rather than by fixed male-female groups. Cameron (2008) asserts that differences in speech are due to circumstances and power structures rather than innate biological or gender-specific traits, thus refuting the assumption that style is based on predetermined gender roles. Hence, the text in question has been criticized for its lack of empirical rigor and for its generalizations. Nevertheless, it preempts the problem of gender imbalances, but its claims have not yet been proved. Accordingly, the current study prioritizes empirical data, academic discourse, and data-driven conclusions over popular or anecdotal claims, thereby grounding the study of gender and language acquisition in a strictly evidence-based context.

2. Research Questions

The following questions are the ones that the paper attempts to find answers to:

1. What is the quality of interactions between sex hormones and the FOXP² gene in the explanation of gender differences in language acquisition?
2. What are the correlations of neuroanatomy differences in linguistically relevant regions and other language performances between the two genders?
3. Why should a multidimensional view be better at explaining variations in language acquisition than a one-factor view?

3. Previous Studies

The study of gender differences in language acquisition has a growing scholarly interest, and scholars have used diverse methods and theories to deconstruct the complex interaction between biology, environment and learning. Systematic reviews and comparative field studies, as well as experimental studies, have helped the researchers to develop a more profound picture in terms of the role of gender in language development; however, longitudinal researches remain deficient. This synthesis tries to outline the recent contributions to the larger interdisciplinary discourse in terms of the methodological rigor, cross-disciplinary synthesis, and the future directions. Alsharif and Smith's (2024) study is related to language learning, gender, and the education of women with emergent literacy of refugee origin. They want to know what these women go through to learn how to read and write and how they bargain for agency and identity in resettlement situations. The 14 women interviewed in New Zealand and Sweden (semi-structured interviews) in the study were data collectors, with little or no previous formal education. This paper discusses the affordances that learners possess and how they construct identities in the past, present, and future. The findings indicate that, in spite of the structural barriers and incompatibilities between pedagogical activities and the needs of these women, they negotiate learning strategies and identities in an abundant way, thereby demonstrating high degrees of agency and aspirations that are in line with personal, family, and social goals. Koka (2024) explores how gender influences language learning strategies among English learners who use language-learning applications at King Khalid University. The research seeks to establish differences in the strategies used by male and female learners and the role of gender in choosing a strategic approach. A questionnaire was used to gather data from 240 learners aged between 18 and 35 years, and the data were obtained across six categories of strategies: metacognitive, cognitive, mnemonic, compensatory, affective, and social. Gender differences were analyzed using descriptive statistics and independent-samples t-tests. The results indicate that all six categories of strategies were employed by the learners, with metacognitive strategies being the most prevalent, and that gender played a major role in strategy choice. According to the authors, language-learning applications require gender-sensitive instructional design. Maulina (2019) attempts to summarize the existing literature on gender differences in language development, acquisition, comprehension, and production, particularly in English as a Foreign Language (EFL). The aim is to describe contemporary trends, challenge theoretical descriptions, and comment on pedagogical implications. The article is a literature review but presents no original empirical findings, as its theoretical-comparative framework is grounded in psycholinguistics, neurolinguistics, and second-language acquisition (SLA). The findings indicate that girls tend to demonstrate earlier and more successful performance on expressive language, comprehension, and acquisition tasks, which can be attributed to brain maturation and differences in thinking; males, on the other hand, have

greater lexical variety and amount in their speech. Nevertheless, the findings appear to be context-specific and not applicable across all spheres. Pedagogical recommendations emphasize the necessity of distinguishing between teaching and tasks to help these inclinations without reinforcing stereotypes. The author concludes that gender differences exist and are determined by converging biological and environmental factors, that knowledge of such inclinations can be applied to establish more responsive and inclusive teaching, and that more empirical studies are needed to minimize the impact of biological and sociocultural factors. According to Rasha and Rasha (2019), regarding cognitive abilities, research indicates that girls' brains mature in some areas of language more quickly than boys', whereas the reverse applies to other areas of language. At the social level, family members such as fathers, mothers, and siblings are critical to accelerating language acquisition. The more a child interacts, the sooner he/she learns language than one who does not. Moreover, children who have older siblings express themselves better than firstborns. Based on the above research, the present study aims to synthesize the results of the biological, neurological, and socio-environmental approaches, thereby providing a more detailed and comprehensive explanation of the nature of gender differences in language acquisition and communication, as opposed to single-factor explanations.Xia (2013) discusses variation in the use of language by men and women, as well as speech in terms of pronunciation, intonation, vocabulary, syntax, discourse strategies, and nonverbal communication. The following are the aims of the research: to identify specific spheres of gendered linguistic variation, to document historical changes, and to explain these variations through social, cultural, and physiological variables. Using a descriptive sociolinguistic approach drawing on existing research, Xia discusses language use without appealing to a quantitative approach, suggesting that gendered linguistic differences are conditioned by social roles and communicative norms and cannot be explained solely by biological factors. As the results reveal, women are more likely to speak with standardized pronunciation, higher pitch, rising intonation, greater expressiveness, and greater politeness, and men are more likely to use colloquial lexicon, falling intonation, and direct speech patterns; all of this is also exhibited in nonverbal behavior and attitude toward conversations. It concludes that gender remains a central aspect of language use, but changing social norms and increasing equality between genders mean that certain longstanding differences are being eroded, with repercussions for language teaching, intercultural communication, and sociolinguistic theory. Although much has been done in the study of gender differences in language acquisition, a number of gaps remain. The majority of the research is divided, and only each of these areas is examined individually: genetics, hormones, neuroanatomy, or socialization, without a systematic approach to the combination of these variables. Longitudinal studies in humans that investigate FOXP2 expression and sex-hormone changes during critical developmental stages are scarce, thereby limiting understanding of their dynamic roles in language development. Neuroanatomical studies primarily rely on volumetric approaches and do not correlate language network activity with actual performance. Endocrinological studies focus on general cognition, not language-specific performance, as a developmental cycle.Similarly, socio-environmental studies show gendered patterns of interaction but often do not take biological predispositions into consideration. Most researches continue to reproduce simplistic dichotomous gender constructs, ignoring personal differences, cultural background, and developmental patterns. Finally, no single multidimensional model has ever integrated genetic, hormonal, neurological, and environmental factors into a testable model of gendered language acquisition, and the mechanisms underlying the observed differences remain poorly understood.

4. **Genetic differences**

4.1 FOXP2 and Sex Interaction

According to the Encyclopedia Britannica article, a gene is a specific segment of DNA (Deoxyribonucleic Acid) or RNA (Ribonucleic Acid), typically located on a chromosome. This is the basic unit of heredity, which coordinates the transfer and expression of inherited traits. Genes are thus the functional determinants of heritable material present in all living cells, each with a particular biological role (Chang et al., 2011). The FOXP2 gene is among the genes involved in the acquisition of human language. It is the initial genetic interplay empirically associated with language development in humans (Enard et al., 2002). In that respect, French (2014) claimed that changes in FOXP2 are usually linked to a lack of, and unstable control of the coordinated motor patterns needed for fluent speech. Namely, these disturbances interfere with accurate control over the articulatory organs, such as the tongue, the lips, and the jaw (Fisher, 2009). Another empirical evidence shows that FOXP2 protein levels are significantly higher in females than in age-matched males, suggesting a sex difference in this language-related protein (Bowers et al., 2013)Recent studies have elucidated an intricate interaction between FOXP2 and estrogen receptor1 (ER1), a nuclear receptor that responds to estrogenic signals. These occur in the female reproductive tissues, mammary tissue, and other tissues, and in some types of cancer cells. These data indicate that ER1 can regulate FOXP2 transcriptional activity in vivo, which can help to explain discernible sex

differences in language acquisition (Lakhi & Fanucchi, 2024). In line with this, clinical studies show that women have higher levels of estrogen than men (Dluzen, 2005; Lakhi & Fanucchi, 2024), thus giving them the ability to learn language earlier than men. The implications of these findings are that the ER1-FOXP2 interaction might indirectly influence the regulation of speech and language genes by suppressing FOXP2- DNA binding, which might contribute to sex differences in development (Dluzen, 2005; Lakhi & Fanucchi, 2024). The other relationship that is observed is between FOXP2 and testosterone. Male serum testosterone levels are four to fivefold higher than those of females (Clark et al., 2019). Therefore, the late onset of early language acquisition in males has been theorized to be the result of testosterone-FOXP2 interaction in ontogenesis. Testosterone controls FOXP2 expression region-specifically: it increases it in the striatum and decreases it in the cerebral cortex and cerebellum, thereby causing a relative delay in the development of cortical language networks (Bowers et al., 2014). Considering the fundamental role of FOXP2 in neuroplasticity and the timely acquisition of phonological and linguistic skills, hormonal changes during critical periods can temporarily delay the onset of babbling, vocabulary building, and verbal fluency in males. This implies that the initial language disparities across sexes have a biological-developmental foundation to hormones and genes, an imbalance that reduces as brain maturation is achieved and the environmental factors are dominant (ibid.).Overall, these developmental delays in babbling, lexical development, and verbal fluency reveal boys' predisposition to a further delay in language acquisition than girls; and that these developmental phenomena are driven by hormonal and genetic factors, not by a lack of language competence.

4.2 Left-Hemisphere Language Regions and Sex-Based Structural Variations

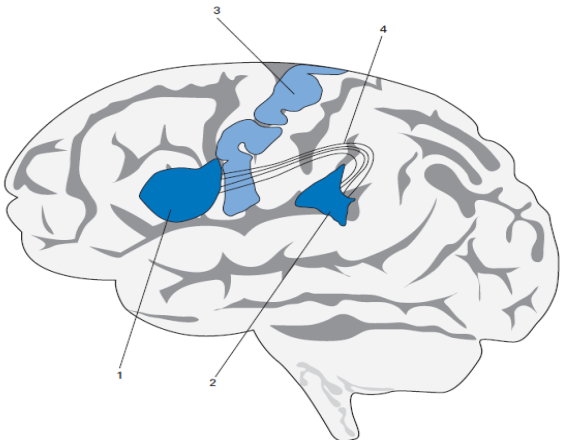
This section examines the sex-based differences in cognitive and language development, likely as a result of variations in brain structure through the lens of a neurolinguistics perspective. Neurolinguistics is "the study of language and brain relations" (Blumstein, 1988, p1). Therefore, it is essential to identify where the language is located in the human brain and which area is precisely responsible for language production, and later investigate the differences. According to Yule (2010), the region responsible for language is predominantly located in the left hemisphere of the human brain. It consists of four components:

1. Broca's area: is scientifically known as "anterior speech cortex" and involves ability to speak.
2. Wernicke's area: is technically named "posterior speech cortex" and deals with speech comprehension.
3. The motor cortex: controls the physical articulators of speech.
4. Arcuate fasciculus: consists of a bundle of neural fibers that connects Broca's area and Wernicke's area.

Illustrated respectively in the following figure:

Figure 1 Human Brain

As the figure shows, females and males brains include identical elements. However, they are not equal in terms of size. For instance, Harasty et al (1997) conclude that Broca's area is larger in a female in 0.2 percentage points



than in a male. In females, this area is 1.4% while in males is 1.2%. Furthermore, Wernicke's area is comparatively larger in females' brain than in males in 0.2 points. That is, it is 0.8 and 0.6 in females and males' brain respectively. These structural variations might relate to the superior language skills often exhibited by females. In other words, females exhibit relatively larger volumes in both the planum temporale (the central region of Wernicke's area) and the inferior frontal gyri (Broca's area in the dominant hemisphere) compared with males. That, generally, gives females the preference on language-related tasks. In the same vein, it is particularly notable that the most pronounced sex-related differences were observed specifically in these language-associated regions, whereas comparable differences were not found in non-language areas (ibid)Another distinction

demonstrates how the two hemispheres (left and right) activate while engaging in the language tasks. That is, a female is more sensitive and suitable to acquire language than a male from a very early stage by developing the five senses in females prior to males. This is evidenced by females' emotional response to infant cues or superiority in advanced problem-solving, such as puzzles (Rasha & Rasha, 2019). Although biological factors provide valuable insight, they do not fully account for the complexity of language acquisition.

5. Hormonal rhythms

An emerging literature on neuroendocrinology and cognitive psychology reveals that hormonal rhythms that predict attention, memory, emotion regulation, and executive functioning are the cause of differences in cognitive performance, but not categorical sex-based differences in brain structure. Among them, alterations in estrogen and progesterone in women and testosterone in men are particularly significant in creating optimal learning conditions, including those for language learning (Pardue & Wizemann, 2001). Endocrinology research indicates that there are two popular cycles of Testosterone: daily and seasonal. The highest level of testosterone in men is in the morning, two or three hours after sleep (Diver et al., 2003; Brambilla et al., 2009). In addition to daily patterns, testosterone varies seasonally, with average levels higher in spring and summer than in fall and winter (Axelsson et al., 2005). These rhythmic variations are trustworthy and necessary in the biological system of conceptualizing day-to-day and seasonal variations in cognitive functioning. Additionally, hormonal cycles play a crucial role in skill acquisition. Aleman et al., (2004) and Yeo et al. (2011) assert that testosterone is associated with better verbal, visual, and spatial skills, working memory, and concentration when it is at optimal average levels, rather than at high or low levels. Namely, periods during normal testosterone levels might be the most appropriate for intensive learning, such as learning vocabulary or grammar in depth. Nonetheless, passive language exposure and acquisition techniques, including lengthy reading and listening, can be done in the evening when testosterone levels and physiological activity are low. The theory is supported by studies on memory consolidation during sleep, which indicate that sleep and the later hours of the day are key to storing and consolidating newly acquired language (Stickgold, 2005). Unlike the fundamental 24-hour cycle seen in males, the female hormonal cycle exhibits a roughly monthly pattern characterized by frequent fluctuations in estrogen and progesterone. There are characteristic patterns in the menstrual cycle of females, among them: the decrease of hormone levels during menstruation, the increase of estrogen during the follicular period, its maximum during ovulation, and the increase of progesterone during the luteal period (Sherman and Kornman, 1975; Reed and Carr, 2018)Likewise, these hormonal changes do not limit themselves to the reproductive functions but may have a profound effect on the central nervous system. Various researchers have established that changes in progesterone and estrogen significantly affect decision-making, motivation, emotion regulation, and cognition. It is known that estrogen has a specific influence on verbal memory, cognitive flexibility, and emotional regulation by modulating prefrontal and hippocampal activity. Based on this, the menstrual cycle is commonly subdivided into four major cognitive stages, each linked to specific cognitive affordances (Hampson, 1990; Andreano & Cahill, 2010; Pletzer et al., 2011). Physical activity is reported to be at low level during the menstrual phase, when levels of both progesterone and estrogen are relatively low, but levels of reflective, evaluative, and analytical information processing seem high. The dominant aspect of this stage is the cognitive profile that includes careful functioning which has a powerful impact on the central nervous system. These conditions are particularly applicable to low-pressure learning activities such as systematic reviews, passive listening and extensive reading because of the requirement of monitoring and low impulsiveness. They are tasks whose basis is not so much on fast encoding or inter-social communication but on long-term attention and judgment (Hampson and Kimura, 1988; Schmidt et al., 1998). High estrogen levels, with the deepening of the cycle toward the follicular phase, correlate with decreased anxiety, enhanced creativity, and improved cognitive flexibility. Estrogen also suppresses fear-related effects and promotes exploratory and socially interactive behavior that can be particularly beneficial for interactive language use (Sundström & Gingnell, 2014). As a result, speaking, tutoring, language mixing, and creative language production can be easily employed by learners at this stage and impose a lower intellectual burden on the brain (ibid).Studies like Hausmann et al. (2000) and Maki et al, (2002) indicate that there is an increase in confidence, verbal fluency, and memory encoding efficiency at ovulation, particularly when estrogen peaks and testosterone also rise slightly. In addition, short-term recall, verbal competence, social motivation, and communication confidence are enhanced during this stage. During the luteal phase, when progesterone is high and estrogen is decreasing, a lot of women experience heightened emotion, fatigue, and lowered ability to handle cognitive overload. In other words, the progesterone has been linked to an increased sensitivity to less challenging stimuli. Together, these findings call into question the popular approaches to language acquisition, such as "one-size-fits-all", often used in learning language and cultural development. Such approaches have given prominence to the view that men, may actually be

unconsciously obedient to male hormonal cycles; and they do not even consider the female cyclical variation (Farage et al., 2008; Pletzer et al., 2011).

6. Environmental Differences

Gender differences have been illustrated for adults, young adults, and children; for each of these age groups, woman (and girls) have been shown to hold more pro-environmental engagement than men (and boys). A widely used approach to explain these gender differences is based on gender roles and socialization. Socialization theory posits that individuals are shaped by gender expectations within the context of cultural norms. Females across cultures are socialized to be more expressive, to have a stronger ethic of care, and to be more interdependent, compassionate, nurturing, cooperative, and helpful in caregiving roles; males, however, are socialized to be more independent and competitive (Boeve-de Pauw et al, 2014)Intrinsically, the importance of language is primarily conveyed due to parental influence on their children's language acquisition (Bartram, 2006). In this configuration, home is like a linguistic island, where children are more likely to reach high levels of proficiency in the minority language(s) (Dewaele,2020). Beyond general exposure, the child-parent's interaction is varied in terms of structures (i.e., units, and subunits), time, and features. For instance, Lovas (2010) states that a mother participates more with her daughter, and perhaps a father, in supportive, interpretive, and conversational communication. This suggests, according to Anderson et al (2021), that the linguistic environment may play a significant role in the emergence of gender differences in language development. These interactional differences appear to have long-term consequences. Explicitly, females show a stable advantage in verbal and associative fluency that persists from childhood into adulthood (De Frias, 2006). Conversely, males experience higher rates of language difficulties, including stuttering and learning disabilities (Kennison, 2003). These linguistic patterns are also linked to social and emotional expectations. In view of that, a female tends to be more emotional to manage her relationship with her family; while a male is expected to keep emotion holding and be action-oriented (ibid). From a structural perspective, Kokkinaki & Vasdekis (2020) further argue that mothers interact differently with their children according to the child's gender. That is to say, the mother favors unit-speech level with her daughter in contrast with subunit-speech with her son. Therefore, based on that, vocabularies that would be used by both sexes to present their ideas and personality would be slightly different. For example, Labov (2001) and Trudgill (1972) present fundamental ideas about gender differences based on environmental engagements, as follows:

1.Women utilize more prestige linguistic forms compared to men, who tend to use more nonstandard forms. For instance, 'r*unning*' used by women comparing to more informal 'runnin' used by men.

2.Women are inclined towards adopting incoming prestige forms linked to higher social consciousness in language change from above. In other words, women used more prestigious compositions, *'e.g. To whom did you speak?'*; while men prefer using less prestigious structures, *'e.g. to who did you speak?'*

3.They also often spearhead changes from below, characterized by variations that lack stereotyping or attachment to specific social groups. This kind of alteration is most noticeable in the pronunciation of vowels, such the lifting of / æ / as in cat to proximately /keət/.

7. Discussion & Results

The findings of the study can be used to support an integrated concept of gender differences that does not rely on binary and essentialist frameworks, usually allegorically associated with the work of John Gray (1992) "Men Are from Mars, Women Are from Venus". Despite the book depicting gender differences as universal and innate, this paper demonstrates that these differences are more appropriately perceived as the result of interactions of genetic, hormonal, environmental, and cultural factors. The results of our investigation suggest that the prevalence of the regular gender-based differences in the patterns of verbal communication, emotional processing patterns, and coping strategies seem to be impacted by:

1. The importance of genetic factors, particularly the importance of FOXP² in verbal fluency and language processing.

2. Anatomical differences in the primary regions of the language, such as the Broca's and Wernicke's areas،

3. Testosterone, emotional bonding, and communication are correlated with hormones, e.g. task-oriented-behavior.

4. The expressive role of females and the problem-solving role of males are reinforced by the environmental factors, including gendered socialization.

To begin with, the genetic role of FOXP2 offers a credible explanation for variation in speech and emotional expression. However, the results also indicate that genetic influence is not deterministic; indeed, it provides a platform on which other factors act. The gene can be expressed in the male and female and it can be influenced by more general biological and environmental influences. The role of hormones further narrows this interpretation

down. It is found that testosterone supports task-oriented and solution-oriented behavior in relation to men, and estrogen and oxytocin support the relational behavior and expression of emotions by women. What is more, the genetic processes may involve interactions between hormonal effects and specific genetic factor such as FOXP2, which are involved in using language and communication in social contexts. These findings challenge generalized approaches of language acquisition that lack considerations of biological rhythms, hence creating new, more adaptive and personal ideas of language acquisition. There are also the environmental and cultural considerations which significantly and greatly support such biological inclinations، Socialization processes have a tendency to associate men with independence, emotional repression, and problem-solving behavior. The women, on the contrary، are taught to be emotionally expressive and interpersonally communicative. These acquired practices are employed to explain the similarity of patterns observed in the text and how context plays a role in the development of gendered communication. Overall, gender differences in discourse emphasize the significance of a biopsychosocial approach. Rather than being based on a purely biological and/or environmental perspective on explaining behavior, this perspective recognizes interactions among genes (e.g., FOXP2), the brain, hormones, and the social world. Not only is it a more sensitive interpretation of John Gray's work, but this study is also more closely aligned with current studies in linguistics, psychology, and neuroscience. In addition, it suggests that gender disparities are a combination of both biological tendencies and actions that are constructed by the society, and not just one cause. Similarly, future research should focus on further study of the interaction between biological and environmental factors, particularly across various cultural contexts, to develop more adaptive and efficient learning models.

8. Conclusion

This paper will re-create the gender differences discussed by John Gray in "Men Are from Mars, Women Are from Venus" in a logical approach based on genetic, hormonal, neurological, and environmental factors with a specific focus on language acquisition. The understandings and syntheses are founded on empirical research in psycholinguistics, genetics, endocrinology, and sociolinguistics. Findings indicate that interaction between biological and social determinants results in differences in communication rather than any of the factors. Genetic, hormonal, and socio-environmental are among the most substantial factors which cause the development of language. This paper goes beyond the classical reductionistic theories of gendered communication, which merely constrained it to one of biology or culture in favor of a biopsychosocial approach which incorporates these different factors. The process of language acquisition is therefore predetermined by genetic mechanisms, hormones, and the environment. To illustrate this point, females acquire vocabulary earlier, on average, than males; in certain cultures, this is attributed to language being introduced at an earlier age, and to the effects of estrogen on brain development. Genetic studies have also found that young females exhibit higher FOXP2 protein expression, which may explain early verbal fluency. Concurrently, the components of social norms encourage more expressive speech among women and less among men, which impact the patterns of communication as well. Such examples are used to illustrate how the gendered language development process is perpetuated, as biological and environmental factors continue to interact. This scientific paradigm presents people as multifaceted and changeable unlike the essentialist concept by Gray who presents a simplified, though essentialist, description of gender differences. Future research should consider genetic and hormonal variables across diverse social contexts, cultures, and life-course development to establish their influence on communicative practices. This integrative paradigm could be used to refine educational interventions to better support student development and encourage individually by taking into account biological diversity and the role of socialization. These are some measures that can be employed to discourage stereotypes and encourage equity in language learning and communication.

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